Master of Technology (M.Tech)
(Environmental Science & Engineering)

SYLLABUS

Department of Civil Engineering
Faculty of Engineering & Technology
Jamia Millia Islamia
New Delhi – 110025 (India)

July 2025

Course Structure

Course No.	Course Title		Periods per Week			Marks		
		Credits	L	T	P	Mid Sem	End Sem	Practical
1st Semester (Credits = 22)								
MEN-101	Environmental Chemistry & Microbiology	4	3	1	-	40	60	-
MEN-102	Sustainable Urban Environmental Design	4	3	1	--	40	60	--
MEN-103	Environmental Systems Modelling	4	3	1	-	40	60	-
MEN-104	Water Treatment Processes	4	3	1	--	40	60	-
MEN-105	Air Pollution	4	3	1	-	40	60	-
MEN-110	Environmental Monitoring Lab	2	-	-	4	-	20	30
2nd Semester (Credits = 24)								
MEN-201	Wastewater Treatment Processes	4	3	1	--	40	60	--
MEN-202	Air and Noise Pollution Control Systems	4	3	1	-	40	60	-
MEN-203	Solid and Hazardous Waste Management	4	3	1	--	40	60	--
MEN-204	Environmental Data Analysis & Machine Learning	4	3	1	-	40	60	-
MEN-210	Environmental Simulation Lab	2	-	-	4	-	20	30
MEN-211	Environmental Impact Assessment & Auditing	4 (Only One Elective to be opted)	3	1	-	40	60	-
MEN-212	Occupational Health & Environmental Safety							
MEN-213	Disaster Management & Mitigation							
MEN-214	Separation Processes in Water Treatment							
MEN-220	Seminar	2	0	0	4	-	20	30
3rd Semester (Credits = 14)								
MEN-301	Industrial Wastewater Treatment & Reuse	4	3	1	-	40	60	-
MEN-311	Applications of Remote Sensing & GIS	4 (Only One Elective to be opted)	3	1	-	40	60	-
MEN-312	Surface Water Hydrology							
MEN-313	Post Treatment of Anaerobic Effluent							
MEN-314	Optimization in Environmental Designs							
MEN-350	Dissertation Part – I	6	0	3	6	90	60	-

4th Semester (Credits = 12)								
MEN-450	Dissertation Part – II	12	0	6	12	-	120	180

Credit Summary

Semester	Core Course / Electives	Lab / Seminar / Project	Total Credits
I Semester	20	2	22
II Semester	20	4	24
III Semester	8	6	14
IV Semester	0	12	12
Total			**72**

Note: As per the new **SWAYAM** policy of **Jamia Millia Islamia**, it is mandatory for all students to complete **minimum credit requirement** through courses offered on the **SWAYAM online platform**.

FIRST SEMESTER

ENVIRONMENTAL CHEMISTRY & MICROBIOLOGY

Paper Code	**MEN-101**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0)**	**Credits**	**4**
Course Marks (Mid-End-Total)		**(40-60-100)**			

Course Objectives

- Provide understanding of basic concepts of water chemistry, chemical reactions and contaminants in water and wastewater
- Application of chemical reactions, equilibria and mass balance in water & wastewater treatment processes
- Basic understanding of microbiology involved in the biological treatment of wastewater

Course Description

Water Chemistry

Unit 1

Introduction - Role of chemistry in public health and in the control of pollution; water and wastewater pollution, industrial and hazardous wastes, air pollution; Basic concepts of general chemistry – oxidation–reduction reactions, gas laws, chemical equations, equilibrium; Alkalinity, Nitrogen & Phosphorous, Residual chlorine and chlorine Demand; DO, BOD, COD and TOC relationships

Unit 2

Fundamental of process kinetics – Types of chemical reactions, chemical kinetics i.e. reaction rates, kinetics of organic matter i.e. nature of BOD reaction; Material balance and reactor configuration; Solubility concept; Precipitation, sedimentation and adsorption mechanisms; Fate of organics - detergents and pesticides

Environmental Microbiology

Unit 3

Introduction - Taxonomy and Phylogeny - classification of microorganisms, aerobic and anaerobic bacteria; Infectious diseases - epidemiology of infectious diseases, water and air borne pathogens and their life cycle

Unit 4

Microorganisms - habitat requirements and population dynamics; Microbiology of purification processes – microbes of suspended growth and attached growth systems, methane forming organisms, anammox, microbes in water and waste water, soil and atmosphere

Unit 5

Microorganisms - detection techniques; Sampling strategies and monitoring network for surface water and ground water resources and distribution networks, pathogens-indicator of pollution; Molecular tools; Method of isolation

Text Books

- Chemistry of Environmental Sciences and Engineering, Sawyer and McCarty, Tata McGraw Hills Pvt. Ltd. New Delhi, India
- Process Chemical for Water and Wastewater Treatment, L.D. Benefield, Prentice Hall Inc. New Jersey, USA
- Microbiology for Environmental Engineering, Tata McGraw Hill Series

Reference Books
• Environmental Engineering, Gerard Kiely, The McGraw Hill Co. USA • Introduction to Environmental Engineering and Science, Gilbert and Masters, Pearsons, Education • Environmental Biotechnology, Rittmann and McCarty, Tata McGraw Hill Pvt. Ltd. India

SUSTAINABLE URBAN ENVIRONMENTAL DESIGN

Paper Code	**MEN-102**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0)**	**Credits**	**4**
Course Marks (Mid-End-Total)		**(40-60-100)**			

Course Objectives

- Disseminate knowledge and skill for proper design of water supply, sewerage system, urban hydrology as well as rainwater harvesting.
- To inculcate the understanding on selection of location and engineering design of landfill sites for municipal solid waste.

Course Learning Outcome

- Trained and skilled environmental engineer having sufficient knowledge to plan and design water supply, sewerage, drainage, rainwater utility system.
- Skilled Engineer who can select and design engineering landfill site.

Course Description

Unit 1

Site selection criteria for secured land fill sites, estimation of area required for land fill sites, design of engineering land fill site, design of natural and artificial lining system, geo-liner, design of leachate collection system, design of gas recovery system.

Unit 2

Municipal water requirements, water supply appurtenances distribution systems, optimum design of water main, design of water distribution network, computer applications in water supply design,

Unit 3

Quantification of rain water- runoff, sewer appurtenances quantification and variation of municipal sewage, design of open and closed sewerage systems, computer application in design of sewerage system

Unit 4

Water conservation – principles and practices, rainwater harvesting system, different types of rainwater harvesting system(RWH), characteristics of good rainwater harvesting system, design parameters and design of RWH units.

Text Books

- Water Supply, Steel and McGhee, McGraw Hill Series
- Environmental Engineering by Peavy, McGraw Hill
- Introduction to Environmental Engineering, Davis and Cornwell, McGraw Hill Series

Reference Books

- Manual of Water Supply, CPHEEO, MoUD, Govt. of India
- Manual of Sewerage System, CPHEEO, MoUD, Govt. of India
- Manual of Solid Waste Management, CPHEEO, MoUD, Govt. of India

ENVIRONMENTAL SYSTEMS MODELLING

Paper Code	**MEN-103**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0)**	**Credits**	**4**
Course Marks (Mid-End-Total)		**(40-60-100)**			

Course Learning Outcome

- Develop fundamental understanding of the idea, methodology and basic tools of environmental modeling
- Understand 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 Description

UNIT - I

Introduction to fundamental quantities and mathematical models, reaction kinetics, and analysis of rate data, effect of temperature. Completely mixed systems, Mass balance steady state solution of completely mixed systems. Concepts of Assimilation Factor, Transfer Function and Response Time.

UNIT- II

Temporal Aspects of pollutant reduction. Particular Solutions for different types of loading including Impulse Loading, Step Loading, Ramp Loading, Exponential Loading.

UNIT – III

Feed forward system: Mass balance – steady state and time variable, Cascade Model. Feed backward systems – steady state and time variable response. Numerical methods for solution of problems.

UNIT-IV

Stream Water quality. Effects of Point source and distributed sources under uniform flow and varying flow conditions. Point source Streeter-Phelps equation and modified Streeter-Phelps equation.

UNIT – V

Water quality in incompletely mixed systems, concept of diffusion, Distributed systems (steady state and time-variable), control volume approach. Water quality in estuaries, estuary transport, net estuary flow, estuary dispersion.

Text Books and references

- Environmental Modeling by Jerald L Schnoor, John Wiley & Sons Co.
- Modeling Tools for Environmental Engineers by N. Nirmalakhandan, CRC press.
- Surface Water Quality Modeling by Steven C Chapra, McGraw Hill Companies Inc.
- Principles of Surface Water Quality Modeling and Control by Rovert V Thomann and John A Mueller, Harper & Row Publishers

WATER TREATMENT PROCESSES

Paper Code MEN-104 (Lectures-Tutorial-Practical)/Week (3-1-0) Credits 4
Course Marks (Mid-End-Total) (40-60-100)

Course Objectives

- Provide basic knowledge of water quality parameters and their standards
- Provide scientific understanding on water treatment operations and processes
- Provide hands on expertise to design independently water treatment systems

Course Learning Outcome

Expected to become a successful Environmental Engineers having capability to design independently water treatment systems

Course Description

Unit 1

Introduction – water quality parameters, sources; Water intake (surface and subsurface), screening of water, different types and arrangements of screens, aeration – removal of dissolved gases, iron and manganese, Sedimentation theory, different types of settling and their applications

Unit 2

Coagulation and flocculation – basic concepts, various types of coagulants and their applications, design of flocculators; theory of filtration, types of filters - rapid and slow sand filters and dual filters, various types filter design

Unit 3

Water softening; chemical precipitation -ion balance; ion exchange - ion exchange principles, cation and anions exchangers, types of resins and their suitability

Unit 4

Disinfection - theory of disinfection, common disinfectants, suitability of disinfectants, chlorination – pre-chlorination, post chlorination, super-chlorination, de-chlorination, design of disinfection facilities

Unit 5

Advance water treatment techniques; membrane separation techniques – microfiltration, ultra-filtration, nanofiltration, reverse osmosis; adsorption - types of adsorbents, applications and limitations, adsorption isotherms

Text Books

- Environmental Engineering, Peavy and Row, Tata McGraw Hills Pvt. Ltd. New Delhi, India
- Water Supply, Steel and McGhee, McGraw Hill Publications
- Water Technology, Hammer and Hammer, Tata McGraw Hills Pvt. Ltd. New Delhi, India

Reference Books
• Environmental Engineering, Gerard Kiely, The McGraw Hill Co. USA • Environmental Engineering, Sincero and Sincero, Tata McGraw Hills Pvt. Ltd. New Delhi, India • Introduction to Environmental Engineering and Science, Gilbert and Masters, Pearsons, Education

Software or other Requirement
• EPANET, Water CAD

AIR POLLUTION

Paper Code	**MEN-105**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0) Credits 4**
Course Marks (Mid-End-Total)	**(40-60-100)**		

Course Objectives

- The course provides basic understanding of air pollution, sources, effects and dilution mechanism of pollutants.
- The prime objective of this course is to develop skills among the students to design industrial stacks, predict the pollutant concentrations and become well aware of air quality monitoring and with its instrumentations.

Course Learning Outcome

Environmental Engineers capable of designing industrial stacks, predict the pollutant concentrations and become well aware of air quality monitoring and with its instrumentations

Course Description

Unit 1

Introduction, definition of air pollutant, general nature of air pollution problem, effects of major pollutants on human, vegetation and other materials, global air pollution impact e.g. global warming, depletion of ozone layer, acid rain etc.

Unit 2

Meteorology, lapse rate, stability conditions, wind velocity profile, stack plumes, plume rise, calculation of plume rise, effective stack height

Unit 3

Dispersion of pollutant in the atmosphere, factors affecting the desperation phenomena, eddy diffusion model, Gaussian dispersion equation, reduction of Gaussian dispersion equation to ground level C/L concentration and for line sources, assumptions and limitations

Unit 4

Air quality monitoring; sampling duration, selection of sampling sites, principle of sampling instruments, measurement units, sampling and analysis of SPM, RSPM, SOX , NOx, and CO

Unit 5

Indoor pollution; introduction, types of pollutants, sources, effects, indoor air quality modeling

Text Books

- Introduction to Air Pollution, Crawford, Tata McGraw Hill Pvt. Ltd. New Delhi India
- Air Pollution, Neol De Nevers, Tata McGraw Hill Pvt. Ltd. New Delhi India
- Environmental Engineering, Peavy and Rowe, Tata McGraw Hill Pvt. Ltd. New Delhi India
- Introduction to Environmental Engineering, Masters & Masters, Printice Hall

Reference Books

- Fundamentals of Air Pollution, Daniel A. vallero, Science Direct Publication

SECOND SEMESTER

WASTEWATER TREATMENT PROCESSES

Paper Code	**MEN-201**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0)**	**Credits**	**4**
Course Marks (Mid-End-Total)		**(40-60-100)**			

Course Objectives

- To provide basic knowledge of wastewater characterization and their effluent discharge standards
- To provide scientific understanding on wastewater treatment operations and processes
- To provide hands on expertise to design independently wastewater treatment systems

Course Learning Outcome

- Environmental Engineers acquire the capability to design wastewater treatment systems
- The student will become well acquainted with basic design and operation of treatment plants for advanced physico-chemical-biological treatment of domestic wastewater with regard to carbon, nitrogen and phosphorous removal. It also gives an insight of natural and decentralized treatment system.

Course Description

Unit 1

Municipal wastewater – characteristics and composition; preliminary treatment systems - screening, grit removal and primary sedimentation – theory and design, flow measurement techniques.

Unit 2

Biological treatment process - aerobic and anaerobic treatment systems, basic fundamentals of aerobic and anaerobic treatment of wastewater, reaction kinetics

Unit 3

Biological treatment systems, suspended and attached growth systems, activated sludge process (ASP) and its modifications, aeration principle and mechanism, diffused and surface aerators,

Unit 4

Attached growth systems; trickling filter, types of trickling filters, reaction kinetics, efficiency calculations and design, bio-filters and rotating biological contactors – working principle and design

Unit 5

Low cost systems, stabilization ponds, lagoons, oxidation ditches, tertiary treatment system, recycling and resources recovery, sludge treatment.

Text Books

- Wastewater Treatment, Treatment and Reuse, Metcalf and Eddy, Tata McGraw Hill Pvt. Ltd. New Delhi India
- Wastewater Technology, Hammer and Hammer, Tata McGraw Hill Pvt. Ltd. New Delhi India

Reference Books
• Process Chemistry for Water and Wastewater Treatment, L.D. Benefield, Prentice Hall Inc. New Jersey, USA • Treatment Plant Design, S.R.Qasim, TA Publishing, USA • Introduction to Environmental Engineering and Science, Masters, Tata McGraw-Hill

AIR AND NOISE POLLUTION CONTROL SYSTEMS

Paper Code	**MEN-202**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0)**	**Credits**	**4**
	Course Marks (Mid-End-Total)	**(40-60-100)**			

Course Objectives

- Provide students with an introduction to air pollution control devices-constructional features and working principles
- Understanding of technical aspects of regulating and controlling air pollution
- Trained the students to design the control equipment independently
- Familiarize the students to basic concept of noise pollution and its control

Course Learning Outcome

- Expected to become a successful Environmental Engineers having capability to design independently air pollution control systems
- The student will become well acquainted with basic design and operation of air pollution control systems

Course Description

Unit 1

Introduction, gaseous pollutants control devices and their working principle, absorption, adsorption, combustion and condensation, SOx control and NOx control, process control, in combustion process and treatment of flue gases, catalytic converters.

Unit 2

Introduction, particulate control equipments; gravity settling chambers, cyclone separators, fabric filters, electrostatic precipitators and wet scrubber, working principle, design, advantage, and disadvantages and limitations of equipments. Design of ventilation system, basics of hood and duct design.

Unit 3

Noise pollution, different types of noise sources, noise standards, noise propagation, inverse square law, noise measurements, addition and subtraction of noise levels, noise rating system, effects of noise on hearing, working performance, damage-risk -criteria, annoyance, speech interface

Unit 4

Noise prediction modeling, various type of models and input parameter required, application, advantages, disadvantage and limitations of noise prediction models, Noise control - control at source, during transmission and at receptor end, noise barriers and their design.

Text Books

- Air Pollution and Control, Crawford, McGraw Hill Series
- Environmental Engineering, Peavy and Rowe, McGraw Hill Series

Reference Books

Fundamentals of Air Pollution (Fourth Edition), Daniel A. Vallero, Science Direct

SOLID AND HAZARDOUS WASTE MANAGEMENT

Paper Code MEN – 203 (Lectures-Tutorial-Practical)/Week (3-1-0) Credits 4
Course Marks (Mid-End-Total) (40-60-100)

Course Objectives

- Provide basic knowledge of solid waste in terms of characteristics and composition
- Provide understanding of processes used for sustainable solid wastes disposal systems
- Develop skill to design the municipal solid waste management systems

Course Learning Outcome

Expected to become a competent Environmental Engineers having sufficient knowledge on design and application of solid waste management systems

Course Description

Unit 1

Definition and classification of different categories of solid wastes (municipal, industrial and biomedical), identification of sources of waste generation, method of inventory and auditing of sources. Physical, chemical and biological properties of wastes.

Unit 2

Characteristics of wastes, screening criteria, waste toxicity, flammability, corrosivity, reactivity, bio-accumulation, waste compatibility matrix, high toxic-low volume and low toxic industrial waste, mass balance.

Unit 3

Integrated wastes management system Waste minimization, process modification, cost benefit analysis of waste minimization, material and energy recovery, concept of waste exchange and balanced industrial complexing, Case Studies.

Unit 4

Collection and transportation of solid waste, collection equipments, systems of collection, garbage chutes, bailing and compacting, transfer station, design of wastes collection and transportation system, Route optimization

Unit 5

Disposal methods – landfills: site selection, design and operation of sanitary landfills, leachate and landfill gas measurement, incineration process, open dumping, ocean disposal, various methods of refuse processing, composting, pyrolysis, incinerators, compost plants etc. fertilizer, fuel and food values, design of incinerators, compost plants, legislation related to solid wastes management

Text Books

- Environmental Engineering, Peavy and Row, Tata McGraw Hill Pvt. Ltd. New Delhi India
- Wastewater Treatment, Treatment and Reuse, Metcalf and Eddy, Tata McGraw Hill Pvt. Ltd. New Delhi India
- Solid Waste management, Gorge Tchonobanoglous, Tata McGraw Hill Series

Reference Books

- Environmental Engineering by Sincero and Sincero, Tata McGraw Hill Series
- CPHEEO Manual on Municipal Solid Waste Management

ENVIRONMENTAL DATA ANALYSIS AND MACHINE LEARNING

Paper Code	**MEN – 204**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0) Credits**	**4**
Course Marks (Mid-End-Total)		**(40-60-100)**		

Course Objectives

- The course is designed to acquaint students with the principles of experimental design, analysis of variance and regression and correlation analysis.
- The course includes basic statistical methods: computing descriptive statistics, hypothesis testing and analysis of variance along with graphical representation of data.
- The course aims at to develop the ability among the student to analyzed the environmental data and make it presentable form in a scientific manner.

Course Learning Outcome

- Environmental engineer becomes familiar with basic statistical methods: computing descriptive statistics, hypothesis testing and analysis of variance along with graphical representation of data.
- Environmental Engineers having ability to analyzed the experimental data and make it presentable form in a scientific manner.

Course Description

Unit 1

Survey and experiments, sources of error in experiments, minimization of error at source, requirements for good experiments, reduction of error, precision measurement and estimation choice of units, observations and treatments

Unit 2

Basic statistical concepts of data analysis; normal distribution, properties of Gaussian distribution, area under the normal distribution curve, standardised normal distribution,

confidence level, central limit theorem, significance test, chi- square test for goodness of fit, criteria for goodness of fit.

Unit 3

Graphical representation and curve fitting of data, equation of approximate curve, determination of parameters, linear relationships, least square equation of second degree and higher.

Unit 4

Introduction to environmental modeling, various modeling approaches, development of simple models, neural networks, basic concept of artificial neural network, application of artificial neural network on environmental modeling.

Text Books

- Statistical Methods, Nagpal, Tata McGraw Hill Series
- Statistics Methods and Applications, Paul Lewicki and Thomas Hill, Tata McGraw Hill

Reference Books

- Introduction to Basics of Statistics, Gerhard Bohm, Desy Books,

Software or other Requirement

- Statistica
- Statsoft
- SPSS

THIRD SEMESTER

INDUSTRIAL WASTEWATER TREATMENT AND REUSE

Paper Code MEN - 301 (Lectures-Tutorial-Practical)/Week (3-1-0) Credits 4
Course Marks (Mid-End-Total) (40-60-100)

Course Objectives

- Provide basic knowledge of industrial operations and principal effluent generation units along with the effluent characterization
- Application of fundamental principles (learned in treatment process I and II) for the treatment of industrial wastewaters
- Disseminate knowledge of wastewater in river pollution and its modeling, disposal of effluent in sea and lakes

Course Learning Outcome

- Expected to become a successful Environmental Engineers having capability to design independently industrial effluent treatment systems
- The student will become well acquainted with basic design and operation of treatment plants for industrial effluent
- Students are expected to understand the river pollution and its control and management.

Course Description

Unit 1

Characteristics and composition of different industrial waste, sampling, preservations and analysis techniques Standards for waste disposal, General methods of treatment of industrial effluent. Nutrient and its role in the treatment.

Unit 2

Pre Treatment of effluent waste volume and strength reduction, equalization and proportioning of wastes. Neutralization of wastes, oil removal and floatation.

Unit 3

Sources of Effluent generation, its characteristics, and treatment scheme for high strength organic effluent industries, such as textiles, dairy, sugar, brewery, distillery pulp and paper etc.

Unit 4

Sources of Effluent generation, its characteristics, and treatment scheme for chemical industries, such as fertilizer, tanning, iron and steel, metal finishing and thermal power plant.

Unit 5

Disposal of waste in streams and estuaries, self-purification in stream, physical, chemical and biological forces of self-purification, stream constants, oxygen balance in streams, stream surveys and investigation.

Text Books

- Industrial Pollution Control, Numero Nelson, Tata McGraw Hill Pvt. Ltd. New Delhi India
- Wastewater Treatment, Treatment and Reuse, Metcalf and Eddy, Tata McGraw Hill Pvt. Ltd. New Delhi India

Reference Books
• Industrial Pollution Control, Eckenfelder, Tata McGraw Hill Series • Wastewater Treatment by M.N. Rao and A.K.Datta, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi • Design of municipal Wastewater Treatment Plants, WEF Manual of Practice No. 8, Vol.1, McGraw Hill Series, New York

DISSERTATION I

Paper Code	**MEN 350**	**(Lectures-Tutorial-Practical)/Week**	**(0-0-6) Credits**
6	**Course Marks (Mid-End-Total)**	**(90-60-150)**	

Course Objectives

- **The purpose of educational tour is to provide an exposure to the students of various processes involved in industries/ typical ecosystems, environmental issues associated with them & a hands on exposure of developing an environmental management plan for the same.**
- **Students are motivated to critically examine various environmental aspects of industries / ecosystems visited by them.**

Course Learning Outcome

- **Environmental Engineers becomes fully aware of various processes involved in industries/ typical ecosystems, environmental issues associated with them & a hands on exposure of developing an environmental management plan**

FOURTH SEMESTER

DISSERTATION II

Paper Code	**MEN 450**	**(Lectures-Tutorial-Practical)/Week**	**(0-0-6)**	**Credits**	**6**
Course Marks (Mid-End-Total)	**(180-120-300)**				

Course Objectives

- **The purpose of project II is to provide an exposure to the students about basics of data analysis, interpretation of results and carrying out research on various processes involved in industries/ municipal wastewater treatment, typical ecosystems, environmental issues associated with them & a hands on exposure of developing an environmental management plan for the same**
- **Students are motivated to critically examine experimentally and analytically to evaluate various problems on water and wastewater**

Course Learning Outcome

- **Environmental Engineers becomes fully aware of various processes involved in industries/ typical ecosystems, environmental issues associated with them & a hands on exposure of data analysis**

(Elective Courses)

ENVIRONMENTAL IMPACT ASSESSMENT AND AUDITING

Paper Code	**MEN – 211**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0)**	**Credits**	**4**
Course Marks (Mid-End-Total)		**(40-60-100)**			

Course Objectives

- **This course aims at providing a sufficient insight into the environmental impact assessment methodologies.**
- **The course includes topics related to description of environmental settings, prediction of impacts, evaluation of impacts & their mitigation plan.**
- **Regulatory requirements of EIA & procedure for obtaining environmental clearance from regulatory agencies also form integral part of course.**

Course Learning Outcome

- Environmental engineer becomes familiar with insight into the environmental impact assessment methodologies, environmental settings, prediction of impacts, evaluation of impacts & their mitigation plan.
- Environmental Engineers acquire sufficient knowledge that helps to obtain environmental clearance from regulatory agencies

Course Description

Unit 1

Definition of environmental impact assessment and environmental auditing, objectives of EIA. Types of environmental impacts, various steps in EIA. Environmental legislations,

NEPA, environmental protection act 1986, other acts, organizational setup.

Unit 2

Description of Environment: Air, water, land, ecology, noise, human aspects, socio-economic aspects and resources, Definition of the attribute, Activities that affect the attribute. Source of impacts, Variables to measure. Data sources, skill required, instruments.

Unit 3

Evaluation and interpretation of data, geographical and temporal limitations, mitigation of impact and temporal effects. Prediction of impacts on environmental parameters related to air, water, land, noise, flora &fauna, socio-economic, human health etc.

Unit 4

Impact assessment methodologies, selection of methodology, categorization of methodologies, review criteria, methodology descriptions, review and future directions, generalized approach for impact analysis.

Unit 5

Environmental attributes, institutional constraints, environmental setting and computer based system (introduction), procedure for developing IA, EIS and EA and its review.

Ministry of environmental guidelines, case studies on EIA/EIS and EA.

Text Books

- EIA, Canter, Tata McGraw Hill Pvt. Ltd. New Delhi India
- Essentials of Environmental Studies, Joseph and Nagendran, Pearson Education

Reference Books
• Environmental Impact Assessment: A Methodological Approach, Richard K. Morgan, Springer Science Publication • Environmental Impact Assessment" Cambridge, Gilpin • Introduction to Environmental Engineering and Science, Masters, Tata McGraw-Hill • Environmental Assessment Sourcebook - The World Bank • Environmental Management in Organizations – The IEMA Handbook, John Brady, Earthscan, London

DISASTER MANAGEMENT AND MITIGATION

Paper Code	MEN-213	(Lectures-Tutorial-Practical)/Week	(3-1-0)	Credits	4
Course Marks (Mid-End-Total)		(40-60-100)			

Course Objectives

- **To provide knowledge to students about the natural disasters and mitigation**
- **To familiarize the students about the causes and consequences of natural disasters**

Course Learning Outcome

- **Providing sufficient knowledge onthe causes, consequences and mitigation efforts for different types of natural disasters - prevalent at national and international level**
- Environmental Engineers should be able to understand about the approach to mitigate the natural disasters

Course Description

Unit 1

Disaster - definitions, concept and perceptions. Different types of disasters. Disaster and development. IDNDR / ISDR, Yokohama Strategy and Hyogo Framework of disaster mitigation and management. Disaster management policy – national and states. Disaster management act – national and states. Recent initiatives at national and state level.

Unit 2

Disaster management mechanism – national, state and district levels. Select global practices. Disaster management plans- various levels. Role of NGOs / CBOs and Armed Forces in disaster management. Community Based Disaster Preparedness (CBDP) – framework and formulation. Disaster education and awareness.

Unit 3

Natural Disasters - physical phenomenon, causes and consequences mitigation and management practices – cyclones, floods, earthquakes etc. Forecasting and early warning systems. Documentation and case studies on natural disasters. Importance of communication and information technology in disaster management

Unit 4

Disaster and environment. Natural resource management. Land use planning. Urban risk mitigation. Relationship between environmental pollutions, global warming, ozone layer depletion, climate change with disaster mitigation efforts. El-Nino and la-Nina effects and their impacts. Environmental consequences of disaster events

Text Books

- An Introduction to Sustainable Development, Peter P. Rogers, Tata McGraw Hill
- Disaster and Development, Andrew E. Collins, Tata McGraw Hill

Reference Books

- Disaster Management, A.L. Caressi, Routledge, taylor and Francis Publication

APPLICATION OF REMOTE SENSING AND GIS

Paper Code	**MEN-311**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0) Credits 4**
Course Marks (Mid-End-Total)		**(40-60-100)**	

Course Objectives

- To study the basic concepts and principles of remote sensing.
- To study various image enhancement and classification techniques.
- To study and understand basic principles of GIS

Course Learning Outcome

- The students will be able to know about different types of satellites products and their characteristics.
- They will be able to interpret and classify remote sensing data products
- They will be able to geo reference maps and images using different coordinate systems

Course Description

Unit I

Geographic coordinates- latitude and longitude; Survey of India toposheets, basic projections and coordinate systems.

Basic concept of remote sensing- energy sources and radiation principle, EMR and spectrum; EMR interaction with atmosphere and earth surface features- reflection, absorption, emission and transmission; spectral response pattern- vegetation, soil, water bodies; Characters of remote sensing system- platforms and sensors, orbits types, resolutions; Characters and applications of satellites- IRS series, LANDSAT series, SPOT series, high resolution satellites.

Unit II

Image geometric distortion- sources and causes of distortion, rectification- GCP, resampling, image registration/geo referencing; Image Enhancement- satellite image statistics, basics of histogram; contrast stretching- spatial feature manipulations, spatial filtering, convolution low pass and high pass filters, edge detection; Image Classification- introduction, classification techniques, supervised-training stage, classification stage, parallelepiped classifier, Gaussian maximum Likelihood classifier, unsupervised classification.

Unit III

Introduction, definition of GIS, components of GIS, functions of GIS, spatial entity, spatial data model-raster and vector, data structure, attribute data- input and management, concept of Metadata; Process of GIS- data capture, data sources, GPS, data encoding methods, linking of spatial and attribute data;

Unit IV

Spatial data analysis- measurement of length, perimeter and area, queries, reclassification techniques, buffering and neighbourhood functions, spatial interpolation; overlay analysis-vector and raster overlay; surface analysis and interpolation-DEM, slope, aspect, watershed analysis; application of GIS in Civil Engineering.

Theoretical knowledge gained will be put into practice through hands-on laboratory exercises utilizing the software such as ERDAS IMAGINE and ArcGIS.

Text Books

- Remote Sensing and Image Interpretation by Lillesand and Kiefer, John Wiley & Sons, Inc.
- Principles of Geographic Information Systems by Burrough, P.A. and McDonnell R.A., Oxford: Clarendon Press.
- Remote Sensing and GIS byBasudebBhatta, Oxford University Press.

Reference Books

- Principle of Remote Sensing by Paul J. Curran, Longman, London and New York
- Remote Sensing Principles and Interpretation by Floyd F. Sabins, W H Freeman and Company

Software or other Requirement

- ERDAS IMAGINE
- ArcGIS

SURFACE WATER HYDROLOGY

Paper Code	**MEN-312**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0) Credits 4**
Course Marks (Mid-End-Total)		**(40-60-100)**	

Course Objectives

- Providing basic knowledge on study of hydrology is a pre-requisite for efficient design of water resource systems.
- Design of hydraulic structures such as dams, flood protection works, and irrigation facilities require hydrological information as essential input.
- Techniques for stream flow and velocity measurement form an important part of data collection procedures, and will be discussed in detail in this course.

Course Learning Outcome

- Providing sufficient knowledge on application of basic principles of hydrology on estimation of design flood and useful life of reservoirs.
- Practicing engineers would be able to work within the fields of either earth or environmental science, physical geography, and civil and environmental engineering

Course Description

Unit I

Precipitation: Hydrologic cycle, Types and Forms of precipitation, Adequacy of rain gauges, generation of rainfall data, depth- area duration analysis. Consistency in rainfall records. Average rainfall. Frequency analysis.

Loses from precipitation: Evaporation process, Transpiration, Evapotranspiration and Evaporation Control.

Unit II

Infiltration: Infiltration process, measurement of infiltration and infiltration indices.

Runoff: Factors affecting runoff, yield and its estimation, flow duration curve, and rainfall - runoff correlation.

Unit III

Steam flow measurement; measurement of stage and velocity, direct and indirect measurement of discharge, rating curves, stage discharge relationship.

Hydrograph; component parts of a hydrograph, base flow separation, unit hydrograph, unit hydrographs for different durations, unit hydrograph for complex storms.

Unit IV

Flood frequency studies: Introduction, Design flood. Frequency analysis using Gumbel's method and log Pearson type III distribution

Flood Routing: basic equations of flood routing, hydrologic channel routing through reservoirs and channels

Unit V

Reservoir Planning: Types of reservoir, Reservoir planning, Site selection, Storage zones, Reservoir yield, Mass curve and determination of storage capacity and yield. Reservoir sedimentation, sedimentation control, advanced topics

Text Books

- Engineering Hydrology. K. Subramanya, Tata McGraw Hill
- Water Resource Engineering. K.C. Patra. McGraw Hill

Reference Books

- Surface Water Quality Modeling. Chapra, Lewis Publication
- Physical Hydrology, (Second Edition); Fetter,
- Hydrology and Hydraulic Systems, Gupta, Third Edition

OPTIMIZATION IN ENVIRONMENTAL DESIGN

Paper Code	MEN-314	(Lectures-Tutorial-Practical)/Week	(3-1-0) Credits
4		Course Marks (Mid-End-Total)	(40-60-100)

Course Objectives

- **Provide basic knowledge of optimization as a powerful tool that can be systematically applied for obtaining efficient and cost-effective solutions to a wide variety of engineering problems.**
- **Introduce and apply commercially available as well as open source software to the solution of engineering optimization problems**

Course Learning Outcome

- Providing sufficient knowledge on application of various application-oriented presentations of the fully array of traditional and recently developed optimization techniques being used by the engineers.
- Emphasis is laid on the application of optimization techniques to real-world problems from various areas of environmental engineering.
- Should have a sound knowledge of basic theoretical principles of optimization and to formulate optimization models.

Course Description

Unit 1

Introduction to optimization, historical development, engineering application of optimization, formulation of design problems as mathematical programming problems, classification of optimization problems, introduction to stochastic and deterministic algorithms.

Unit 2

Linear programming, graphical method, simplex method, duality in linear programming, post-optimality analysis, LP for multi period decision process, application of LP to environmental engineering problems, use of spread sheets for solving LP problems.

Unit 3

Non-linear programming, Single variable and Multi variable unconstrained optimization techniques, direct search methods, descent methods, constrained optimization, multivariable optimization with equality and inequality constraints, direct and indirect methods, Kuhn- Tuker conditions for constrained optimization.

Unit 4

Dynamic programming, characteristics of dynamic programming problems, Computational procedure, Multi decision processes, Concept of sub optimization and the principle of optimality, Discrete differential dynamic programming, Application of environmental engineering problems.

Text Books

1. Hillier, F. S., and G. J. Lieberman, "Introduction to Operations Research", McGraw Hill, 2001
2. R.L. Fox, "Optimisation Methods for Engineering Design", Addison Wesley USA, 1971
3. G. Haddley, "Linear Programming", Reading, Mass., Addison-Wesley, 1962
4. Wayne L Winston, Operations Research: Applications and Algorithms, Cengage Learning; 4

edition, 2003

Reference Books

1. Deb, K. "Optimisation for Engineering Design", Prentice Hall of India, 2000.
2. S. S. Rao, "Optimisation Theory and Applications", Wiley Eastern, New Delhi, 1978.
3. Taha, Hamdy"Operations Research, Pearson, USA.
4. D. E. Goldberg, "Genetic Algorithm in Search, Optimisation and Machine Learning", Reading, Mass., Addison-Wesley, 1989