Program of Study

Syllabus

M.Tech (Environmental Science & Engineering)

Department of Civil Engineering

Jamia Millia Islamia

New Delhi - 110025

ABOUT THE PROGRAM

The Department of Civil Engineering is one of the oldest and the largest department in the Faculty of Engineering & Technology and offers an undergraduate program in Civil Engineering. Civil Engineering involves the exploration, research, planning, analysis, design, construction, and operation of facilities essential to modern life. The academic activities of the Department lays emphasis on deep understanding of fundamental concepts, development of creative ability to handle the challenges of Civil Engineering, and the analytical ability to solve problems which are interdisciplinary in nature. Graduates have a wide variety of employment opportunities in both the private and public sectors. The program provides excellent technical knowledge in all the emerging areas of Civil Engineering that deals with the construction and design of public and private sector works such as bridges, roads, dams and buildings. The curriculum is updated from time to time as per the recommendations of the Board of Studies in order to keep in pace with the latest developments in the area.

The department has been planned on modern lines with state of art facilities to be utilized for research and consultancy in addition to the training of students. Civil Engineering graduates well trained in all aspects of civil engineering and adequately prepared to be acceptable globally.

PROGRAM EDUCATIONAL OBJECTIVES

The **PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)** are the statements that describe the expected achievements from the programme. They are guided by global and local needs, the vision of the department, long term goals etc. The Programme Educational Objectives of B-Tech in Civil Engineering includes:

1. To train and equip graduates in Civil Engineering with professional skills for successful careers dealing with analysis, design and management of infrastructural projects both in India and Abroad.
2. To develop core competency in the civil engineering field so as to formulate, analyze and solve civil engineering and allied problems using the principles of mathematics and science and applying basic engineering tools.
3. To provide the students with a comprehensive and balanced understanding of the several branches of Civil Engineering such as Structural Engineering, Geotechnical Engineering, Transportation Engineering, Hydraulic and Water Resources Engineering, Environmental Engineering.
4. To inculcate in students in maintaining high ethical standards, effective oral and written communication skills, to work as part of teams on multidisciplinary projects in diverse professional environments, and relate engineering issues to the society and nation.
5. To provide student with an academic excellence, leadership as well as team work management skills and the life-long learning needed for a successful professional career.

PROGRAM OUTCOMES

The curriculum and syllabus for B-Tech Civil Engineering program conform to result oriented teaching learning process. In general, **ELEVEN PROBLEM OUTCOMES (POs)** have been identified and the curriculum and syllabus have been structured in such a way that each of the courses meets one or more of these outcomes. Program outcomes are statements that describe significant and essential learning that students have achieved, and can reliably demonstrate at the end of a course or program. Program outcomes identify what students will know and be able to do by the end of a course or program – the essential and enduring knowledge, abilities (skills) and attitudes (values, dispositions) that constitute the integrated learning needed by a graduate of a course or program.

Graduates of the civil engineering program will be able to:

1. Apply the knowledge of mathematics, science, engineering fundamentals and principles in the solution of complex civil engineering problems.
2. Design and conduct experiments, as well as to analyze and interpret the results and report them in a professional format.
3. Design Civil Engineering projects while following standard specifications and IS codes and meeting individual requirements within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. Learn basic techno-economic and techno-legal aspects of engineering projects, and preliminary aspects of project management and to work in a multidisciplinary environment.
5. Understand the impact of the professional Civil Engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
6. Use current techniques, skills, and modern engineering tools such as CAD, FEM, GIS etc. necessary for computing and engineering practice.
7. Develop appropriate skills of written, oral and visual communications and make effective documentations and presentations.
8. Recognise and develop confidence for self education and ability to engage in continuing professional development.
9. Analyze the local and global impact of contemporary engineering issues on individuals, organizations and society.
10. Demonstrate their role as managers or entrepreneurs and contribute their skills to the society.
11. Recognize the importance of civil Engineering professional development by pursuing postgraduate studies or face competitive examinations that offer challenging and rewarding careers in computing

FIRST SEMESTER

Course No.	Course Title	Credit	*Period per week*			*Marks*		
			L	T	P	Sessional	Final	Practical
EM 511	Environmental Chemistry & Microbiology	4	3	1	--	40	60	-
EM 512	Treatment Process I	4	3	1	--	40	60	-
EM 513	Environmental Lab	2	-	-	4	-	20	30
Total		**6**	**6**	**2**	**4**	**80**	**140**	**30**
Total credit = 6			**Total Periods Per week = 12**			**Total Marks = 250**		

SECOND SEMESTER

Course No.	Course Title	Credit	*Period per week*			*Marks*		
			L	T	P	Sessional	Theory	Practical
EM 521	Solid Waste Management	4	3	1	--	40	60	--
EM 522	Urban Environmental Utility Design	4	3	1	--	40	60	--
EM 523	Treatment Process II	4	3	1	--	40	60	--
Total		**12**	**9**	**3**	**0**	**120**	**180**	**0**
Total credit = 12			**Total Periods Per week = 24**			**Total Marks = 300**		

Sum credit First and Second semester (6 + 12) = 18

THIRD SEMESTER

Course No.	Course Title	Credit	*Period per week*			*Marks*		
			L	T	P	Sessional	Theory	Practical
EM 631	Ecosystem & Water Management	4	3	1	-	40	60	-
EM 632	Air Pollution	4	3	1	-	40	60	-
EM 633	Industrial Water Pollution Control	4	3	1	-	40	60	-
Total		**12**	**9**	**3**	**0**	**120**	**180**	**0**
Total credit = 12			**Total Periods Per week = 12**			**Total Marks = 300**		

FOURTH SEMESTER

Course No.	Course Title	Credit	*Period per week*			*Marks*		
			L	T	P	Sessional	Theory	Practical
EM641	Air and Noise Pollution Control Systems	4	3	1	-	40	60	-
EM642	Experimental Design & Data Analysis	4	3	1	-	40	60	-
EM643	Environmental Impact Assessment	4	3	1	-	40	60	-
Total		**12**	**9**	**3**	**0**	**120**	**180**	**0**
Total credit = 12			**Total Periods Per week = 12**			**Total Marks = 300**		

Sum credit Third & Fourth semester (12 + 12) = 24

FIFTH SEMESTER

Course No.	Course Title	Credit	*Period per week*			*Marks*		
			L	T	P	Sessional	Final	Practical
EM 751A	Project part I	6	3	1	-	90	60	-
EM 761	Educational Tour/ Seminar	2		1	-	30	20	-
	Elective	4	3	1	-	40	60	-
Total		**12**	**6**	**3**	**0**	**160**	**140**	**0**
Total credit = 12			**Total Periods Per week = 9**			**Total Marks = 300**		

SIXTH SEMESTER

Course No.	Course Title	Credit	*Period per week*			*Marks*		
			L	T	P	Sessional	Final	Practical
EM 751F	Project Part II	12	-	-	6	-	120	180
Total		**12**	**0**	**0**	**6**	**0**	**120**	**180**
Total credit = 12			**Total Periods Per week = 6**			**Total Marks = 300**		

Sum credit Fifth and Sixth semester (12 + 12) = 24

- ***Marks based on participation in the tour and submission of report**
- **#Marks based on final presentation (External Examiner)**

Project Part-I (Project) is meant for formulation of problem and literature survey

Project Part-II (Dissertation) is meant for experimental /field work, analysis of data and final presentation

List of Electives

Course No.	Course Title
EM-7EL1	Disaster Management
EM-7EL4	Remote Sensing & GIS in Environmental. System
EM-7EL2	Design of Water Retaining Structures
EM-7EL5	Ground Water Management
EM-7EL3	Optimization Techniques
EM-7EL6	Surface Water Hydrology

FIRST SEMESTER

ENVOIRMENTAL CHEMISTRY & MICROBIOLOGY

Paper Code	**EM - 511**	**(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 and chemical reactions in water and contaminants
- Application of chemical reactions in water and wastewater treatment processes
- Basic understanding of microbiology involved in the biological treatment of wastewater

Course Learning Outcome

- Students have sufficient knowledge in the application of chemical reactions in wastewater
- Expected to apply reaction/rate kinetics to water and wastewater treatment processes
- Expected to understand and apply microbiological reaction kinetics involved in wastewater treatment processes

Water Chemistry

Unit 1

Introduction - Role of chemistry in public health and in the control of pollution; Pollutants - types of water pollutants organic /inorganic; DO, BOD, COD and TOC relationships, summary of parameters of pollution control;

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, annamox, 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

TREATMENT PROCESS – I

Paper Code	**EM - 512**	**(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

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

ENVIRONMENTAL LABORATORY

Paper Code	**EM - 513**	**(Lectures –Tutorial - Practical)/Week**	**(0-0-4)**
Credits	**2**	**Course Marks (Mid-End-Total)**	**(30-20-50)**

Course Objectives

- To provide learning on basic experimental techniques to analyze different water and wastewater samples
- To inculcate basic concepts for environmental quality monitoring, assessment and evaluation

Course Learning Outcome

- To enable students to quantify and assess different water and wastewater quality parameters
- Expected to plan an approach for monitoring the industrial and municipal wastewater treatment facility and different field-testing

TITLE OF EXPERIMENTS

Water Quality Analysis

To carry out the experiments on determination of basic water quality parameters such as

(i) pH and Alkalinity

(ii) Turbidity and Optimum Coagulant Dose

(iii) Sulphate

(iv) Chloride

(v) Microbiological Water Quality Parameter – MPN Technique

Wastewater Characterization

To carry out the experiments on wastewater characterization for

(vi) TSS, TDS, Fixed and Volatile Solids

(vii) Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD)

(viii) Chemical Oxygen Demand (COD) of given samples of water

(ix) Phosphorous

(x) Kjeldhal Nitrogen and Ammonia

(xi) Determination of Coagulant Dose by Jar Test

Text Books

- Chemistry for Environmental Sciences and Engineering, Sawyer and McCarty, Tata McGraw Hill Pvt. Ltd. New Delhi India
- Wastewater Treatment, Treatment and Reuse, Metcalf and Eddy, Tata McGraw Hill Pvt. Ltd. New Delhi India
- Standard Methods for Examination of Water and Wastewater, AWWA, APHA, 21st edition, USA

Reference Books

- Process Chemistry for Water and Wastewater Treatment, L.D.Benefield, Prentice Hall Inc. New Jersey, USA

SEMESTER II

SOLID WASTE MANAGEMENT

Paper Code	**EM - 521**	**(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

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, 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

URBAN ENVIRONMENTAL UTILITY DESIGN

Paper Code	**EM - 522**	**(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 and sewerage system as well as rainwater harvesting.
- To inculcate the understanding on selection of location and engineering design of landfill sites for municipal solid is also taught.

Course Learning Outcome

- To obtain a trained and skilled environmental engineer having sufficient knowledge on design and application of sewerage system

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

- Wastewater Treatment, Treatment and Reuse, Metcalf and Eddy, Tata McGraw Hill Pvt. Ltd. New Delhi India
- Water Supply, Steel and McGhee, Tata Mc Graw Hill Series

Reference Books

- Process Chemistry for Water and Wastewater Treatment, L.D.Benefield, Prentice Hall Inc. New Jersey, USA

TREATMENT PROCESS – II

Paper Code	**EM - 523**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0)**
Credits	**4**	**Course Marks (Mid-End-Total)**	**(40-60-100)**

Course Objectives

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

Course Learning Outcome

- Expected to become a successful Environmental Engineers having capability to design independently 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.

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

SEMESTER III

ECOLOGY AND WATER MANAGEMENT

Paper Code	**EM - 631**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0)**
Credits	**4**	**Course Marks (Mid-End-Total)**	**(40-60-100)**

Course Objectives

- Provide basic knowledge of ecological principles and ecosystem
- Impart basic knowledge of ecological principles and ecosystem for sustainable environmental development
- Provide an understanding of principles and practices of water management approaches

Course Learning Outcome

- Environmental Engineers having knowledge of ecological principles and ecosystem for sustainable environmental development as well as fully aware of principles and practices of water management approaches

Unit 1

Ecology – meaning and scope, ecosystem and its attributes, elements of environment, man as a component of ecosystem, food chain, food web and tropic levels, tropic structure and ecological pyramids.

Unit 2

Terrestrial ecology – equatorial, hot deserts, taiga, tundra and mountains ecosystems, ecosystem development and ecological succession, disruption of ecological systems, impact of man on environment, global environmental challenges and ecological policies.

Unit 3

Introduction: area of the basin, stream order, drainage density, stream density, length of the basin, shape of the basin, relief of the basin, slope of the basin.

Unit 4

Watershed characteristics: Schumm's hypothesis of basin area, basin shape and their expected hydrographs, slope of the basin by grid method, estimation of basin length,

Hortons law of channel number and channel length, concept of channel slope based on Kennedy's theory, stream frequency.

Unit 5

Watershed classifications, based on the size and land use pattern, soil and water conservation, soil erosion, measures for erosion control, types of soil surveys

Text Books

- Environmental Engineering, Grady, Tata McGraw Hill Pvt. Ltd. New Delhi India
- Ecology and Environment, S.D. Sharma, Chand Publications, Meerut, India

Reference Books

- Environmental Studies, Eruch Barucha, University Press India

AIR POLLUTION

Paper Code	**EM - 632**	**(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

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, SO_x, NO_x, 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

INDUSTRIAL WATER POLLUTION CONTROL

Paper Code	**EM - 633**	**(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 wastewater generation units along with the wastewater characterization
- Application of fundamental principles (learned in treatment process I and II) for the treatment of industrial wastewaters

Course Learning Outcome

- Expected to become a successful Environmental Engineers having capability to design independently industrial wastewater treatment systems
- The student will become well acquainted with basic design and operation of treatment plants for industrial wastewater

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, 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 3

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 4

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

SEMESTER IV

AIR & NOISE POLLUTION CONTROL SYSTEMS

Paper Code	**EM - 641**	**(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

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, its kinetics, properties of sound waves. Measurements and characterization of noise, levels and decibel, Noise rating System. Effects of noise on hearing, working performance, Damage-risk -criteria, Annoyance, Speech Interface and its remedial measures.

Unit 4

Different types of noise sources, Transmission of sound outdoors, Traffic noise prediction, Introduction to noise control technique, Design of acoustic insulation and noise control system.

Text Books

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

Reference Books

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

Software or other Requirement

- Name of relevant software's

EXPERIMENTAL DESIGN AND DATA ANALYSIS

Paper Code	**EM - 642**	**(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.

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

Neural networks, basic concept of artificial neural network, recognition patterns, statistics used in performance evaluation; back propagation and cascade correlation etc., training and testing algorithms.

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

ENVIRONMENTAL IMPACT ASSESSMENT AND AUDITING

Paper Code	**EM - 643**	**(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 having ability to obtain environmental clearance from regulatory agencies

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

Reference Books

Environmental Impact Assessment: A Methodological Approach, Richard K. Morgan, Springer Science Publication

SEMESTER V

EDUCATIONAL TOURS/VISITS/SEMINARS

Paper Code	**EM - 761**	**(Lectures-Tutorial-Practical)/Week**	**(0-3-0)**
Credits	**2**	**Course Marks (Mid-End-Total)**	**(30-20-50)**

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

Visit to medium and large scale industry / environmentally significant structures/settings e.g. reservoir, lake, dam, coastal area, back-water, forest wetland etc.

Study of environmental policies issues and problem, presentation of environmental status report and recommendation for possible improvements.

Project Part I

Paper Code	**EM – 751A**	**(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

SEMESTER VI

Project Part II

Paper Code	**EM – 751F**	**(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

Disaster Mitigation for Sustainable Development

Paper Code	**EM7EL1**	**(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 mitigation and natural disasters
- To Familiarize the students about the causes and consequences of natural disasters

Course Learning Outcome

- Providing sufficient knowledge on the 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

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

DESIGN OF WATER RETAINING STRUCTURE

Paper Code	**7EL2**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0)**
Credits	**4**	**Course Marks (Mid-End-Total)**	**(40-60-100)**

Course Objectives

- Providing basic knowledge of and skill for different types of reinforced cement concrete structures commonly used in water supply and sewerage system.
- To disseminate knowledge to students for design of water retaining structures

Course Learning Outcome

- Providing sufficient knowledge on application of various fundamental principles to design the water retaining structures
- Environmental Engineers should be able to understand about basics of designing the structures involved in water and wastewater

Unit 1

Basic concepts of RCC design, durability requirement, provision of Indian standards and their applications;

Unit 2

Design of water retaining structures, IS 2911-1965,

Unit 3

Circular and rectangular tanks, overhead tanks,

Unit 4

Underground and on-ground, pipes and conduits, IS 1893-2002.

Text Books

- Design of Reinforced Concrete, A.K. Jain, Khanna Publishers, India
- Reinforced Concrete Construction for Water Retaining Structure, K.K. Meghashyam Jain Book Depot India

Reference Books

- Design of Water Retaining Structure, Batty, John Willey Publication

OPTIMISATION METHODS

Paper Code	**EM7EL3**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0)**
Credits	**4**	**Course Marks (Mid-End-Total)**	**(40-60-100)**

Course Objectives

- Providing basic knowledge of optimization as a powerful tool to engineers with a systematic method for obtaining efficient and cost-effective solutions to a wide variety of engineering problems.
- Proving an increased computational capability, ease-of-use and industry wide recognition of the financial and competitive impact of optimization tools has made it indispensable for engineers.

Course Learning Outcome

- Providing sufficient knowledge on application of various application-oriented presentation 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.

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

- Optimization Techniques, Peter P. Rogers, Tata McGraw Hill
- Numerical Optimization, Andrew E. Collins, Tata McGraw Hill

Reference Books

- Numerical Optimization Techniques for Engineers Design, A.L. Caressi, Routledge, taylor and Francis Publication

REMOTE SENSING AND GIS

Paper Code	**EM7EL4**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0)**
Credits	**4**	**Course Marks (Mid-End-Total)**	**(40-60-100)**

Course Objectives

- Providing basic knowledge of on applications of remote sensing & GIS in the management of environment.
- This course will enable the student to learn about different remote sensing platforms, data generated there from & interpretation of the data. Study of various features of GIS & its tools shall also be undertaken in this course.

Course Learning Outcome

- Providing sufficient knowledge on application of GIS and remote sensing in environmental management
- Environmental Engineers should be able to apply the GIS tools independently on environmental problems.

Unit 1

Basics of remote sensing, various platforms for remote sensing and their altitude, viz. aircraft, satellite, skylab, ground sensors, sensors under water, sensing devices; return beam,

Unit 2

vidicon, multi-spectral scanners, radar sensing, sonar beams and X-ray, Sensing, sensing by visible spectrum, introduction to data processing and analysis, application to the fields of environmental management.

Unit 3

Basic of geographical information systems (GIS), databases and database management systems; spatial databases, coordinate systems and geo-referencing, interpolation methods;

Unit 4

deterministic and statistical method, digital elevation models and their applications. Strategies for development, implementation and management of GIS, Case Studies on use of GIS. in the field of environmental engg.

Text Books

- Principles of GIS, O.Huismann, Prentice Hall Inc.
- Application of GIS, B.M. Alam, InTech Publication

Reference Books

- Essentials of GIS, J.Campbell, Amazon Publications

GROUND WATER MANAGEMENT

Paper Code	**EM7EL5**	**(Lectures-Tutorial-Practical)/Week**	**(3-1-0)**
Credits	**4**	**Course Marks (Mid-End-Total)**	**(40-60-100)**

Course Objectives

- Providing basic knowledge on Ground Water Resources and its role in sustainable development.
- Impart to students basic concepts of ground water investigator and long term yield assessment and design of ground water exploration.

Course Learning Outcome

- Providing sufficient knowledge on application of concept of pollutant movement in saturated media and its remediation

Unit 1

The concept of hydrologic cycle, ground water condition and behavior, basic parameters for groundwater characterization with time and space.

Unit 2

Groundwater investigation, groundwater investigation using indirect methods, numerical problems with field application.

Unit 3

Groundwater balance study, Scenario at a glance, universal budgeting of groundwater, analysis of ground balance study using water level fluctuation and specific field method, numerical problems. Concept of basin management, groundwater development case studies

Unit 4

Pollutant movement in ground water, dispersion, diffusion, remediation and natural attenuation

Text Books

- Groundwater Management Practices, CRC Press
- Groundwater Resources, www.google.books.com

Reference Books

- Urban Groundwater Management, Springer Publications

SURFACE WATER HYDROLOGY

Paper Code	**EM – 7EL6**	**(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

Unit 1

Precipitation: Hydrologic cycle, Forms and types of precipitation, Rain gauge network, generation of data, depth- area duration analysis. Loses of precipitation; evaporation process, reservoir evaporation and methods for its reduction, evapotranspiration and its measurement, infiltration process and infiltration indices, runoff; yield and its estimation, flow duration curve and runoff correlation, rating curves.

Unit 2

Steam flow measurement; measurement of stage and velocity, direct and indirect measurement of discharge, hydrograph; component parts of a hydrograph, base flow separation, unit hydrograph, unit hydrographs for different durations, unit hydrograph for complex storms.

Unit 3

Flood frequency studies, Gumbel's method, log Pearson type III distribution, limitation of frequency studies, flood routing; basic equations, hydrologic channel routing, hydraulic storage routing.

Unit 4

Reservoir sedimentation, reduction in reservoir capacity, sedimentation control, advanced topics; linear regression and correlation analysis, probability and stochastic methods of flood estimation, some mathematical models in hydrology.

Text Books

- Ground and Surface Water Hydrology, L.W.Mays, Willey and Sons.
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Reference Books

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