

First Year Curriculum of Postgraduate Degree in Environmental Management

1st year syllabus for ME Environmental Management (Semester-1)

Sr No	Category	Course Code	Course Title	Hours per week			Total Hours	Total Credits	E	M	I	V	Total
				L	T	P							
1	Program Core I	EM3101	Air Pollution Control	3	0	2	5	4	70	30	20	30	150
2	Program Core II	EM3102	Wastewater Treatment Technologies	3	0	2	5	4	70	30	20	30	150
3	Program Elective I	EM3103	Solid & Hazardous Waste Management	3	0	2	5	4	70	30	20	30	150
4	Program Elective I	EM3104	Pollution Prevention & Environmental Management	3	1	0	4	4	70	30	20	30	150
5	Program Elective II	EM3105	Environmental Management - I	3	1	0	4	4	70	30	20	30	150
6	Program Elective II	EM3106	Groundwater Contamination and Prevention	3	1	0	4	4	70	30	20	30	150
7	Research Methodology and IPR	MH3101	Research Methodology and IPR	2	0	0	2	2	0	0	20	30	50
8	Audit Course	MH3102	Disaster Management	2	0	0	2	0	30	20	0	0	50
Total							23	18	310	140	100	150	700

(SEM 2)

Sr No	Category	Course Code	Course Title	Hours per week			Total Hours	Total Credits	E	M	I	V	Total
				L	T	P							
1	Program Core III –	EM3107	Air Pollution Control Equipment Design & Air Quality Modelling	3	1	0	4	4	70	30	20	30	150
2	Program Core IV –	EM3108	Design of Wastewater Treatment Plant	3	0	2	5	4	70	30	20	30	150
3	Program Elective III –	EM3109	Environmental Management - II	3	0	2	5	4	70	30	20	30	150
4	Program Elective III –	EM3110	Advance Anaerobic Biotechnologies	3	1	0	4	4	70	30	20	30	150
5	Program Elective IV –	EM3111	Environmental Legislation	3	1	0	4	4	70	30	20	30	150
6	Program Elective IV –	EM3112	Environmental Risk Assessment & Management	3	1	0	4	4	70	30	20	30	150
7	Open Elective	EM3113	Analytical & Instrumentation Techniques	2	0	0	2	2	70	30	0	0	100
8	Open Elective	EM3114	Green Technologies for Process Industries	2	0	0	2	2	70	30	0	0	100
9	Audit Course	MH3103	Constitution of India	2	0	0	2	0	30	20	0	0	50
Total							22	18	380	170	80	120	750



A. Course code and definition:

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
E	Theory External Examination Marks
M	Theory Internal Examination Marks
I	Practical Internal Examination Marks
V	Practical External Examination Marks

Shroff S.R. Rotary Institute of Chemical Technology

Master of Engineering

Subject Code: EM3101

Subject Name: Air Pollution Control

Semester: - I

Type of course: Program Core

Prerequisite: Students shall have basic knowledge of Air Pollution Standards, Sources & types of Air Pollutions & its effects.

Rationale: To provide knowledge related to various air pollution control methods and equipment.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Meteorology & Air Pollution: Various types of air pollution sources, Meteorological factors affecting air pollution, Methods for measurement of Meteorological variables, Determination of Maximum Mixing depth (MMD), Wind Profiles, Topographic Effects, Temperature Profiles in atmosphere, Stability, Inversions, Plume Behavior, Turbulent Diffusion, Concept of Mixing Height and determination of Stability Class.	05
2	Methods of Measurements of conventional Air Pollutants: Sampling modes, Stack & Ambient air quality sampling system, Standards analytical method for Sulphur Dioxide (SO ₂), Oxides of Nitrogen (NO _x) & Particulate Matter, Sampling program, Air pollution Standards and Indices, Comprehensive Air Pollution Index.	05
3	Automobile Emission & Control: Sources of automobile air pollution, A/F ratio theory & calculations, factors affecting emissions, determination Control of exhaust gas emissions by fuel change, engine design change external reactors, Vehicle emission standards & Fuel quality standards. Noise Pollution: Difference between sound and noise, Pitch and Frequency, Sound Pressure, Sound Pressure level (Decibel), Leq, sources	07

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Master of Engineering

Subject Code: EM3101

Subject Name: Air Pollution Control

	of noise and harmful effects of noise, noise measurement and noise control measures.	
SECTION-B		
4	Control equipment of Particulate Matters: Selection criteria for various types of control equipment, Particulate matter removal mechanisms, Control equipment theory, principle, Construction, operation & application. Operational Problems in various Particulate matter control equipment & Factors effecting efficiency & modifications.	07
5	Control of Gaseous Pollutants: Various methods for control of Sulphur Dioxide (SO ₂) & Oxides of Nitrogen (NO _x), Dry & wet scrubbing methods, Theory of control of gaseous pollutants by Adsorption, Absorption & Combustion. Sources of Volatile Organic Compounds & control methods, Control of gaseous pollutants like HCL, Ammonia, VOC.	07
6	Air Quality Monitoring: Objectives, time and space variability in air quality; Analysis and Interpretation of air pollution data, Stack monitoring, CEMS, Dust control and abatement measures in industries and mines, Indoor Air Quality.	05

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	10	15	10	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Recommended Books:

1. Environmental pollution control engineering by Rao C.S., New age international Ltd, New Delhi, 1995.
2. Air pollution its origin and control by Wark Kenneth and Warner C.F, Harper and Row Publishers, New York, 1981.
3. Air Pollution by Perkins H.C. - Tokyo, McGraw Hill

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Subject Name: Air Pollution Control

4. Environmental Engineering by Peavy, H.S., Rowe, D.R., Tchobanoglous, G. McGraw Hills, New York 1985.
5. Air Pollution Control Engineering - Noel de Nevers, McGraw Hill, Singapore, 1995.
6. Air Pollution Control in Industries, Vol. 1 & 2 – T. K. Ray, Technip Books International, 2003.
7. Air Pollution Control Equipment - H. Brauer & YBG Verma, Springer-Verlag, Berlin Heidelberg, NY, latest Ed.

List of Practical:

1. Determination of SPM in ambient air.
2. Determination of PM_{2.5} and PM₁₀ in ambient air.
3. Sampling of SO₂ in ambient air.
4. Sampling of NO_x in ambient air.
5. Analysis of SO₂ sampled in ambient air.
6. Analysis of NO_x sampled in ambient air.
7. Sampling of HCl in ambient air.
8. Analysis of HCl sampled in ambient air
9. Measurement of Noise using Sound Level meter
10. Stack sampling and determination of Particulate Matter using stack monitoring kit.

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Recollect various air pollution sources and meteorological data
CO-2	Identify various sampling and analysis methods for various air pollutants
CO-3	Explain the concept of vehicular emission
CO-4	Distinguish between various types of control equipment for particulate

Shroff S.R. Rotary Institute of Chemical Technology**Master of Engineering****Subject Code: EM3101****Subject Name: Air Pollution Control**

	control
CO-5	Explain various methods for control of gaseous pollutants
CO-6	Appraise the use of air quality monitoring

List of Open-Source Software/learning website:

- NPTEL
- WRPLOT

Shroff S.R. Rotary Institute of Chemical Technology

Master of Engineering

Subject Code: EM3102

Subject Name: Wastewater Treatment Technologies

Semester: - I

Type of course: Program Core

Prerequisite: Students shall have basic knowledge of Physico-chemical & biological treatment of wastewater

Rationale: To provide knowledge related to the requirements of water and wastewater treatment technologies.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	20	30	150

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Introduction: Wastewater sources and characteristics, components & analysis of wastewater flow rate, constituent mass loading, Concentration & selection of design flow rates, Reactors used for treatment of water & wastewater, Types of unit Processes & operations, Types of treatment, Conventional water & wastewater treatment units.	05
2	Screening and Grit removal: Classification & Applications of different types of screens, Head loss Calculations, Grit Characteristics, Types of Grit chambers. Mixing & Flocculation: Rapid Mixing & its types, Flocculation & types of flocculator. Power requirement calculations. Coagulation: Colloid Stability & destabilization, coagulation chemistry for different coagulants and dose Calculations, Coagulant Aids.	07
3	Sedimentation: Concept of sedimentation, Application and types of sedimentation Phenomenon, Zones of sedimentation tank, types of sedimentation tank, High rate clarification, Tube settlers, Lamella plate clarification, Swirl & vortex separator, design considerations. Softening: Different methods of softening & its reaction chemistry, Dose	06

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Master of Engineering

Subject Code: EM3102

Subject Name: Wastewater Treatment Technologies

	calculations. Filtration: Concept, Types of filters for water, Grain size Characteristics, Filter Hydraulics Calculation.	
SECTION-B		
4	Biological treatment: Wastewater Microbiology, bacterial bio chemistry for aerobic, Anaerobic and Anoxic decomposition, Reaction rate kinetics, Conventional Activated sludge process, Cyclic Activated sludge system, Integrated fixed film activated sludge System, Biotower & Rotating Biological contractor, Conventional anaerobic treatment, High rate anaerobic reactors, Staged multiphase anaerobic treatment, membrane bioreactors, and sequential batch reactor.	05
5	Tertiary treatment & Advanced Wastewater Treatment Methods: Tertiary treatment methods, Ion Exchange process, Membrane Processes, Reverse Osmosis, Microfiltration, Nano-filtration, Dialysis, Electrodialysis, Disinfection, Chlorination, MEE, ZLD system, sand bed & carbon filter	07
6	Environmental Modeling: Eutrophication of lakes, stoichiometry, phosphorus as limiting nutrient, mass balance on total phosphorus in lakes, models for Eutrophication assessments.	06

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	10	15	10	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Recommended Books:

1. Wastewater Treatment Concepts & Design Approach by G.L Karia & R.A Christian.
2. Wastewater Engineering, Treatment and Reuse by Metcalf and Eddy, Tata McGraw- Hill Publication, New Delhi, 2003.
3. Water & Waste Water Engineering by Fair and Gayer.

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Subject Code: EM3102

Subject Name: Wastewater Treatment Technologies

4. Environmental Engineering by Peavy, H.S., Rowe, D.R. and Tchobanoglous, G., McGraw Hills, New York 1985.
5. Water Quality and Treatment (A handbook of community water supplies 5th edition): Published by American Water Works Association
6. Environmental modeling: Fate & transport of pollutants in Water, Air and Soil by Jerald L Schnoor.
7. Modeling the Eutrophication Process by M W Lorenzen

List of Practical/ tutorials:

1. To determine pH of given sample
2. To determine Acidity of given sample
3. To determine Alkalinity of given sample
4. To determine Turbidity of given sample
5. To determine Conductivity of given sample
6. To determine TDS of given sample
7. To determine TSS of given sample
8. To determine Chemical Oxygen Demand of given sample
9. To determine Biochemical Oxygen Demand of given sample
10. To determine Dissolved Oxygen of given sample

Course Outcomes:

After Learning this Course students will be able to:

Sr. No.	CO statement
CO-1	List out different water quality parameters typically used to characterize wastewater.
CO-2	Describe various types of unit process used for preliminary and primary treatment.
CO-3	Explain the principles of the suspended and attached growth biological processes and the factors that influence and control these processes.

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CO-4	Recognize emerging technologies for advanced wastewater treatment and water recycling.
CO-5	Draw schematics of typical water and wastewater treatment plants.
CO-6	Assess the fate and transport of water pollutants which are discharge into environmental sinks like river & lake.

List of Open Source Software/learning website:

- <http://nptel.ac.in/>
- Modeling using software - ETP Soft



Master of Engineering

Subject Code: EM3103

Subject Name: Solid & Hazardous Waste Management

Semester: - I

Type of course: Program Elective - I

Prerequisite: Students shall have basic knowledge regarding different types of Solid waste, Need for Solid and Hazardous waste management.

Rationale: To understand the concepts of Municipal & Hazardous Solid Waste management Practices.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	20	30	150

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Introduction to Solid Waste Management: History, Sources and types of solid waste; Composition and its determinants of Solid waste; Factors influencing generation; Quantity assessment of solid wastes; Material Flows; Need for ISWM; Legislative & Policy aspects of Solid Waste; Circular Economy & Solid Waste; Current Challenges & Future Trends.	3
2	Municipal Solid Waste: Characteristics and Quantities; Composition and Generation; Segregation & Recycling, Collection Systems and Design; Linear Programming Application in Collection; Transportation and Transfer of Wastes; Transfer Stations Need & Design requirements. Handling & Processing of Municipal Solid Waste: Storage; Conveying; Compacting; Shredding; Pulping, Roll Crushing; Granulating. Material Separation: General Expressions; Picking, Screens; Float/Sink Separators; Magnets and Electromechanical Separators; Other Devices; Material Separation Systems; Material Recovery Facilities; Material Recycling. Landfills: Planning; Siting; Permitting; Landfill Processes; Landfill Design; Landfill Operations; Post-Closure Care and Use of Old Landfills; Landfill Mining; Application of GIS in Locating Landfill Site, Leachate	10

Master of Engineering

Subject Code: EM3103

Subject Name: Solid & Hazardous Waste Management

	management.	
3	<p>Hazardous Waste Management: Need for hazardous waste management; Sources, classification and characteristics of hazardous solid waste; Transportation criteria and storage criteria, Problems in developing countries.</p> <p>Strategy: Waste Minimization; Waste Exchange; Recycling</p> <p>Disposal Methods: Site selection criteria; Landfill operation; Liner and Leachate collection system; Cover System; Water Controls; Closure & Post-closure.</p>	6
SECTION-B		
4	<p>Treatment Technologies & Energy Recovery: Physico-chemical Treatment, Biological Treatment; Thermal Treatment-Incineration and other thermal processes; Solidification and Stabilization.</p> <p>Material Recovery: Recovery of chemical and biological products; Recovery of Energy.</p>	7
5	<p>Biomedical Waste Management: Sources; Generation; Storage; Transportation; Disposal; Waste Treatment: Disinfection; Irradiation; Incineration</p> <p>Construction & Demolition waste Management- Rules & Requirements.</p> <p>Plastic Waste Management- Rule; Role & Responsibilities; recycle options; Methods of disposal including Energy recovery and coprocessing; Present Scenario.</p>	5
6	<p>E-waste Management: Sources; Global Perspective of E-waste Generation; E-waste Recovery and Recycling technologies; Disposal; Current status in India.</p> <p>Radioactive Waste Management: Sources; measures and health effects; waste generation from nuclear power plants; nuclear power plants and fuel production; Management & Containment; Disposal options.</p> <p>Tyre waste management.</p>	5



Master of Engineering

Subject Code: EM3103

Subject Name: Solid & Hazardous Waste Management

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	10	10	05	05

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Recommended Books:

1. Solid & Hazardous waste Management by PM Cherry
2. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management", the McGraw- Hill, New York, 3rd Ed., 1993.
3. M.S. Bhatt, "Solid Waste Management-An Indian Perspective", 2020.
4. Kiely G., "Environmental Engineering", McGraw Hill Book Company, 1998.
5. Rao C.S., "Environmental Pollution Control and Engineering", New Age International (P) Limited, 1991.
6. Manual on Municipal Solid waste management by Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.

List of Practical/ tutorials:

1. To determine the Calorific value of a given solid waste using Bomb Calorimeter.
2. To determine the concentration of Potassium in given solid waste sample by Flame photometer.
3. To determine the concentration of Sodium in given solid waste sample by Flame photometer.
4. To determine the moisture content in given solid waste sample.
5. Study of different sections of a hazardous waste landfill site.

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Subject Code: EM3103

Subject Name: Solid & Hazardous Waste Management

6. To determine the pH of a given sample of hazardous waste.
7. To carry out Paint Filter Liquid Test (PFLT) for a given sample of hazardous waste to check the availability free moisture content.
8. To Determine Loss on ignition (% organic matter) of given sample of solid waste.
9. To determine the total chloride in given sample of solid waste using Bomb Calorimeter.
10. To determine the total sulfur content in given sample of solid waste using Bomb Calorimeter.

Course Outcomes:

After learning this course, students will be able to:

Sr. No.	CO statement
CO-1	Understand the characteristics of different types of solid and hazardous wastes and the current challenges.
CO-2	Describe handling, material separation, collection and transportation of Municipal Solid and Hazardous Waste Management.
CO-3	Interpret the importance of processing, recovery and disposal of solid and hazardous waste.
CO-4	Illustrate about design criteria for hazardous and sanitary waste landfill.
CO-5	Identify the ways in handling the Biomedical Waste, Plastic and C&D waste generated in India.
CO-6	Explain the methods and practices to deal with E-waste and Radioactive waste.

List of Open Source Software/learning website:

- MOEF&CC
- NPTEL



Master of Engineering

Subject Code: EM3104

Subject Name: Pollution Prevention & Environmental Management

Semester: - I

Type of course: Program Elective I

Prerequisite: Knowledge of Environmental laws and policies

Rationale: Knowledge of preventive practices is essential to avoid the treatment and curative strategies.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	1	0	4	70	30	20	30	150

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Introduction: The environment in the context of 21st century, Present status of India's Environment	02
2	Indian Environmental Policy : Concerned statutory regulatory bodies, Frame work and Implementation, Current environmental laws in India	08
3	Preventive Environmental Management Tools: Environmental Audit, Environmental Impact Assessment, Life Cycle Analysis, Inventorization and Environmental Management system	08
SECTION-B		
4	Preventive Environmental Management Initiatives: Cleaner Production, Green chemistry and cleaner technologies, Green choices in process Industries, Redesigning of unit operations and unit processes, International Agreements & Global environmental issues.	08
5	Recycle and Reuse of waste water, Eco-industrial network, CDM as preventive Environmental management initiative	05
6	Relationship between industry and environment	05

Master of Engineering

Subject Code: EM3104

Subject Name: Pollution Prevention & Environmental Management

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	10	15	10	15	05

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Recommended Books:

1. Preventive Environmental Management: An Indian Perspective by Dr. Shyam R. Asolekar & Dr. R. Gopichandran
2. Cleaner Production Strategies: Developing preventive Environmental Management by Tim Jackson published by Lewis publishers.
3. Practical guide to Environmental Management 9th edition by Frank B Friedman

Course Outcomes:

After Learning this Course Students will be able to:

Sr. No.	CO statement
CO-1	Discuss the knowledge of environmental policy of India and current environmental laws.
CO-2	Understand and apply the different preventive tools like environmental audit, EIA and Life Cycle Assessment.
CO-3	Undertake and implement preventive environmental initiatives like Cleaner production, Green chemistry, Recycle and reuse of wastewater.
CO-4	Explain the different preventive tools like environmental audit, EIA and Life Cycle Assessment.
CO-5	Apply the different preventive tools like environmental audit, EIA and Life Cycle Assessment.
CO-6	Implement preventive environmental initiatives like Cleaner production, Green chemistry, Recycle and reuse of wastewater.



Master of Engineering

Subject Code: EM3104

Subject Name: Pollution Prevention & Environmental Management

List of tutorials:

Assignments on the questions related to:

1. Current environmental laws
2. Indian Environmental policy
3. Environmental audit
4. Environmental Impact assessment
5. Life Cycle Analysis
6. Cleaner Production
7. Clean Development Mechanism
8. Recycle and reuse of wastewater
9. Relation between Industry & Environment
10. Case studies on the Environmental Management Issues

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Master of Engineering

Subject Code: EM3105

Subject Name: Environmental Management - I

Semester: - I

Type of course: Program Elective II

Prerequisite: Fundamentals of Environmental Management

Rationale: The main objective of this subject is to make students aware about Environmental Management systems and new approaches adopted by industries.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	1	0	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Environmental Management system: Environmental Management System & Quality control: EMS Introduction, Core Element, Benefits, Documentation for EMS, Introduction of ISO 14000, Implementation of EMS Conforming to ISO 14001:2018, OHSAS 18001 and its comparison with ISO 14001, PDCA cycle, Audit & certification.	06
2	Green Business: Responsible Care (Guiding principles, Codes, Present scenario), Green Ammonia, Carbon Credit, Carbon footprint, Energy recovery. Design of Green Belt, Advantage of Green Belt Development, Rain Water harvesting, Water resource management including water balance, Environmental Management Plan.	08
3	Carbon Footprint: Concept, Carbon neutrality, Importance, Estimation, Reduction in carbon footprint. Emission Trading: Concept, Carbon Credit, Present Scenario. Rate Analysis: Prerequisites, factors affecting rate analysis, procedure for rate analysis. Scheme introduced by MOEF/ GPCB at Surat. Various International Conventions: Stockholm convention, Montreal protocol, Paris Agreement, UNFCCC and its Role.	08
SECTION-B		

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Subject Code: EM3105

Subject Name: Environmental Management - I

4	Life Cycle Assessment: Framework of Life Cycle Assessment, methods and challenges involved in applying LCA to relevant industrial and social issue, process-based, input output based, and hybrid LCA methods, strengths and weaknesses of these types of LCA models, document and publish LCA studies.	06
5	Cleaner production concept: Theory of cleaner production, Effect of CP on Industrial economy, Six steps methodology for CP, its mechanisms and their applications, Green productivity and implementation	02
6	New approach for environmental management & Compliance Sustainable Development Goals and status of India, Circular Economy, Eco-industrial Park, CEPI, Institutional Framework of Environmental Regulations in India, Environmental Policy, Penalty for violation of environmental requirements and Compensation for damage/pollution-Method of calculation based on NGT order	06

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	20	10	10	10	05

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s Taxonomy)

Recommended Books:

1. Environmental Engineering and Management by Dr. Suresh K. Dhameja
2. Environmental Management, Agarwal, APH Publishing, 2005.
3. Environmental Engineering by Gerard Kiely
4. Environmental Management (National and Global perspectives) by Swapan C. Deb.
5. Environment by Shankar, IAS Academy book publication (6th Edition).
6. Complete Guide To ISO 14000 by Richard B. Clement, Simon & Schuster, 1st Ed., 1996
7. The Hitch Hiker's Guide to LCA Paperback – March 12, 2004 by Henrikke Bauman, Anne-Marie Tillman

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Master of Engineering

Subject Code: EM3105

Subject Name: Environmental Management - I

Course Outcomes:

After Learning this Course Students will be able to:

Sr. No.	CO statement
CO-1	Analyze Environmental Management System.
CO-2	Predict Life Cycle Assessment, green businesses, Climate Change & Environmental Management.
CO-3	Understand and implement preventive environmental initiatives like Cleaner production, Green chemistry, Recycle and reuse of wastewater.
CO-4	Evaluate Carbon Footprint and Emission Trading.
CO-5	Explain the idea of Sustainable Development Goals, circular economy, etc.
CO-6	Remember the new approaches for environmental management in the industries.

List of Tutorials:

1. ISO 14001 and OHSAS 18001 and its comparison.
2. Guiding principles, Codes and Present scenario of Responsible Care
3. Carbon footprint
4. Various International Conventions
5. Methods and challenges involved in applying life cycle assessment.
6. Six steps methodology for Cleaner Production.
7. Sustainable Development Goals and status of India
8. Institutional Framework of Environmental Regulations in India
9. Comprehensive Environmental Pollution Index (CEPI).
10. Penalty for violation of environmental requirements and Compensation for damage/pollution

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Master of Engineering

Subject Code: EM3106

Subject Name: Groundwater Contamination and Prevention

Semester: - I

Type of course: Program Elective II

Prerequisite: Knowledge of groundwater contamination

Rationale: To learn the principles and theories regarding ground water contamination and prevention

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	1	0	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Introduction: Definition of ground water, aquifers, vertical distribution of sub surface water, hydrological properties of water bearing strata, ground water in hydrologic cycle.	03
2	Ground water hydraulics: Darcy's law, its range of validity, Dupuit's assumptions, Applications of Darcy's law for simple flow systems, Governing differential equations for confined and unconfined aquifers, steady and unsteady flow solutions for fully penetrating wells, partially penetrating wells, interference of wells, test pumping analysis with steady and unsteady flows, delayed yield, method of images	12
3	Ground water quality : Indian and international standards for different purposes	02
SECTION-B		
4	Ground water pollution : Sources, remedial and preventive measures	06
5	Ground water conservation: Ground water budget, seepage from surface water, artificial recharge	06
6	Ground water Restoration and Treatment: Source control strategies, Treatment technologies, In situ treatment methods, Pump, Soil Contamination & remediation	07

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Master of Engineering

Subject Code: EM3106

Subject Name: Groundwater Contamination and Prevention

	and treat method, Bioremediation	
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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	10	15	10	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Recommended Books:

1. Ground Water : by Raghunath
2. Ground Water Hydrology: By D K Todd
3. Groundwater Resources Education by W C Walton
4. Numerical Ground Water Hydrology by Roger Diewest.
5. Ground water hydrology and contamination by Nicholas Cheremenisoff

Course Outcomes:

After Learning this Course Students will be able to:

Sr. No.	CO statement
CO-1	Apply the laws of ground water hydraulics and solve the differential equations for different types of aquifers.
CO-2	Understand the different purpose of the Indian and international water standards.
CO-3	Identify the sources of ground water contamination and suggest the remedial and preventive measures to overcome ground water contamination.
CO-4	Examine the mechanisms for ground water conservation.
CO-5	Conduct ground water survey work to check the quantity and quality of ground water.
CO-6	Design the wells.

Shroff S.R. Rotary Institute of Chemical Technology**Master of Engineering****Subject Code: EM3106****Subject Name: Groundwater Contamination and Prevention****List of Tutorials:**

1. Hydrological properties of water bearing strata
2. Sources of Groundwater contamination.
3. Effects of groundwater pollution.
4. Derive Darcy's Law.
5. Different methods of groundwater conservation.
6. Various measures that can be adopted to reduce the groundwater pollution in India.
7. Different treatment technologies for groundwater treatment and restoration.
8. Case study related to the groundwater pollution problems in India.
9. Important physico-chemical methods for performing contaminated soil remediation.
10. Status of groundwater quality in India.

Master of Engineering

Subject Code: MH3101

Subject Name: Research Methodology & IPR

Semester: - I

Type of course: Mandatory level Course (MLC)

Prerequisite: Students who have completed undergraduate studies in Engineering will be in a better position to benefit from this course.

Rationale: The primary objective of this course is to develop a research orientation among the scholars and to acquaint them with fundamentals of research methods. Specifically, the course aims at introducing them to the basic concepts used in research and to scientific social research methods and their approach. It includes discussions on sampling techniques, research designs and techniques of analysis. Some other objectives of the course are

- To develop understanding of the basic framework of the research process.
- To develop an understanding of various research designs and techniques.
- To identify various sources of information for literature review and data collection.
- To develop an understanding of the ethical dimensions of conducting applied research. Appreciate the components of scholarly writing and evaluate its quality.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	0	2	0	0	20	30	50

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Research:- Research as source of knowledge, research process, constructs & concepts, variables & its types, induction & deduction, scientific methods, Literature survey & finding research gaps, Formulating research problem & determining research objectives, Ethics in Research, Limitations in Research. Types of research design exploratory, descriptive & experimental, Quantitative & Qualitative Research.	04
2	Measurement & Scaling Techniques:- Measurement in Research, Types of data: Primary & Secondary, Types of Scales: Ratio, Interval, and Ordinal Nominal, Characteristics of a good measurement, Sources of error in measurement, Scaling and scale classification bases, Important scaling	04

Master of Engineering

Subject Code: MH3101

Subject Name: Research Methodology & IPR

	techniques, Scale construction techniques. Various methods of Data collection.	
3	Research report & Publication:- Thesis writing, research paper writing, Preparing synopsis & summary of research thesis work. Interpretation and report writing – Meaning, Need & Techniques for Interpretation. Significance of report writing, Different steps and layout in writing report, Precautions for writing research reports, Developing a Research Proposal.	04
SECTION-B		
4	Intellectual property: Innovation, Intellectual property rights (IPR), Pre – IPR system intellectuality/trade protection. Basic forms of IPRs – Patent, copyright, Trademark, Designs, Evolution of IP status, Patent searching and indexing from different databases. IPR for new technologies, Process patent vs Product patent, Art of writing a patent/innovation and claims. White space mapping.	04
5	Patents, Designs, Trade and Copyright: Process of Patenting and Development: Technological research innovation, patenting, development. International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT	04
6	Patent Rights: Scope of Patent Rights: Licensing and transfer of technology. Patent information and databases, Patent system administration, New developments in IPR, IPR of Environmental systems.	04

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	15	15	10	10	5

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Recommended Books:

1. Naresh K Malhotra, Satyabhan Das, Pearson Education ; Marketing Research 5th edition
2. Stuart Melville and Wayne Goddard, Research Methodology an introduction for Science & Engineering Students.
3. Ganesen MJP Publishers, Chennai, 201, Research Methodology for Engineers

Master of Engineering

Subject Code: MH3101

Subject Name: Research Methodology & IPR

4. Kenneth S. Bordens & Bruce B. Abbitt. Research Design & Methods, A process approach. McGraw Hill, 8th edition.
5. Cooper Donald, Schindler Pamela, Business Research Methods, McGraw Hill
6. KN Krishna Swamy, Appa Iyer Sivakumar & M Mathirasan, Pearson, Management Research Methodology.
7. C. R. Kothari, Research Methodology, New Age International (P) Ltd., Publishers, New Delhi
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes:

After Learning this Course Students will be able to:

Sr. No.	CO statement
CO-1	Describe the importance of literature survey and ethics in research along with various types.
CO-2	Explain measurement and scaling techniques used in data analysis of research.
CO-3	Apply suitable data for preparation of report, synopsis and for development of research proposal.
CO-4	Analyze the patenting system for developing IPR for new technologies, process and products
CO-5	Summarize the process of patenting and procedures for grant of patenting in IPR.
CO-6	Categorize patent information and databases for licensing and transfer of technology complying with patent system administration.

Shroff S.R. Rotary Institute of Chemical Technology

Master of Engineering

Subject Code: MH3102

Subject Name: Disaster Management

Semester: - I

Type of course: Audit Course

Prerequisite: To provide students an exposure to disasters, their significance, types & Comprehensive understanding on the concurrence of Disasters and its management.

Rationale: To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention, risk reduction and the basic understanding of the research methodology for risk reduction measures. Equipped with knowledge, concepts, and principles, skills pertaining to Planning, Organizing, Decision- making and Problem solving methods for Disaster Management.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	0	0	30	20	0	0	50

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Introduction Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	04
2	Repercussions Of Disasters And Hazards: 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	04
3	Disaster Prone Areas In India 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	04
SECTION-B		

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Master of Engineering

Subject Code: MH3102

Subject Name: Disaster Management

4	Disaster Preparedness And Management 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, Emergency Stage, Post Disaster stage-Rehabilitation. Remedy to Disasters, Role of panchayats in disaster mitigations	04
5	Risk Assessment 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.	04
6	Disaster Mitigation Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	04

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
09	09	08	08	08	08

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Recommended Books:

1. Disaster Science and Management by Bhattacharya,T., Mc-Graw Hill.
2. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies ""New Royal book Company
3. Disaster Mitigation Experiences And Reflections by Sahni, Pardeep,Prentice Hall Of India, New Delhi.
4. Understanding Earthquake Disasters by Sinvhal, A., Mc-Graw Hill.
5. Environmental Geography by Singh, S., Prayag Pustak Bhawan.
6. Disaster Management by Gupta, H.K., University Press.

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7. Sahni, Pardeep Et.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.
8. Goel S. L. , Disaster Administration And Management Text And Case Studies” ,Deep &Deep Publication Pvt. Ltd., New Delhi

Course Outcomes:

After Learning this Course, Students will be able to:

Sr. No.	CO statement
CO-1	Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations
CO-2	Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response
CO-3	Understand Disaster management and Risk Reduction measures.
CO-4	Apply the concepts in real life scenario.
CO-5	Identify 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-6	Classify understanding of key concepts in disaster risk reduction and humanitarian response

List of Open Source Software/learning website:

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



Master of Engineering

Subject Code: EM3107

Subject Name: Air Pollution Control Equipment Design & Air Quality Modelling

Semester: - II

Type of course: Program Core

Prerequisite: Students shall have basic knowledge of Air Pollution Standards, Sources & types of Air Pollutions & its effects Air pollution control methods.

Rationale: To provide knowledge related to designing of various air pollution control methods and equipment and to learn various air quality models.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Design of particulate control equipment: 1. Gravity Settling Chambers 2. Cyclones 3. Electrostatic precipitator 4. Bag Filter	10
2	Design of gaseous control equipment: 1. Venturi Scrubbers 2. Absorption tower 3. Adsorption tower	10
3	Auxiliary Equipment: Design of hood, duct, stack height.	04
SECTION-B		
4	Air Quality Modeling: Types of modeling techniques, Modeling for nonreactive pollutants, single source, multisource and area source models, fixed box models, diffusion models, dispersion models, receptor and source-oriented models	05
5	Gaussian equation for Point source of pollution & its assumptions, Plume rise theory & equations, Wind Rose diagram & applications, Various air	04

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Master of Engineering

Subject Code: EM3107

Subject Name: Air Pollution Control Equipment Design & Air Quality Modelling

	dispersion models.	
6	Applications: Software based applications- Air quality	03

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	10	15	10	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Recommended Books:

1. Environmental pollution control engineering by Rao C.S., New age international Ltd, New Delhi, 1995
2. Air Pollution Control equipment calculations by Louis Theodore.
3. Air pollution its origin and control by Wark Kenneth and Warner C.F, Harper and Row Publishers, New York, 1981.
4. Air Pollution by Perkins H.C. - Tokyo, McGraw Hill
5. Air Pollution Control Engineering - Noel de Nevers, McGraw Hill, Singapore, 1995.
6. Air Pollution Control in Industries, Vol. 1 & 2 – T. K. Ray, Technip Books International, 2003.

List of Practical:

1. Air quality modelling for a point source using AERMOD software.
2. GLC determination for a receptor using AERMOD software.
3. Plot wind rose for a given location using WRPLOT software.
4. Study line source emission using CALINE software.



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Master of Engineering

Subject Code: EM3107

Subject Name: Air Pollution Control Equipment Design & Air Quality Modelling

5. Study the working of Gravity Settling Chamber and determination of pollutant removal efficiency.
6. Study the working of Cyclone Separator and determination of pollutant removal efficiency.
7. Study the working of ESP and determination of pollutant removal efficiency.
8. Study the working of Bag Filter and determination of pollutant removal efficiency.
9. Study the working of Scrubber and determination of pollutant removal efficiency.
10. Study the working of Adsorption Tower and determination of pollutant removal efficiency.

Course Outcomes:

After Learning this course, Students will be able to:

Sr. No.	CO statement
CO-1	Outline the design of various particulate control equipment
CO-2	Explain the design of various gaseous control equipment
CO-3	Calculate the design of various auxiliary equipment
CO-4	Categories various air quality models
CO-5	Formulate the air pollution dispersion using Gaussian model of dispersion
CO-6	Appraise the use of air quality models and software

List of Open-Source Software/learning website:

- NPTEL
- WRPLOT



Master of Engineering

Subject Code: EM3108

Subject Name: Design of Wastewater Treatment Plant

Semester: - II

Type of course: Program Core

Prerequisite: Students shall have basic knowledge of concepts and equations regarding water and wastewater treatment plants

Rationale: To provide knowledge related to the designing of wastewater treatment units.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	20	30	150

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Introduction to flow measuring device Detailed Design of Preliminary Treatment Units: <ol style="list-style-type: none"> 1. Approach Channel 2. Screen 3. Grit Chamber 4. Oil & Grease Trap 	05
2	Detailed Design of Primary Treatment Units: <ol style="list-style-type: none"> 1. Flow Equalization 2. Clariflocculator 3. Tube Settler 4. Rapid Sand Filter 5. Plain Sedimentation Tank 	07
3	Detailed Design of Aerobic Secondary Treatment Units: <ol style="list-style-type: none"> 1. Activated Sludge Process 2. Oxidation Ditch 3. Waste Stabilization Ponds 	06
SECTION-B		

Master of Engineering

Subject Code: EM3108

Subject Name: Design of Wastewater Treatment Plant

4	Detailed Design of Anaerobic Secondary Treatment Units: 1. Rotating Biological Contactor 2. Up flow Anaerobic Sludge Blanket Reactor	05
5	Sludge Management: Treatment Concept, Sludge Sources, Sludge Quantities, Sludge Quality & Characteristics, Dewatering equipment's, selection of equipment, Quantity of Methane gas Produced, Design of sludge digester. Design of Chlorination system.	07
6	Overall Design of ETP & STP Plant, Approach for ZLD system, Treatability studies.	06

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	10	15	10	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Recommended Books:

1. Wastewater Treatment Concepts & Design Approach by G.L Karia & R.A Christian.
2. Wastewater Engineering, Treatment and Reuse by Metcalf and Eddy, Tata McGraw- Hill Publication, New Delhi, 2003.
3. Water & Waste Water Engineering by Fair and Gayer.
4. Wastewater Engineering by Dr. B.C Punamia, Er. Ashok Jain, Dr. Arun Jain
5. Wastewater Treatment Plants, Planning, Design & Operations by Syed R Qasim.
6. Wastewater Treatment for Pollution Control & Reuse by Soli J Arceivala & Shyam R Asolekar



Master of Engineering

Subject Code: EM3108

Subject Name: Design of Wastewater Treatment Plant

List of Practical/ tutorials:

1. To determine MLSS & MLVSS of given sample
2. To determine Residual Chlorine of given sample
3. To determine Hardness of given sample
4. To determine Coagulant Dose of given sample using Jar test apparatus
5. To determine Sludge Volume Index of given sample
6. To determine Ammonical nitrogen of given sample
7. Designing of Screen (Single unit) using ETP Soft
8. Designing of Clarifier (Single unit) using ETP Soft
9. Designing of STP using ETP Soft
10. Designing of ETP using ETP soft

Course Outcomes:

After Learning this Course students will be able to:

Sr. No.	CO statement
CO-1	Describe different methods used for wastewater treatment
CO-2	Classify preliminary, primary, secondary treatment of wastewater.
CO-3	Solve complex problems related to design of wastewater treatment units
CO-4	Manage sludge and methane gas system
CO-5	Explain operational difference between aerobic and anaerobic treatment units.
CO-6	Design overall sewage and effluent treatment plant



Master of Engineering

Subject Code: EM3108

Subject Name: Design of Wastewater Treatment Plant

List of Open Source Software/learning website:

- <http://nptel.ac.in/>
- Modeling using software - ETP Soft

Shroff S.R. Rotary Institute of Chemical Technology

Master of Engineering

Subject Code: EM3109

Subject Name: Environmental Management-II

Semester: - II

Type of course: Program Elective

Prerequisite: Basics of Environmental Impact Assessment and Audit

Rationale: To make students aware about assessing Environmental Impacts and to create awareness about Environmental Audit

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	1	0	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Basic Concept of EIA: Introduction, origins of EIA, EIA procedure, project screening for EIA, Scope studies for EIS, Preparation of an EIS, Review of EIS, Introduction to Environmental Management System (EMS), Systematic Approach for using EIA as a planning tool for Major Project Activities, EIA Methodologies, EIA in India, EIA in Asian Countries, EIA Notification 2006 (along with all the latest Amendments).	08
2	Air Quality Impact Assessment, Water Quality Impact Assessment, Soil and Geological Impact Assessment, Biotic Impact Assessment, Assessment of Aesthetic Environmental Impacts, Economic Approaches to Environmental Impact Assessment, Contamination Assessment, Performance Assessment of EMS, Performance Assessment of ETP.	06
3	Introduction of Environmental Audit, Definitions, Benefits, Objectives and Scope, Need of Environmental Audit, General Approach of Environmental Auditing, Audit Procedures: Pre-Audit Activities, Activities at site and Post audit activities, GPCB scheme for Environmental Audit, Case Studies: Environmental Audit in Cement Industry, Fertilizer Industry, Pulp and Paper Industry, Sugar Industry, Thermal Power Station.	10
SECTION-B		

Shroff S.R. Rotary Institute of Chemical Technology

Master of Engineering

Subject Code: EM3109

Subject Name: Environmental Management-II

4	Introduction to water Conservation and Auditing, Process of conducting water Audit, Water Management Strategy, Conduction of Water Audit in Buildings (Interior and Exterior), Instrumentation and Flow Measurement, Preparation of Water Audit Report, Difference between water audit and Environmental Audit.	04
5	Emission Trading Scheme, Calculation of Penalty for violation, Corporate Social Responsibility: Introduction, Relations to Corporate Social Responsibility, Worldwide Perspectives on Corporate Environmental Responsibility, Drivers and Challenges, Benefits of Corporate Environmental Responsibility.	03
6	Green Building: Green Concepts and Vocabulary, Components of Sustainable Design and Construction, Green Building Principles and components, High Performance design strategies, Green Design and the Construction Process, Design process for high performance buildings, Traditional green design-Bid-Build Project delivery, Green Construction Management.	05

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	10	00	20	00

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Recommended Books:

1. R.R. Barthwal, "Environmental Impact Assessment", New Age International Publishers, 2nd Edition.
2. Y. Anjaneyulu Valli Manickam, "Environmental Impact Assessment Methodologies, Second Edition, B.S. Publications.
3. Gerard Kiely, "Environmental Engineering", McGraw-Hill International Editions Chemical and Petroleum Engineering Series.
4. Prof. A.K. Shrivastava, "Environmental Impact Assessment", APH Publishing Corporation, New Delhi.
5. Sam Kuba, "Handbook of Green Building, Design and Construction", LEED, BREEAM and Green Globes.
6. Geon Ho, Martin Anda and John Brennan, "Water Auditing and Water Conservation", Second Edition.
7. Environmental Auditing – CPCB Publication.
8. Environmental Impact Assessment: By Larry Canter.

Shroff S.R. Rotary Institute of Chemical Technology**Master of Engineering****Subject Code: EM3109****Subject Name: Environmental Management-II****Course Outcomes:**

After Learning this course, Students will be able to:

Sr. No.	CO statement
CO-1	Examine procedures of EIA, EIS and EMS.
CO-2	Explain EIA Methodologies and EIA Notification.
CO-3	Develop concept of water audit and Corporate Environmental Responsibility.
CO-4	Analyze concept of green building.
CO-5	Evaluate audit in Different Industries.
CO-6	Create understanding about Emission Trading Scheme.

List of Tutorials:

1. Concepts & Methodologies of EIA
2. Environmental Management System
3. Emission Trading Scheme
4. Air Quality and Water Quality Impact Assessment
5. Water Audit and Corporate Environmental Responsibility
6. Introduction, Objectives and scope of Environmental Audit
7. Green Building
8. Case Study of Environmental Audit
9. EIA Notification
10. Design of Green Building

Master of Engineering

Subject Code: EM3110

Subject Name: Advanced Anaerobic Biotechnologies

Semester: - II

Type of course: Program Elective III

Prerequisite: Knowledge of basic Biological Processes for Wastewater Treatment

Rationale: Anaerobic treatment technologies of waste water offer an attractive treatment options for wastewater treatment along with opportunities for energy recovery

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	1	0	4	70	30	20	30	150

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Anaerobic Treatment: Fundamental concept & Application: Advantages & disadvantages of Anaerobic Treatment, Principles of Anaerobic Treatment, Methanogenic series, Metabolism, COD equivalence of Methane, Factors affecting Anaerobic Treatment, Evaluating the applicability of Anaerobic Treatment	05
2	Microbiology and Biochemistry of Anaerobic Treatment processes: Sources of Methane in Anaerobic Treatment, Role of Acid fermentation and Methane fermentation, Characteristics	05
3	Anaerobic Reactor Configuration: Anaerobic Suspended growth processes, Anaerobic Attached growth processes, Anaerobic Sludge Blanket processes	04
SECTION-B		
4	Conventional and High Rate Reactors Conventional reactors: Stabilization pond, Oxidation pond, anaerobic lagoons standard rate and high rate sludge digesters. High rate reactors: Upflow Anaerobic Sludge Blanket, Upflow Anaerobic Filters, Expanded Granule Sludge Blanket, Internal Circulation, migrating blanket, biphasic anaerobic reactors	07

Master of Engineering

Subject Code: EM3110

Subject Name: Advanced Anaerobic Biotechnologies

5	Process operation parameter: Mixing and facilities, Heating facilities Design of Anaerobic reactors : Conventional treatment units including stabilization pond, Oxidation pond, anaerobic lagoons, standard rate and high rate sludge digesters, High rate reactors : Upflow Anaerobic Sludge Blanket , Upflow Anaerobic Filters, Methane gas recovery & utilization	07
6	Treatability Protocol: Assay techniques, Biochemical Methane Potential (BMP), Anaerobic toxicity assay, Treatability Parameters, pilot plant Studies	08

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	10	15	10	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Recommended Books:

1. Anaerobic Biotechnologies for bioenergy production, principles & application by Samirkumar Khanal
2. Anaerobic Biotechnology for Industrial Wastewater by Dr. R.E. Speece
ARCHAE PRESS
3. Wastewater Engineering Treatment and Reuse by Metcalf & Eddy
4. Design of Anaerobic Process for the Treatment of Industrial and Municipal Wastes by J. F. Malina
5. Biological Process Design for Wastewater Treatment by Larry D Benefield, Clifford W Randall



Master of Engineering

Subject Code: EM3110

Subject Name: Advanced Anaerobic Biotechnologies

Course Outcomes:

After Learning this course, Students will be able to:

Sr. No.	CO statement
CO-1	Understand the pathways of anaerobic treatment
CO-2	Design different types of anaerobic bioreactors depending upon the suitability of each for different types of waste
CO-3	Optimize the performance of anaerobic reactors
CO-4	Discuss the effect of heating and mixing on treatment efficiency.
CO-5	Explain the treatability protocol.
CO-6	Apply advance anaerobic biological process for wastewater treatment

List of tutorials:

Assignments on the questions related to:

1. Advantages & Disadvantages of Anaerobic treatment
2. Biogas production
3. Fermentation process
4. Bioreactor
5. Application of Anaerobic Suspended growth processes,
6. Application of Anaerobic Attached growth processes
7. Digester Diagrams
8. Application of UASB
9. Microbial Granular Technology
10. Case study regarding Anaerobic Technology

List of Open Source Software/learning website:

- NPTEL

Shroff S.R. Rotary Institute of Chemical Technology

Master of Engineering

Subject Code: EM3111

Subject Name: Environmental Legislation

Semester: - II

Type of course: Program Elective IV

Prerequisite: Students shall have basic understanding of various environmental acts and rules amended timely.

Rationale: To provide knowledge regarding legal provision related to environmental prevention.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	1	0	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Emergence of Environmental Law: Overview of legal system and basic concepts; Origin of Environmental Law; Overview of Constitution of India; Constitutional Perspective related to environment- Fundamental duties and rights; General principles in Environmental law; Environmental concerns in IPC, Cr.PC, Torts; Major international treaties, conventions and conferences related to environmental legislation; Institutional framework (SPCB/CPCB/MOEF).	6
2	Water Act, 1974: Familiarization with important sections and clauses of the Act; Comments on certain provisions, lacunae; Amendments to the Water Act 1974; Water rules. General norms and specific norms for effluent discharge	4
3	Air Act, 1981: Familiarization with important sections and clauses of the Act; Amendments to Air Act 1981; Air rules. Various emission norms- Ambient air quality, AQI, Stack emission norms	6
SECTION-B		

Shroff S.R. Rotary Institute of Chemical Technology

Master of Engineering

Subject Code: EM3111

Subject Name: Environmental Legislation

4	<p>A. Environmental Protection Act, 1986: Familiarization with important sections and clauses of the Act; Amendments to EPA,1986</p> <p>B. Rules & Notifications under EPA 1986 and its amendments if any: Solid Waste Management Rules, 2016; Hazardous And Other Wastes (Management and Transboundary Movement) Rules, 2016; Biomedical Waste Management Rules, 2016; Plastic Waste Management Rules, 2016; Construction and Demolition Waste Management Rules, 2016; E-waste (Management) Rules, 2016; Coastal Regulation Zone Notification, 2011; Noise Pollution (Regulation and Control) Rules, 2000; Salient features of Battery Waste Management Rules 2020.</p>	12
5	Public Liability Insurance Act, 1991; Public Interest Litigation Act; 1991; The National Green Tribunal Act, 2010; The Forest Conservation Acts, National Policy of Environmental protection and forest, Guidelines published by CPCB for OCMS, Solid Fuels and Fly ash utilization.	4
6	<p>Case studies: Insights into the important features of recent environmental court cases.</p>	4

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	10	10	05	05

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s Taxonomy)

Recommended Books:

1. Environmental Law 4th Edition 2021 by Dr. S R Myneni, Asia Law House
2. Constitution of India
3. The Water (Prevention and Control of Pollution) Act, 1974
4. The Air (Prevention and Control of Pollution) Act, 1981
5. The Environmental (Protection) Act, 1986
6. Amendments and notifications published under above Acts

Shroff S.R. Rotary Institute of Chemical Technology**Master of Engineering****Subject Code: EM3111****Subject Name: Environmental Legislation**

7. Environmental Law and policy in India, Armin Rozencaranz, Shyam Divan

Marhta L. Noble, Tripathi publication

Course Outcomes:

After Learning this course, Students will be able to:

Sr. No.	CO statement
CO-1	Recognize the constitutional perspective related to environmental protection.
CO-2	Assess the various Environmental Laws and their evolution in India.
CO-3	Analyze different Notifications under Environmental Protection Act
CO-4	Support the industries in achieving compliance with environmental laws and regulations.
CO-5	Implement various Rules and Acts for the prevention and control of Environment.
CO-6	Identify Regulation and Control rules and management and handling rules.

List of Tutorials:

1. Emergence of Environmental Law
2. Provisions under Water (Prevention and Control of Pollution) Act
3. Provisions under Air (Prevention and Control of Pollution) Act
4. Provisions under Environmental Protection Act
5. Provisions under The Hazardous Waste (Management and Handling) Rules
6. Provisions under The Biomedical Waste(Management and Handling) Rules
7. Provisions under The Plastics Waste Management Rules
8. Provisions under The Noise Pollution (Regulation and Control) Rules
9. Provisions under Coastal Regulation Zone
10. Case Studies on recent environmental court cases



Shroff S.R. Rotary Institute of Chemical Technology

Master of Engineering

Subject Code: EM3111

Subject Name: Environmental Legislation

List of Open Source Software/learning website:

1. www.gpcb.gujarat.gov.in
2. www.cpcb.nic.in
3. www.moef.nic.in

Shroff S.R. Rotary Institute of Chemical Technology

Master of Engineering

Subject Code: EM3112

Subject Name: Environmental Risk Assessment and Management

Semester: - II

Type of course: Program Elective IV

Prerequisite: Knowledge of Risk Assessment and Management

Rationale: To make students aware about managing and assessing risks in industries.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	1	0	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Introduction to Risk Assessment Standards and Definitions, Objectives, Need, Key standards requiring Risk Assessments, ISO 31000/ANSI/ASSEZ690 Risk Management Series	4
2	Hazard Identification, Hazard Assessment, Purpose of Assessing Risk, The Risk Assessment Process, Selecting a Risk Assessment Matrix, Risk Assessment Team	10
3	Risk Analysis, Risk Evaluation, Risk Treatment, Documentation, Monitoring and Continuous Improvement	4
SECTION-B		
4	Exposure Assessment, Dose Response Assessment, Risk Characterization, Source Apportionment	6
5	Ecological Risk Assessment, Future of Risk Assessment, Migration of various pollutants through different media, Various models used for Risk Assessment, Risk Prediction	6
6	Maximum Credible accidents (MCA) analysis, Consequence Analysis, Disaster Management Plan (DMP) and Emergency Preparedness Plan (EMP)	6

Shroff S.R. Rotary Institute of Chemical Technology

Master of Engineering

Subject Code: EM3112

Subject Name: Environmental Risk Assessment and Management

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	20	00	10	00

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s Taxonomy)

Recommended Books:

1. Ted Simon, “Environmental Risk Assessment a Toxicological Approach”, CRC Press, Taylor and Francis Group.
2. Georgi Popov, Bruce K. Lyonbruce Hollcroft, “RISK ASSESSMENT, A Practical Guide to Assessing Operational Risks”, WILEY
3. Hand book of Env Risk Assessment and Management Edited: By Peter Callow

Course Outcomes:

After Learning this course, Students will be able to:

Sr. No.	CO statement
CO-1	Examine Hazard Identification and Hazard Assessment.
CO-2	Explain Purpose of Risk Assessment and migration of pollutants through different media
CO-3	Develop Risk Management Plan
CO-4	Analyze Maximum Credible Accidents and Exposure Assessment
CO-5	Evaluate Risk Analysis
CO-6	Create understanding of Risk Assessment Models

List of Tutorials:

1. Risk Assessment and its objectives
2. Need of Risk Assessment and standards requiring risk assessment
3. Hazard Identification

Shroff S.R. Rotary Institute of Chemical Technology**Master of Engineering****Subject Code: EM3112****Subject Name: Environmental Risk Assessment and Management**

4. Hazard Assessment
5. Exposure Assessment
6. Response Assessment
7. Risk Analysis and Risk Evaluation
8. Risk Treatment
9. Disaster Management Plan and Emergency Response Plan
10. Maximum Credible Accidents Analysis

Shroff S.R. Rotary Institute of Chemical Technology

Master of Engineering

Subject Code: EM3113

Subject Name: Analytical & Instrumentation

Techniques

Semester: - II

Type of course: Open Elective

Prerequisite: Fundamental of instrumentation

Rationale: The main objective of this subject is to make students aware about the importance of instrumentation in Environmental Management.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	0	2	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Photoionization, Portable versus stationery analytical instrument, Gas survey instruments, Ion chromatography for the analysis of inorganic anions in water, ultra violet analysis of water and wastewater, Thermal conductivity detector, pH analyzer and their application.	4
2	Turbidimetry and nephelometry Visual method and instrumental method of turbidity measurement	4
3	Instrumentation for Noise and Sound Measurements, Quality Control Assurance in Sampling, Electronic Direct Reading Instrumentation	4
SECTION-B		
4	Gas analyzer, Gas chromatography, Control of specific gaseous Pollutants, Measurement of automobile pollution, Smoke level meter, CO/HC analyzer.	4
5	Water pollution: Sources and classification of water pollution, Waste water sampling and analysis, Waste water sampling techniques and analyzers: Gravimetric, Volumetric, Calometric, Potentiometric, Flame photometry, Atomic absorption spectroscopy, Ion chromatography, Instruments used in waste water treatment and control, Latest methods of Wastewater treatment plants, remote calibrations for OCMS	4
6	Pollution Management: Management of radioactive pollutants, Noise level measurement techniques, Noise pollution and its effects, Solid	4

Master of Engineering

Subject Code: EM3113

Subject Name: Analytical & Instrumentation
Techniques

	waste management techniques, social and political involvement in the pollution management system	
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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	10	10	5	5

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Recommended Books:

1. Environmental Science and Engineering Volume 7 : Instrumentation, Modelling & Analysis. Author: Bhola R Gurjar
2. Chemistry for Environmental Engg, Sawyer Macarty Macgraw Hills
3. Environmental Instrumentation and Analysis Handbook, Editor(s):Randy D. Down P.E.,Jay H. Lehr
4. Standard methods for the examination of water and wastewater; published by American public Health Association, American water works Association, Water pollution control federation (21st Edition & later).
5. Chemistry for Environmental Engineering by Sawyer and M C Carty (4th Edition- McGraw-Hill Publishing Company Ltd.)
6. Environmental Instrumentation and Analysis Handbook, Editor(s):Randy D. Down P.E.,Jay H. Lehr

Course Outcomes:

After Learning this course, Students will be able to:

Sr. No.	CO statement
CO-1	Use the instrumental method of analysis
CO-2	Evaluate fundamentals of Analytical Techniques



Master of Engineering

Subject Code: EM3113

**Subject Name: Analytical & Instrumentation
Techniques**

CO-3	Understand working of instruments as well as development of new technologies
CO-4	Assess assurance of quality and safety
CO-5	Differentiate various instrumentation used for environment analysis
CO-6	Explain various instrumentation process used for environment analysis

List of Open Source Software/learning website:

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

UPL University of Sustainable Technology

Shroff S.R. Rotary Institute of Chemical Technology



Master of Engineering



Subject Code: EM3114

Subject Name: Green Technologies for Process Industries

Semester: - II

Type of course: Open Elective

Prerequisite: Green Technology is a new and rapidly emerging branch that came into light with the goal of reducing the damage caused to the environment by man-made materials and the processes used to produce them. This concept also could include anything from reducing waste to even disposing of waste in an appropriate manner. All chemical waste should be disposed of in the best possible manner, without causing any damage to the environment and its various life forms.

Rationale: Green Technology is an approach to the design, manufacture and use of chemical products so as to reduce or eliminate chemical hazards intentionally. The goal of Green Technology is to create better, safer, chemicals while choosing the safest, most efficient ways to synthesize them. The main goal of Green Technology is to eliminate hazards right at the design stage. The principles of Green Technology demonstrate how chemical production could be achieved without posing hazard to human health and environment while at the same time being efficient and profitable.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	0	2	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	Introduction of Green protocol: Need, Goal and Limitation of Green Technology, Principles of Green Technology with their explanations and examples. Sustainable development, atom economy, reduction of toxicity	4
2	Waste: Production, Prevention, Problems and Source of waste, cost of Waste, Waste minimization technique, waste treatment and recycling.	4
3	Environmental chemicals: Chemical speciation – speciation of lead, mercury, arsenic and chromium. Structure and property – activity relationship, fate of organics in the environment – transformation reactions	4



	(hydrolysis, elimination, oxidation-reduction etc). Risk evaluation of environmental chemicals, Biochemical effects of arsenic, lead, mercury and pesticides.	
SECTION-B		
4	Water and Biodegradation: Analysis of water and water quality parameters – concept of pH, measurement of acidity, alkalinity, hardness, residual chlorine, chlorides, DO, BOD, COD, fluoride and nitrogen. Biodegradation – biodegradation of carbohydrates, proteins, fats and oils and detergents	4
5	Atmosphere: Structure of atmosphere, chemical and photochemical reactions in the atmosphere. Ozone Chemistry: formation and depletion of ozone layer, oxides of nitrogen and sulphur. Acid rain mechanism of formation and effects. Photochemical smog, and sulfurous smog. Greenhouse effect, global warming, greenhouse gases.	4
6	Green Synthesis and Industrial Process: Green oxidation and photochemical reactions, Microwave and Ultrasound assisted reactions, Synthesis of Green Reagents, Green solvents. Pollution statistics from various industries, polymer industry, textile industry, greener approach of dyeing, ecofriendly pesticides, pharmaceutical industry, wastewater treatment.	4

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	15	15	10	10	5

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Recommended Books:

1. Ahluwalia, V.K. Green Chemistry: Environmentally Benign Reactions, Ane Books India, New Delhi, 2006.
2. C.N Sawyer, P.L McCarty and G.F Parkin, Chemistry for Environmental Engineering and Science, 5th ed. Tata McGraw-Hill, 2003
3. Das, A. K. Environmental Chemistry with Green Chemistry, Books and allied (P) Ltd.

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Master of Engineering



Subject Code: EM3114

Subject Name: Green Technologies for Process Industries

4. Sanghi, R. and Srivastava, M.M. Green chemistry: Environment Friendly Alternatives, Narosa Publishing House.
5. Paul Anastas, John C. Warner, John Warner Joint; Green Chemistry: Theory and Practice New Ed Edition; Oxford University press, USA, 2000

Course Outcomes:

After Learning this course, Students will be able to:

Sr. No.	CO statement
CO-1	Describe the principles of Green Technology and Sustainable development.
CO-2	Summarize the concept of waste involving waste minimization, treatment and recycling.
CO-3	Predict the fate of different chemicals in environment and assessing risk evaluation of Environmental Chemicals.
CO-4	Analyze the quality of water for discharging into water bodies along with identification of biodegradation of minerals and detergents.
CO-5	Describe various components of atmosphere and mentioning the after effect of pollution caused by acid rain, smog and GHGs
CO-6	Organize systematically green route of synthesis and process adopted in Industries.



Master of Engineering

Subject Code: MH3103

Subject Name: Constitution of India

Semester: - II

Type of course: Audit Course

Prerequisite: Fundamentals and Concepts of Indian Constitution

Rationale: To make students aware about our Fundamental Rights and Duties prevailing in our Indian Constitution

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	0	0	30	20	0	0	50

Content:

Sr. No.	Content	Total Hrs.
SECTION-A		
1	History of Making of the Indian Constitution History Drafting Committee, (Composition & Working)	4
2	Philosophy of the Indian Constitution: Preamble Salient Features	4
3	Contours of Constitutional Rights & Duties: Fundamental Rights Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.	4
SECTION-B		
4	Organs of Governance: Parliament Composition	4

Master of Engineering

Subject Code: MH3103

Subject Name: Constitution of India

	Qualifications and Disqualifications Powers and Functions Executive President Governor Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions	
5	Local Administration: District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments) Village level: Role of Elected and Appointed officials Importance of grass root democracy	4
6	Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	4

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
09	09	08	08	08	08

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Recommended Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn, Lexis Nexis, 2014.



Master of Engineering

Subject Code: MH3103

Subject Name: Constitution of India

Course Outcomes:

After Learning this Course, Students will be able to:

Sr. No.	CO statement
CO-1	Examine salient features of Indian Constitution
CO-2	Explain the growth of Indian opinion regarding modern Indian intellectuals constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism
CO-3	Develop awareness about administration
CO-4	Address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.
CO-5	Evaluate Roles and Function of Election Commission
CO-6	Create Understanding about the premises informing the twin themes of liberty and freedom from a civil rights perspective