SYLLABUS

Master of Technology

Environmental Sciences & Engineering

M.Tech

Department of Civil Engineering

Faculty of Engineering & Technology

Jamia Millia Islamia

New Delhi - 110025 (INDIA)

www.jmi.ac.in

SYLLABUS

Master of Technology (M.Tech)

(Environmental Science & Engineering)

Department of Civil Engineering

Faculty of Engineering & Technology

Jamia Millia Islamia

New Delhi – 110025 (India)

http://www.jmi.ac.in/

January 2013

Preface

The revision and modification of the syllabus is a continuous process. The department was established in 1985 and a workshop of prominent engineers and educational list was held to develop the curriculum for the B-Tech in Civil engineering. The syllabus was later modified and published in the printed form in 1993. Since then a number of revisions have taken place both in the course structure and course content keeping in view the current trends in civil engineering education and demands of the industry.

The latest version of the syllabus is the outcome of a thorough revision of course structure and course content with inputs from subject experts and professionals. The syllabus has been designed to provide a solid foundation in the core areas of Civil engineering namely; structural engineering, geo-technical engineering, environmental engineering, water resources engineering, civil engineering materials, transportation engineering, surveying and GIS and construction management keeping in view the latest developments in these subject areas.

I wish to acknowledge the hard work put in by the faculty members in the updating and revision of syllabus. I also wish to convey my sincere thanks to the subject experts who gave their valuable inputs in finalizing this syllabus.

Professor Mohammad Shakeel

Head

About the University

Jamia Millia Islamia, an institution originally established at Aligarh in United Provinces, India in 1920 became a Central University by an act of the Indian Parliament in 1988. In Urdu language, Jamia means 'University', and Millia means 'National'.

The story of its growth from a small institution in the pre-independence India to a central university located in New Delhi—offering integrated education from nursery to research in specialized areas—is a saga of dedication, conviction and vision of a people who worked against all odds and saw it growing step by step. They "built up the Jamia Millia stone by stone and sacrifice by sacrifice," said Sarojini Naidu, the nightingale of India.

Under the colonial British rule, two dominant trends joined hands and contributed towards in the birth of Jamia. One was the anti-colonial Islamic activism and the other was the pro-independence aspiration of the politically radical section of western educated Indian Muslim intelligentsia. In the political climate of 1920, the two trends gravitated together with Mahatma Gandhi as a catalyst. The anti-colonial activism signified by the Khilafat and the pro-independence aspirations symbolised by the non-cooperation movement of the Indian National Congress helped to harness creative energies and the subsequent making of Jamia Millia Islamia. Rabindranath Tagore called it "one of the most progressive educational institutions of India".

Responding to Gandhiji's call to boycott all educational institutions supported or run by the colonial regime, a group of nationalist teachers and students quit Aligarh Muslim University, protesting against its pro-British inclinations. The prominent members of this movement were MaulanaMehmud Hasan, Maulana Mohamed Ali, Hakim Ajmal Khan, Dr. Mukhtar Ahmad Ansari, and Abdul Majid Khwaja. Hakim Ajmal Khan, Dr. Mukhtar Ahmed Ansari and Abdul MajeedKhwaja supported by Gandhiji shifted Jamia from Aligarh to Karol Bagh, in New Delhi in 1925. In 1925, after long deliberation, a group of three friends studying in Germany—Dr. Zakir Husain, Dr. Abid Husain and Dr. Mohammad Mujeeb—decided to serve Jamia.

One of the first steps they took was the introduction of the hugely popular evening classes for adult education. This movement was later to become, in October 1938, an institution called Idara-i-Taleem-o-Taraqqi.

In 1928 Hakim Ajmal Khan passed away. That was the beginning of the second financial crisis, as it was Hakim Sahib himself who had been meeting most of Jamia's financial needs. The leadership of Jamia then moved into the hands of Dr. Zakir Husain, who became its Vice Chancellor in 1928. To resolve Jamia of these frequent crises, a group of young Jamia teachers, led by Dr. Zakir Husain, took a pledge to serve Jamia for the next twenty years on a salary not more than Rs. 150. This group was called the Life Members of Jamia. (History repeated in 1942 when a second group of Jamia teachers took a similar pledge).

Jamia's department of Printing and Publications was trifurcated in 1928 with the newly established Jamia Press at Darya Ganj, Urdu Academy, and Maktaba Jamia under the charge of Prof. Mohammad Mujeeb, Dr. Abid Husain and Mr. Hamid Ali respectively.

On 1 March 1935, the foundation stone for a school building was laid at Okhla, then a non-descript village in the southern outskirts of Delhi. In 1936, all institutions of Jamia, except Jamia Press, the Maktaba and the library, were shifted to the new campus. The basic emphasis of Jamia was on evolving innovative education methods. This led to the establishment of a teacher's college (Ustadonka Madrasa) in 1938.

The fame of Jamia as an innovative education movement spread and dignitaries from foreign countries began visiting Jamia. Husein Raouf Bey (1933), Dr. Behadjet Wahbi of Cairo (1934), Ms. Halide Edib of Turkey (1936) were some of them. Foreigners, impressed by Jamia, began working in Jamia. The German lady Ms. Gerda Philips born (popularly known as AapaJaan) served Jamia for many years is buried in Jamia.

In 1939, Maulana Ubaidullah Sindhi (1872-1944), a theologian and freedom fighter, came to stay in Jamia on the invitation of Dr. Zakir Husain. He started a school of Islamic Studies in Jamia, called BaitulHikmal, propagating the ideology of Shah Waliullah. Zakir Husain, later the President of India, recalled those days of indestructible optimism in the face of depravity 'when they had a longing to build and nothing to build with, as "days of joy".

After the attainment of Independence, Jamia continued to grow as an academic institution with a difference. Many foreign dignitaries made it a point to visit Jamia Millia Islamia during their visits to New Delhi. Among those who visited Jamia include Marshal Tito (1954), king Zahir Shah of Afghanistan (1955), crown prince

Faisal of Saudi Arabia, king Reza Shah Pehlavi of Iran (1956) and prince MukarramJah (1960).

In 1962, the University Grants Commission declared the Jamia a 'deemed to be University'. Soon thereafter, the School of Social Work was established in 1967. In 1971, Jamia started the Zakir Husain Institute of Islamic Studies, to honour Dr. ZakirHusain, who had passed away in 1969. BE course in Civil Engineering commenced in 1978; in 1981, the faculties of Humanities and Languages, Natural Sciences, Social Science, and the State Resource Centre were founded. In 1983, it started the Mass Communication Research Centre and the Centre for Coaching and Career Planning. In 1985, it established the Faculty of Engineering & Technology and the University Computer Centre. Academic Staff College and the Academy of Third World Studies followed in 1987 and 1988.

By a Special Act of the Parliament, Jamia Millia Islamia was made a central university of India in December 1988.

At present Jamia has Nine faculties and a number of centres of learning and research, like AJK-Mass Communication Research Centre (MCRC), Academy of International Studies etc. The Jamia is also marching ahead in the field of Information Technology (IT). It offers various undergraduate and postgraduate IT courses. Apart from this, the Jamia has a campus wide network which connects a large number of its departments and offices.

About the Department

The Department of Civil Engineering is one of the oldest and the largest department in the Faculty of Engineering & Technology. The department has produced several eminent engineers who have made important contributions in the planning and execution of many important Civil Engineering projects in India as well as abroad.

The Department offers two undergraduate courses in Civil Engineering. The Department also offers Master's programme with specializations in Environmental Engineering and Earthquake Engineering .In all, there are around 560 students in undergraduate programme and 75 students pursuing their Masters degree. These courses are supported with strong doctoral programmes in all the major specializations of Civil Engineering. More than 45 Ph. D. research scholars including many from foreign countries are currently working in the department on emerging research areas.

The Department is known for its reputed faculty with expertise in diverse fields. Presently, the department has 23 highly qualified, experienced, sincere and dedicated teaching faculty members, actively participating in research and consultancy work. During last 5 years, faculty members have published more than 280 papers in reputed refereed International Journals.

Over a period of time, the Department has built up a wide research potential. The research programmes of the department are funded by various agencies such as Ministry of Human Resource Development (MHRD), Department of Science & Technology (DST), Ministry of Environment & Forests (MoEF), Central Pollution Control Board (CPCB), All India Council of Technical Education (AICTE), University Grants Commission (UGC), Ministry of Steel and Ministry of Urban Development. Major area of research in the Department include; Sustainable Development, low cost sanitation, water treatment, air, noise and water quality modelling, Reuse of concrete, application of GIS and remote sensing in water resources and environment, Vulnerability assessment, Seismic analysis of structures, retrofitting, Soil structure interaction, Hydro-climatology, Water resource assessment and management.

The Department has established a state of the art experimental facilities and laboratories in different fields of Civil Engineering. It has received the prestigious funding under FIST from DST and SAP from UGC. The Department has mobilized

more than Rs 250 millions from various external agencies to carry out research in cutting edge technologies in different fields of Civil Engineering.

The faculty also renders technical advice on live engineering problems to various Government and Private Sector companies throughout the country. These live projects are effectively used as training desk for our students at undergraduate and postgraduate levels. RITES, Military Engineering Services, Municipal Corporations of Delhi, Faridabad, Gurgaon, Gaziabad, NOIDA, PWD, CPWD, DDA, HUDA, Jal Nigam etc. regularly hire services for technical advice and vetting of designs of infrastructure projects. The Department has generated around Rs 800 million through consultancies during the last five years.

International and national conferences, seminars and special lectures are a regular feature of the Department to impart education and training. The Department has active collaboration with academics and industry such as University of Applied Sciences Erfurt (Germany), Wessex Institute (UK), University of Waterloo (Canada), Asian Institute of Technology (Bangkok) and Steel Authority of India (INDIA).

Leading MNCs and public sectors are regular recruiter of our students and many students have been selected in Engineering Services. Several of our alumni pursued higher education in USA, UK, Germany, Canada, Australia and France and have been appointed as faculty members and consultants abroad.

The Department strongly believes in continuous efforts to strive for excellence by exploring new frontiers of knowledge, imparting the latest technical knowledge to the students and conducting high quality research.

About the Program

The department of civil engineering is one of the oldest and the largest department in the faculty of engineering &technology. Currently the department is offering a master degree program in environmental sciences and engineering (part time course) among other three master programs. The department of civil engineering has five specialized faculty in environmental engineering discipline.

The faculty of environmental engineering group involves in the academic, research, planning, analysis and consultancy for designing of various municipal and industrial wastewater treatment facilities. The primary focus of the faculty of environmental engineering group is mainly on extending the knowledge to students on basic concepts and principles of environmental science and applied to solve major environmental issues related to pollution control. The program provides excellent technical knowledge in the area of environmental engineering that deals with the design of municipal/industrial wastewater treatment facilities as well as air and noise pollution control systems.

The ultimate goal of the master's program is to provide advance learning with enhanced analytical ability to solve problems that are interdisciplinary in nature and help in protecting the environment. Graduates of environmental engineering would have a wide variety of employment opportunities in both the private and public sectors.

The curriculum was updated regularly from time to time as per the recommendations of the board of studies in order to keep pace with the latest developments in related area.

The department has been planning to modernize with state of art facilities to be utilized for research and consultancy in addition to training the students.

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 M.Tech (Environmental Sciences and Engineering) includes:

1. To train and equip graduates with professional skills for successful careers dealing with analysis, design and management of projects related to water sector, air/ climate and global issues at national and international level.
2. To develop the competency in the area of environmental engineering so as to formulate, analyze and solve problems using the principles of science and engineering in related field.
3. To provide the students with a comprehensive and balanced understanding of the basics of science and environmental engineering.
4. To inculcate students maintaining high ethical standards, effective oral & written communication skills, work as part of team on multidisciplinary projects in diverse professional environment.
5. To provide student with an academic excellence, leadership as well as team work management skills and the life-long learning required for a successful professional career.

Program Outcomes

The curriculum and syllabus for M.Tech (Environmental Sciences and Engineering) program conform to result oriented teaching learning process. The curriculum and syllabus have been structured to meet one or more problem outcomes (POs).

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 environmental engineering program will be able to:

1. Apply the knowledge of science and engineering and fundamental principles of basic biology to solve various problems related to environmental engineering discipline.
2. Conduct experimental research, analyze the data and interpret the results in the form of conceptual report and format it into a document in the form of thesis, professional report.
3. Follows the standard codes, specifications and IS codes to arrive on some consensus 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. Use current techniques, skills, and modern engineering tools/ software etc. necessary for computing and engineering practice.
6. Develop appropriate skills of written, oral and visual communications and make effective documentations and presentations.
7. Recognise and develop confidence for self education and ability to engage in continuing professional development.
8. Analyze the local and global impact of contemporary engineering issues on individuals, organizations and society.
9. Demonstrate their role as managers or entrepreneurs and contribute their skills to the society.
10. Recognize the importance of environmental engineering professional development by pursuing higher studies and research or face competitive examinations that offer challenging and rewarding careers.

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		**10**	**6**	**2**	**4**	**80**	**140**	**30**
Total credit = 10			**Total Periods Per week = 12**			**Total Marks=250**		

SECOND SEMESTER

Course No.	Course Title	Credit	Period per week			Marks		
			L	T	P	Sessional	Final	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 = 12**			**Total Marks= 300**		

Sum credit First and Second semester (10 + 12) = 22

THIRD SEMESTER

Course No.	Course Title	Credit	Period per week			Marks		
			L	T	P	Sessional	Final	Practical
EM 631	Ecosystem & Watershed	4	3	1	-	40	60	-
EM 632	Air Pollution	4	3	1	-	40	60	-
EM 633	Industrial Effluent Treatment & 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	Final	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
	Elective I	4	3	1	-	40	60	-
	Elective II	4	3	1	-	40	60	-
EM 761	*Educational Tour/ Seminar	2	-	-	-	30	20	-
EM 751A	Project part I	6	3	1	-	90	60	-
Total		**16**	**9**	**3**	**0**	**200**	**200**	**0**
Total credit = 16			**Total Periods Per week = 12**			**Total Marks= 400**		

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 (16 + 12) = 28

- ***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

Total Credit = 22+24+28 = 74

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

ENVIRONMENTAL 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, 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 Learning Outcome

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

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

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

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

Course Description

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

SECOND SEMESTER

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

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

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, 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

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

- 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

THIRD SEMESTER

ECOLOGY AND WATERSHED 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
- To introduce students with the concept of a watershed and its quantitative characteristics.
- To discuss various aspects of watershed development and management – in terms of technological, social. Ecological and environmental issues.

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
- Upon successful completion of this course, student will be able to understand the basic concept of watershed development in context to its morphometric characteristics

Course Description

Ecology (EM631A)

Unit 1

Ecology – meaning and scope, ecosystem and its attributes, concepts of ecosystem, structure and function of ecosystem; Energy flow in ecosystem, Ecological succession

Unit 2
Ecological systems – Freshwater environment, marine system, terrestrial ecosystems; Equatorial, hot deserts, taiga, tundra and mountains ecosystems; Disruption of ecological systems, impact of man on environment, global environmental challenges and ecological policies

Watershed Management (EM631B)
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
- Watershed Management by Murthy J. V. S., New Age International, New Delhi – 1998
- Watershed Hydrology, by Black Peter E., Prentice Hall, London - 1991

Reference Books

- Environmental Studies, EruchBarucha, University Press India
- Watershed Management and Sustainable Management by Gopal Iyer K. and Roy U. N., Kanishka Publishers, New Delhi 2005
- Integrated Watershed Management by Rajesh Rajora, Rawat Publication, New Delhi – 1998

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

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

INDUSTRIAL EFFLUENT TREATMENT & 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 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

FOURTH SEMESTER

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

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

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.

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

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 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

FIFTH SEMESTER

(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 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

DESIGN OF WATER RETAINING STRUCTURE

Paper Code	**EM7EL2**	**(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

Course Description

Unit 1

Design and constructional aspects, durability requirement, provision of Indian standards and their applications;

Unit 2

Design of different water retaining structures, design of cantilever walls to retain liquids, IS 2911-1965,

Unit 3

Design of flat slab, roofs and columns for reservoirs, 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

- 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

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

- 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

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 to students on groundwater resources and its role in sustainable development.
- Impart to students the basic concepts of ground water investigation, long term yield assessment and design of groundwater exploration.

Course Learning Outcome

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

Course Description

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 Hydrology, D.K. Todd
- Hydrogeology, K.R.Karanth
- Groundwater Management Practices, CRC Press
- Groundwater Resources, www.google.books.com

Reference Books

- Urban Groundwater Management, Springer Publications

SURFACE WATER HYDROLOGY

Paper Code	**EM7EL6**	**(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

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.

Course Description

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

SIXTH SEMESTER

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

IMPORTANT CONTACT NUMBERS

Dean, Student's Welfare (DSW)	011-26980164
Proctor	0-9810439970
Dean, Faculty of Engg. & Tech.	011-26985831
Head, Deptt. of Civil Engineering	011-26985227
Training & Placement Officer	011-26989106
Professor Incharge Examination	011-26984127
Faculty of Engineering Library	011-26981717-2207

Department of Civil Engineering

Faculty of Engineering & Technology

Jamia Millia Islamia

New Delhi - 110025 (INDIA)

www.jmi.ac.in