Semester-I

1. Name of the Department: Civil Engineering						
2. Course Name	Quantitative Analysis in Energy and Environment	**L**	**T**		**P**	
3. Course Code	13160119	0	0		2	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem (✔)	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures =		**Tutorials =**	**Practical =**			

8. Brief Syllabus

A review of probability concepts, Forecasting and decision making in view of multivariant techniques, Linear programming, Graphical solution, Simplex method, Duality and post-optimality analysis, Integer programming, Optimal technology mix in micro and macro level energy planning exercises, Sequencing, Queuing theory, Networks, PERT and CPM, Decision theory, Markov analysis, Nonlinear programming, Decision making with uncertainty decision making with multiple objectives, Deterministic and probabilistic dynamic programming, Regression analysis.

9. Learning objectives:

1. To develop the professional and communication skills of learners in a technical environment.
2. To enable the students to acquire functional and technical writing skills.
3. To acquire state-of-the-art presentation skills in order to present technical topics to both technical and non-technical audience.

10. Course Outcomes (COs):

i)	Having an ability to apply mathematics and science in engineering applications
ii)	Having a clear understanding of the subject related concepts and of contemporary issues
iii)	Having an ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient
iv)	Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Introduction**

Functional Language

Basic structures- Tense agreement, Prepositional phrases, Techno-words : Basic Concepts 62, 63
Pronunciation: sounds of syllables: Past tense & plural endings

Technical Expression

Organisational techniques in technical writing , Guided writing: Paragraph Writing, Note Making

Presentation Skills

Techniques of presentation (general topics : speech without visual aids) , Listening to speeches and comprehending

Graphical Skills
Flow chart : Process and Functional description

Unit - 2	**Number of lectures**	**Title of the unit: Technical Skills**

Functional Language
Basic structures- Voice, Conditionals , Techno-words : Basic Concepts 64,65,67, Pronunciation : Word Stress: two syllable words

Technical Expression
Mechanics of Technical Writing and Syntax , Guided writing: Letter and email

Presentation Skills
Interpersonal Communication Skills , Writing techniques for Power point presentation, Group Discussion

Graphical Skills
Technical Illustrations and Instruction

Unit - 3	**Number of lectures**	**Title of the unit: Basic statistical tool for analysis**

Functional Language
Basic structures- Modal Verbs and Phrasal verbs , Techno-words : Basic Concepts 68,69,70,71 , Pronunciation : Word Stress: compound words

Technical Expression
Mechanics of Technical Writing and Syntax , Guided writing: Technical Description

Presentation Skills
Career advancement: Technical Resume and Company Profile Presentation and Group Discussion

Graphical Skills
Pie chart, Bar chart, Line graphs: analysis and interpretation

Unit - 4	**Number of lectures**	**Title of the unit: Statistical inference**

Functional Language
Basic structures- Modal Verbs and Phrasal verbs , Techno-words : Basic Concepts 72,73,74, Functional vocabulary 87 , Pronunciation : Sentence Stress

Technical Expression
Guided and Free writing: Abstract and Technical articles

Presentation Skills
Nuances of Presentation to a Technical audience

Graphical Skills
Oral Presentation of graphical representation

12. Books Recommended (3 Text Books + 2-3 Reference Books)

i) English Vocabulary in Use Advanced, McCarthy & Felicity, CUP, 2003

ii) Sky Pronunciation CD-ROM

iii) Cambridge Advanced Learner's Dictionary CD-ROM, 4. English Master : Grammar

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	**Introduction**	**1,2**
2	**Technical Skills**	**2**
3	**Basic statistical tool for analysis**	**4**
4	**Statistical inference**	**3**

1. Name of the Department: Civil Engineering Department						
2. Course Name	Renewable Energy Technology	**L**	**T**		**P**	
3. Course Code	13160120	3	0		0	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem (✔)	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

Renewable Energy uses energy resources and technologies that are "clean" or "green" because they produce few if any pollutants. Many people use the terms "Alternative Energy", "Renewable Energy" and even "Green Energy" together in the same sentence when taking about energy sources as though they all mean the same thing, but they are not the same. Each term means something different when talking about energy systems. So what does renewable energy mean.

9. Learning objectives:

To expose the student to solar thermal, solar photovoltaic, biomass, wind, small hydro and other renewable energy resources, conversion technologies, processes, systems and devices, and equip the student to take up projects in those areas.

10. Course Outcomes (COs):

At the end of the course, the student will be able to

i) Explain the basic principles of various renewable energy conversion processes and devices used therein.

ii) Identify various parameters that influence the performance of devices/processes.

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Introduction to energy and resources**

Introduction to energy and resources – Renewable energy sources - Avialabiality of solar energy – Sun-earth relationships - Estimation of solar radiation using Page-Angstrom method - Solar radiation measurement – Flat plate collectors – Solar water heating systems – Evacuvated Tubular Concentrators - Solar air heating systems and applications – Concepts on solar drying, cooking, desalination, solar ponds and solar cooling - Passive heating and cooling of buildings – Basics of solar concentrators and types - Solar thermal power generation.

Unit - 2	**Number of lectures**	**Title of the unit: Solar Cells**

Physics of solar cells – Cell types and manufacture – PV applications - Characteristics of cells and module – Performance parameters - Estimation of module power output – PV system configurations – System components: Battery, charge controller and inverter		
Unit - 3	**Number of lectures**	**Title of the unit: Biomass**
Biomass to energy conversion processes – Anaerobic digestion, process parameters, biogas composition, digester types, high rate anaerobic conversion systems – Alcohol from biomass – Biodiesel: preparation, characteristics and application - Biomass combustion and power generation – Briquetting – Gasification: Process, types of gasifiers, applications – Waste to energy technologies.		
Unit - 4	**Number of lectures**	**Title of the unit: Wind Power**
Power in the wind - Types of wind mills – WEG components - Airfoils: lift and drag – Power curves and energy estimation - Micro siting – Indian wind potential. Small Hydro Power: Types, site identification, head and flow measurement, discharge curve, estimation of power potential and system components.		
Unit - 5	**Number of lectures**	**Title of the unit: Renewable Energy Technologies**
Technologies for harnessing other renewable energy sources like geothermal, wave, tidal and ocean thermal energy.		
1. Brief Description of self learning / E-learning component		
2. Books Recommended (3 Text Books + 2-3 Reference Books)		
i) John Twidell and Tony Weir (2006), Renewable Energy Resources, 2nd Edition, Taylor & Francis, USA		
ii) Frank Kreith and D.Yogi Goswami (2007), Handbook of Energy Efficiency and Renewable Energy, CRC Press		

3. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	**Introduction to energy and resources**	**1**
2	**Solar Cells**	**1**
3	**Biomass**	**2**
4	**Wind Power**	**2**
5	**Renewable Energy Technologies**	**2**

1. Name of the Department: Civil Engineering Department						
2. Course Name	Physico-chemical, Biological Principles and Processes	**L**	**T**		**P**	
3. Course Code	13160121	4	0		0	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)	Basic physics, chemistry and mathematics	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem (✔)	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

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

9. Learning objectives:

1. To study about the solid- liquid- gas interactions
2. To understand about process kinetics
3. To deal with the microbial applications in environmental engineering

10. Course Outcomes (COs):

At the end of the course, the student will be able to

1. understand the mass transfer and transport of impurities in system
2. apply the concepts of oxidation- reduction equillibria
3. study and applying practically about microbial kinetics

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Structure and Properties of Water**

Structure and Properties of Water- their significance in environmental engineering, Sources of Water impurities, Abiotic reactions, Biological metabolism. Solid-Liquid-Gas interactions, Mass transfer and transport of impurities in water, diffusion, dispersion. Physical and Chemical interactions due to various forces, suspensions and dispersions.

Unit - 2	**Number of lectures**	**Title of the unit: Chemical reactions**

Chemical reactions, Chemical equilibrium and thermodynamics, Acid-baseequilibria, solubility equilibria, oxidation-reduction equilibria. Process kinetics, reaction rates and catalysis, surface and colloidal chemistry, Adsorption. Settling of particles in water stabilization.

Unit - 3	Number of lectures	Title of the unit: Ecosystems
Ecosystems; biotic and abiotic components, biogeochemical cycles, ecology of population; Ecological niche, Mortality and survivorship, CommModuley Interactions. typical natural and artificial ecosystems.		
Unit - 4	**Number of lectures**	**Title of the unit: Biochemistry**
Biochemistry; Biological compounds– enzymes, coenzymes and amino acids, Microbiological concepts; Cells, classification and characteristics of living organisms, Characterization techniques, Reproduction, Metabolism, Microbial growth kinetics.		
Unit - 5	**Number of lectures**	**Title of the unit: Applications of Microbiological principles to environmental engineering**
Applications of Microbiological principles to environmental engineering; assimilation of wastes, engineered systems, Concepts and Principles of carbon oxidation, Nitrification, Denitrification, Methanogenasis, etc., Concepts of quantization of degradable pollutants.		
12. Books Recommended (3 Text Books + 2-3 Reference Books)		
i) Benefield, L.D. Judkins J.F. and Weand B.L. (1982). Process Chemistry for Water and Wastewater Treatment, End ed., Prentice-Hall, Inc, New Jersey, USA		
ii) Metcalf and Eddy, M.C., "Wastewater Engineering: Treatment, Disposal and Reuse", Tata McGraw-Hill Publications, New Delhi, 2003		
iii) Pelczar, M.J., Chan ECS and Krieg NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India		
iv) Talaro K., Talaro A CassidaPelzar and Reid, (1993) Foundations in Microbiology, W.C. Brown Publishers		
v) Sawyer, McCarty, and Parkin, 2003.Chemistry for Environmental Engineers, 5th" McGraw Hill		

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	**Structure and Properties of Water**	**1**
2	**Chemical reactions**	**3**
3	**Ecosystems**	**2**
4	**Biochemistry**	**1**
5	**Applications of Microbiological principles to environmental engineering**	**3**

1. Name of the Department: Civil Engineering Department						
2. Course Name	Environmental Quality Monitoring	**L**	**T**		**P**	
3. Course Code	13160122	2	0		0	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem (✔)	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)		
Lectures	**Tutorials**	**Practical**

8. Brief Syllabus

Students learn procedures to establish environmental monitoring. They are able to choose the appropriate type of environmental monitoring, both in terms of choice of sampling locations and measured parameters, as well as in terms of choice of medium. Based on practical examples, they realize the importance of proper sampling, data quality assurance and learn about the basic equipment for monitoring. Also, students are able to explain differences in the planning and implementation of environmental monitoring at local, national and international level.

9. Learning objectives:

1. To teach students the general procedure for collection and preservation of samples of water and wastewater
2. To provide standard methodologies for sampling and analysis of environment at whole and its constituents like water, wastewater, air and soil.
3. To teach advance analytical methods for environmental quality monitoring

10. Course Outcomes (COs):

At the end of the course, the student will be able to

- Schedule field studies and other data acquisition activities to be considered for compliance
- Use a tiered monitoring approach consisting of rapid assessment or screening studies at site
- Supervise monitoring techniques of various environmental parameters
- Generate monitoring data relevant to decision making process
- Manage and report environmental quality data in a way that is meaningful and understandable to intended audience

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: General Sampling and Analytical Techniques**

General principles for collection of representative sample, frequency of sampling, validation, interpretation and analysis of data, various statistical techniques, quality control, assessment and management.

Unit - 2	**Number of lectures**	**Title of the unit: Methods for Physicochemical Analysis of Water/ Wastewater**

Gravimetric methods for solids analysis in water and wastewater, determination of acidity, alkalinity and turbidity, analysis of common cations and anions in water/wastewater through various chemical techniques, determination of nitrogen, phosphorus and chemical oxygen demand (COD), acid-base titrations, precipitation titrations, complexometric titrations, oxidation-reduction titrations, working principles of electrodes, different types of electrodes.		
Unit - 3	**Number of lectures**	**Title of the unit: Biological Methods and Microbiology**
Biochemical oxygen demand (BOD), MPN test for microbial pollution, plate counts; confirmatory tests for various microbiological agents		
Unit - 4	**Number of lectures**	**Title of the unit: Air Pollution Measurements**
Sampling techniques for air pollution measurements; analysis of particulates and common chemical air pollutants, analysis of oxides of nitrogen, oxides of sulphur, carbon monoxide, hydrocarbon and poly aromatic hydro carbons.		
Unit - 5	**Number of lectures**	**Title of the unit: Advanced Analytical Methods**
Working principles of Spectrophotometric methods; Nephelometric methods; Atomic absorption spectroscopy and its various analytical versions; Ion chromatography, High performance liquid chromatography, CHNO/S Analyzer, TOC analyzer and other advanced analytical instruments.		
12. Books Recommended (3 Text Books + 2-3 Reference Books)		
i) Metcalf and Eddy, (2003), Wastewater Engineering Treatment and Reuse, 4th edition, Tata McGraw Hill Education Private Limited, ISBN:978		
ii) S.K.Garg (2010), Sewage Disposal and Air Pollution Engineering, Khanna Publishers, ISBN:978		
iii) MN.Rao, H.V.N.Rao, (2007), Air Pollution, Tata McGraw Hill Publishing Company Limited, ISBN:978		
iv) Stanley E. Manahan (2005), Environmental Chemistry, 8th Edition, CRC Press, ISBN: 978		
v) Clair N Sawyer, Perry L. McCarty and Gene F. Parkin (2002), Chemistry for Environmental Engineering and Science, McGraw		

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	**General Sampling and Analytical Techniques**	**1**
2	**Methods for Physicochemical Analysis of Water/ Wastewater**	**1,2**
3	**Biological Methods and Microbiology**	**3,4**
4	**Air Pollution Measurements**	**5**
5	**Advanced Analytical Methods**	**5**

1. Name of the Department: Civil Engineering Department						
2. Course Name	Energy Auditing Conservation and Management	**L**	**T**		**P**	
3. Course Code	13160123	3	0		0	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem (✔)	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

To institute the correct energy efficiency programs, we have to know first which areas in our installation unnecessarily consume too much energy, which is the most cost-effective load. An energy audit to recognize where energy is being consumed and assesses energy saving opportunities so you get to save money where it counts the most.

9. Learning objectives:

14. To teach the basic concepts of energy audit and management.
15. The energy auditing procedures, techniques, policy planning, implementation and energy audit instrument

10. Course Outcomes (COs):

At the end of the course, the student will be able to

23.Understand the general aspect of energy auditing and management

24.Understand the energy auditing procedures, techniques, policy planning and implementation.

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: General Aspects**

General Philosophy and need of Energy Audit and Management. Definition and Objective of Energy Management, General Principles of Energy Management, Energy Management Skills, Energy Management Strategy. Energy Audit: Need, Types, Methodology and Approach. Energy Management Approach, Understanding Energy Costs, Bench marking, Energy performance, Matching energy usage to requirements, Maximizing system efficiency, Optimizing the input energy requirements, Fuel and Energy substitution.

Unit - 2	**Number of lectures**	**Title of the unit: Procedures and Techniques**

Data gathering : Level of responsibilities, energy sources, control of energy and uses of energy get Facts, figures and impression about energy /fuel and system operations, Past and Present operating data, Special tests, Questionnaire for data gathering.

Analytical Techniques: Incremental cost concept, mass and energy balancing techniques, inventory of Energy inputs and rejections, Heat transfer calculations, Evaluation of Electric load characteristics, process and energy system simulation

Unit - 3	**Number of lectures**	**Title of the unit: Energy Policy Planning and Implementation**

Location of Energy Manager, Top Management Support, Managerial functions, Role and responsibilities of Energy Manager, Accountability. Motivating – Motivation of employees, Requirements for Energy Action Planning. Information Systems: Designing, Barriers, Strategies, Marketing and Communicating Training and Planning.

Unit - 4	**Number of lectures**	**Title of the unit: Energy Balance & MIS**

First law of efficiency and Second law of efficiency, Facility as an Energy system, Methods for preparing process flow, Materials and Energy Balance diagram, Identification of losses, Improvements. Energy Balance sheet and Management Information System (MIS) Energy Modeling and Optimization.

Unit - 5	**Number of lectures**	**Title of the unit: Energy Audit Instruments**

Instruments for Audit and Monitoring Energy and Energy Savings, Types and Accuracy

12. Books Recommended (3 Text Books + 2-3 Reference Books)

i) Energy Management: W.R.Murphy, G.Mckay (Butterworths).

ii) Energy Management Principles: C.B.Smith (Pergamon Press).

iii) Efficient Use of Energy : I.G.C.Dryden (Butterworth Scientific)

iv) Energy Economics -A.V.Desai (Wieley Eastern)

v) Industrial Energy Conservation : D.A. Reay (Pergammon Press)

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	**General Aspects**	1
2	**Procedures and Techniques**	1
3	**Energy Policy Planning and Implementation**	2
4	**Energy Balance & MIS**	2
5	**Energy Audit Instruments**	1

1. Name of the Department: Civil Engineering Department						
2. Course Name	Environmental Quality Monitoring Lab	**L**	**T**		**P**	
3. Course Code	13160124	0	0		2	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem (✔)	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

Introduction to multi-media sampling techniques and analytical methods for evaluation outdoor/indoor air, soil/surfaces, and water. The course will cover environmental science and industrial hygiene approaches for anticipating, recognizing, evaluating, and controlling hazards, with the primary focus on recognition and evaluation of contaminants, including data interpretation for risk reduction and regulatory compliance. The course will also emphasize environmental investigative techniques, instrument selection, and quality control, including documentation, calibration, and sample management.

9. Learning objectives:

i) To impart practical knowledge about various environmental related processes.
ii) To understand the practical implications associated with the estimation of different parameters related to environmental engineering.

10. Course Outcomes (COs):

Upon successful completion of this course, students will be able to

i) The students gain better understanding about the processes
ii) The students will have the capacity to develop experiments related to their field of research.

11. Lab component components

Sr. No.	Title	CO covered
1	• Monitoring of chemical and physical parameters	**1**
3	• Monitoring of water (river, lake, sea, underground water)	**1,2**
4	• Monitoring of biological parameters	**1**
5	• Monitoring of soil	**2**

6	• Monitoring of air (ambient air and precipitation)	**2**
7	• Emission factors (definition, application, source of errors)	**1**
8	• Equipment for monitoring	**1**

1. Name of the Department: Civil Engineering Department						
2. Course Name	Renewable Energy Technology Lab	L	T		P	
3. Course Code	13160125	0	0		1	
4. Type of Course (use tick mark)		Core (✔)	PE()		OE()	
5. Pre-requisite (if any)	Renewable Energy	**6.** Frequency (use tick marks)	Even ()	Odd (✔)	Either Sem (✔)	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures =		**Tutorials =**	**Practical =**			

8. Brief Syllabus

Renewable Energy uses energy resources and technologies that are "clean" or "green" because they produce few if any pollutants. Many people use the terms "Alternative Energy", "Renewable Energy" and even "Green Energy" together in the same sentence when taking about energy sources as though they all mean the same thing, but they are not the same. Each term means something different when talking about energy systems. So what does renewable energy mean.

9. Learning objectives:

To expose the student to solar thermal, solar photovoltaic, biomass, wind, small hydro and other renewable energy resources, conversion technologies, processes, systems and devices, and equip the student to take up projects in those areas.

10. Course Outcomes (COs):

At the end of the course, the students will be able to

1. Explain the basic principles of various renewable energy conversion processes and devices used therein.
2. Identify various parameters that influence the performance of devices/processes.
3. Undertake field projects in these areas.

11. Books Recommended (3 Text Books + 2-3 Reference Books)

i) Hand book of Energy Audits by Albert Thuman, P.E.,C.E.M

ii) Energy Management and Conservation Handbook by Kreith & Goswami

iii) Renewable Energy by Godfrey Boyle

iv) Renewable Energy Resources by John Twidell and Tony Weir.

12. Lab component

Sr. No.	Title	CO covered
1	Demonstration of various energy auditing instruments	1
2	Measurement of efficiency of Hybrid Fuel cell	1
3	Measurement of illumination using lux meter and its comparison with IS.	1
4	Calculate cooling load using temp. and humidity measurement	2
5	Measurement of energy consumption using energy meter	3
6	Measurement of Noise level of environment	3
7	Demonstration of weather quality parameters like temperature, humudity, intensity, wind speed,etc	2
8	Emissivity measurement.	2
9	Measurement of heat transfer in natural and forced convection.	1

Second Semester

1. Name of the Department: Civil Engineering Department						
2. Course Name	Energy Instrumentation, Measurement and Control	L	T		P	
3. Course Code	13160225	3	0		0	
4. Type of Course (use tick mark)		Core (✔)	PE()		OE()	
5. Pre-requisite (if any)		**6.** Frequency (use tick marks)	Even (✔)	Odd ()	Either Sem (✔)	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

Instrumentation and control engineering. Instrumentation is defined as the art and science of measurement and control of the process variables within a production or manufacturing area. The process variables used in industries are Level, Pressure, Temperature, Humidity, Flow, pH, Force, Speed etc

9. Learning objectives:

This subject is taught to impart knowledge in the area of numerical integration and Calculus

10. Course Outcomes (COs):

At the end of course, the student will be able to:

1. Study the devices used to measure various forms of energy.
2. Understand the basic working principle of energy measuring devices

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Electrical Energy Metering**

Electrical energy meter, One –Phase energy meters, Three Phase Energy meters, working principle, various compensation, Automatic meter reading systems

Unit - 2	**Number of lectures**	**Title of the unit: Thermal Energy Metering**

Combustion analyser, Fuel efficiency monitor , Flue gas analyzer, Thermometers, Thermocouples & RTDs, Potentiometric & Paperless Recorders, I/P Converters, Temperature Transmitters, Optical Pyrometer, Digital indicators, PID Controllers, Loop Powered Indicators & Isolators, BTU meters, Thermistors, Heat Flux sensor.		
Unit - 3	**Number of lectures**	**Title of the unit: Air Flow Metering**
Air flow meters: vane (flap) type air flow meters and “hot wire" and "hot film" air mass meters. Anemometer, types and its classification, working principle.		
Unit - 4	**Number of lectures**	**Title of the unit: Gas Flow Metering**
Types and its basic working principle, Odometer		
Unit - 5	**Number of lectures**	**Title of the unit: Fluid Flow Metering**
Classification of fluid flow meters based on the operating principle- Differential Pressure Flowmeters, Velocity Flowmeters, Positive Displacement Flowmeters, Mass Flowmeters, Open Channel Flowmeters, Types:-Orifices, Venturies, Nozzles, Rotameters, Pitot Tubes, Calorimetrics, Turbine, Vortex, Electromagnetic, Doppler, Ultrasonic, Thermal, Coriolis		
12. Books Recommended (3 Text Books + 2-3 Reference Books)		
i) Fundamentals of Aerodynamics (McGraw-Hill International Editions: Mechanical Engineering Series) by John David Anderson, Tata Mcgraw-Hill Education.		
ii) Electrical Measurements and Measuring Instruments by A.K Sawhney		
iii) Flow measurement: practical guides for measurement and control by David W. Spitzer, Instrument Society of America		
iv) Energy Management Handbook by Steve Doty		
v) Handbook of Energy Engineering by Albert Thumann		
vi) Guide to Energy Management by B. L. Capehart		

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Electrical Energy Metering	1
2	Thermal Energy Metering	1

3	Air Flow Metering	1
4	Gas Flow Metering	2
5	Fluid Flow Metering	2

Name of the Department: Civil Engineering Department						
Course Name	**Energy Audit & Impact Assessment**	**L**	**T**		**P**	
Course Code	**13160226**	**2**	**0**		**0**	
Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
Pre-requisite (if any)		**Frequency (use tick marks)**	**Even (✔)**	**Odd ()**	**Either Sem (✔)**	**Every Sem ()**
Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures =		**Tutorials =**	**Practical =**			
Brief Syllabus An energy audit is an inspection survey and an analysis of energy flows for energy conservation in a building.						
Learning objectives: To develop a methodical approach on assessment of environmental impacts due to developmental activities and a conceptual outlook on sustainable development.						
Course Outcomes (COs):						
At the end of the course, the student will be able to						
Knowledge on prediction and assessment of environmental impacts due to developmental activities.						
Concepts on various environmental impact assessment methodologies.						
Unit wise detailed content						
Unit-1	**Number of lectures =**	**Title of the unit: Basic concept of EIA and Methodologies**				
Initial environmental Examination, Elements of EIA, – factors affecting E I A Impact evaluation and analysis, preparation of Environmental Base map, Classification of environmental parameters.						
Unit - 2	**Number of lectures =**	**Title of the unit: E I A Methodologies**				
Introduction, Criteria for the selection of EIA Methodology, E I A methods, Ad-hoc methods, matrix methods, Network method Environmental Media Quality Index method, overlay methods, cost/Benefit Analysis.						

Unit - 3	Number of lectures =	Title of the unit: Impact of Developmental Activities
Land use. Introduction, Methodology for the assessment of soil and ground water, Delineation of study area, Identification of activities. Assessment of Impact of development Activities on Vegetation and wildlife, environmental Impact of Deforestation – Causes and effects of deforestation.		
Unit – 4	**Number of lectures =**	**Title of the unit: Prediction and Assessment of Impact:**
Quality, Impact prediction, Assessment of Impact significance, Identification and Incorporation of mitigation measures. E I A in surface water, Air and Biological environment: Methodology for the assessment of Impacts on surface water environment, Air pollution sources, generalized approach for assessment of Air pollution Impact.		
Unit - 5	**Number of lectures =**	**Title of the unit: Environmental Audit & Environmental legislation:**
Objectives of Environmental Audit, Types of environmental Audit, Audit protocol, stages of Environmental Audit, on-site activities, evaluation of Audit data and preparation of Audit report. Post Audit activities: The Environmental pollution Act, The water; Act, The Air (Prevention & Control of pollution Act.), Mota Act. Wild life Act. Case studies and preparation: of Environmental Impact assessment statement for various Industries.		
Books Recommended (3 Text Books + 2-3 Reference Books)		
Environmental Impact Assessment Methodologies, by Y. Anjaneyulu, B.S. Publication, Sultan Bazar, Hyderabad.		
Environmental Science and Engineering, by J. Glynn and Gary W. Hein Ke – Prentice Hall Publishers		
Environmental Science and Engineering, by Suresh K. Dhaneja – S.K.,Katania& Sons Publication., New Delhi		
Environmental Pollution and Control, by Dr H.S. Bhatia – Galgotia Publication (P) Ltd, Delhi		

Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Basic concept of EIA and Methodologies	1
2	E I A Methodologies	2
3	Impact of Developmental Activities	1
4	Prediction and Assessment of Impact:	1
5	Environmental Audit & Environmental legislation:	2

1. Name of the Department: Civil Engineering Department						
2. Course Name	Design of Water and Wastewater Treatment Systems	L	T		P	
3. Course Code	13160227	2	0		0	
4. Type of Course (use tick mark)		Core (✔)	PE()		OE()	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even (✔)**	**Odd ()**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

The objective of wastewater treatment is to reduce the concentrations of specific pollutants to the level at which the discharge of the effluent will not adversely affect the environment or pose a health threat. Moreover, reduction of these constituents need only be to some required level. Although water can technically be completely purified by distillation and deionization, this is unnecessary and may actually be detrimental to the receiving water. Fish and other organisms cannot survive in deionized or distilled water.

9. Learning objectives:

i) To expose the student to various technologies in water treatment in order to make water safe to drink
ii) To teach various options available in treatment of waste water for recycle and safe disposal.

10. Course Outcomes (COs):

At the end of the course, the student will be able to

1. Understand various unit operations involved in water treatment and design various water treatment units required.
2. Design waste water treatment units for desire treatment.

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Definitions and Concepts**

Water sources, Philosophy of water treatment, Review of water quality characteristics and potable water standards, Estimation of water quantity, Theory and design of Conventional Unit Operations used in Water Treatment: Screening, Sedimentation, Floatation, coagulation, flocculation, filtration, softening and disinfection processes.

Unit - 2	Number of lectures	Title of the unit: Theory and Design of Advanced Unit Operations used in Water Treatment
Membrane processes, Ion Exchange, Aeration/stripping, Precipitation, Adsorption, Oxidation-reduction and advanced oxidation processes; Water Treatment Plant Design; Selection of raw water source, Planning and siting of water treatment plant, Chemical requirement and residuals management.		
Unit - 3	**Number of lectures**	**Title of the unit: Philosophy of Wastewater Treatment**
Philosophy of wastewater Treatment, Review of Wastewater quality parameters and discharge standards for aquatic and land disposal, Estimation of wastewater quantity; Wastewater Collection; Design of sewers and sewerage systems		
Unit - 4	**Number of lectures**	**Title of the unit: Wastewater Disposal**
Disposal to inland waters such as lakes reservoirs, rivers and streams, disposal to sea, disposal on Land. Wastewater treatment; Preliminary treatment, Bar-rack, Screens, Grit chamber, Equalization tank, Primary sedimentation		
Unit - 5	**Number of lectures**	**Title of the unit: Secondary treatments**
Aerobic processes, Anaerobic processes. Tertiary treatment, Nutrient removal, Residual management, Design; Planning and sitting of Wastewater treatment plant, Chemical requirements and material balance.		
12. Books Recommended (3 Text Books + 2-3 Reference Books)		
i) Benefield, L.D. Judkins J.F. and Weand B.L. (1982). Process Chemistry for Water and Wastewater Treatment, End ed., Prentice-Hall, Inc, New Jersey, USA		
ii) Pelczar, M.J., Chan ECS and Krieg NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India		
iii) Talaro K., Talaro A CassidaPelzar and Reid, (1993) Foundations in Microbiology, W.C. Brown Publishers		
iv) Sawyer, McCarty, and Parkin, 2003.Chemistry for Environmental Engineers, 5th" McGraw Hill		
v) Metcalf and Eddy, M.C., "Wastewater Engineering: Treatment, Disposal and Reuse", Tata McGraw-Hill Publications, New Delhi, 2003		

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Definitions and Concepts	2

2	Theory and Design of Advanced Unit Operations used in Water Treatment	1
3	Philosophy of Wastewater Treatment	2
4	Wastewater Disposal	1
5	Secondary treatments	2

Name of the Department: Civil Engineering Department						
1. Course Name	**Air Pollution and Its Control**	L	T		P	
2. Course Code	13160228	3	0		0	
3. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
4. Pre-requisite (if any)	**Environment Quality Control**	**5. Frequency (use tick marks)**	**Even (✔)**	**Odd ()**	**Either Sem (✔)**	**Every Sem ()**
6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			
7. Brief Syllabus Air pollution control. Air pollution control, the techniques employed to reduce or eliminate the emission into the atmosphere of substances that can harm the environment or human health. These include adverse effects on human health, property, and atmospheric visibility.						
8. Learning objectives: The course is intended to teach the basics of Air Pollution and measures and technologies required to control air pollution						
9. Course Outcomes (COs):						
At the end of the course, the student will be able to						
1. Identify the type the source of pollutant.						
2. Monitor the Air pollution and analyze the samples.						
3. Control air pollution using different ECS.						
10. Unit wise detailed content						
Unit-1	Number of lectures	Title of the unit: Air Pollution & its Classification				
Definition, Air Quality, Classification of Air Pollutants						
Unit - 2	Number of lectures	Title of the unit: Effects of Air pollution				
Effects of Air pollution on human, plant and animal, Air Pollution Episodes						
Unit - 3	Number of lectures	Title of the unit: Air Pollution Monitoring				

Collection of Gaseous Air Pollutants, Collection of Particulate Pollutants, Measurement of SO_2, Nox, CO, Oxidants and Ozone.		
Unit - 4	Number of lectures	Title of the unit: Meteorology & Dispersion of pollutants
Wind Circulation, Lapse Rate, Stability Conditions, Maximum Mixing Depths, Plume Rise & dispersion		
Unit - 5	Number of lectures	Title of the unit: Emission Control Systems
Air pollution control technologies for particulates and gaseous contaminants, Gravity settlers, Electrostatic precipitators, Bag Filters, Scrubbers, Cyclone, control for moving sources.		
10. Books Recommended (3 Text Books + 2-3 Reference Books)		
i) M.N.Rao& H V N Rao (2000), Air pollution, Tata McGraw Hill Publishing Ltd		
ii) 'Fundamentals of Air Pollution' authored by Daniel Vallero, 4th Edition, Elsevier's Science & Technology, 2008 (ISBN: 978-0-12-373615-4).		
iii) 'Air Pollution Control Technology Handbook' authored by Karl B. Schnelle, Jr. and Charles A. Brown, CRC Press, 2002 (ISBN 0-8493-9588-7).		
iv) 'Air Pollution Control Engineering' Edited by Lawrence K. Wang, Norman C. Pereira and YungTse Hung, Humana Press Inc, 2004 (ISBN: 1-58829-161-8).		
v) 'Advanced Air and Noise Pollution Control' Edited by Lawrence K. Wang, Norman C. Pereira and Yung-Tse Hung, Humana Press Inc, 2005 (ISBN: 1-58829-359-9).		

12. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Air Pollution & its Classification	1
2	Effects of Air pollution	3
3	Air Pollution Monitoring	2
4	Meteorology & Dispersion of pollutants	1
5	Emission Control Systems	2

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Design of Water & Wastewater Treatment Systems Laboratory**	**L**	**T**		**P**	
3. Course Code	**13160239**	**2**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE ()**		**OE ()**	
5. Pre-requisite (if any)	**Design of Water & Wastewater Treatment Systems**	**6. Frequency (use tick marks)**	**Even ()**	**Odd (✔)**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

The objective of wastewater treatment is to reduce the concentrations of specific pollutants to the level at which the discharge of the effluent will not adversely affect the environment or pose a health threat. Moreover, reduction of these constituents need only be to some required level. Although water can technically be completely purified by distillation and deionization, this is unnecessary and may actually be detrimental to the receiving water. Fish and other organisms cannot survive in deionized or distilled water

9. Learning objectives:

i) To expose the student to various technologies in water treatment in order to make water safe to drink
ii) To teach various options available in treatment of waste water for recycle and safe disposal.

10. Course Outcomes (COs):

At the end of the course, the student will be able to

3. Understand various unit operations involved in water treatment and design various water treatment units required.
4. Design waste water treatment units for desire treatment.

11. Books Recommended (3 Text Books + 2-3 Reference Books)

i 'Water and Wastewater Calculations Manual' authored by Shun Dar Lin and C. C. Lee, (2007) 2 nd Edition, The McGraw-Hill Companies, Inc, (ISBN: 0-07-154266-3).

ii) Water Treatment Plant Design' by American Water Works Association, (2012),5 th Edition, McGraw- Hill Inc., (ISBN: 978-0-07-174572-7).

12. Lab components

Sr. No.	Title	CO covered
1	Prepare a pre-design proposal of water treatment plant for the city/town/village/community you live.	1
2	Prepare a mass balance flow of pollution load in water treatment plant for the pre-design proposal you prepared	1
3	Design a water treatment plant for the city/town/village/community you live as in the pre-design proposal you prepared.	2
4	Design a rain water harvesting system for the city/town/village/community/apartment/house you live.	2
5	Design a wastewater treatment plant for the city/town/village/community you live as in the pre-design proposal you prepared.	1
6	Prepare a pre-design proposal of wastewater reuse and recycle for the city/town/village/community/house you live.	1
7	Design a rain water harvesting system for the city/town/village/community/apartment/house you live.	2

Semester-III

Elective Programs

<table>
<tr><td colspan="8">1. Name of the Department: Civil Engineering Department</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Atmospheric Processes and Climate Change</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13160323</td><td colspan="2">3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core (✔)</td><td colspan="2">PE()</td><td colspan="2">OE()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td></td><td colspan="2">6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✔)</td><td>Either Sem (✔)</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures 40</td><td colspan="3">Tutorials 0</td><td colspan="3">Practical 0</td></tr>
<tr><td colspan="9">8. Brief Syllabus
Atmospheric processes play important roles in shaping the Earth’s energy and water cycles. With the help of numerical models, observations and theories, GFDL scientists conduct cutting-edge research to advance the fundamental understanding of atmospheric processes in governing climate variability and change, with the goal of developing more accurate representations of them in climate models. This work makes it possible to quantify the key characteristics of natural and anthropogenic perturbations to the climate system (such as greenhouse gases, aerosols, land use, volcanoes and solar radiation), and to elucidate the mechanisms through which these perturbations influence global and regional climate.</td></tr>
<tr><td colspan="9">9. Learning objectives:
1. The evolution of the earth’s atmosphere
2. Characteristics of the terrestrial atmosphere
3. Homogeneous and heterogeneous processes in the atmosphere
4. A basic understanding of the recent advances made in the understanding of the atmospheric processes leading to climate change</td></tr>
<tr><td colspan="9">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="9">At the end of the course, the student will be able to</td></tr>
<tr><td colspan="9">1. First acquire a basic understanding of the evolution of the earth’s atmosphere
2. Thereafter, learn about the structure and composition of the various atmospheric layers</td></tr>
</table>

3. Gain a basic grounding on atmospheric chemical cycles
4. Understand how atmospheric chemical processes are linked to the dynamics
5. Finally, gain an insightful understanding of the physico-chemical processes leading to climate change

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Introduction to Atmosphere & Radiation**

Origins of the Earth's Atmosphere. Layers of the Atmosphere. Earth–Atmosphere System. Solar and Terrestrial Radiation. Absorption of Radiation by gases. Solar variability and the Earth's Energy Balance. A simple model to estimate Green House Effect.

Unit - 2	**Number of lectures**	**Title of the unit: Conceptual Models**

The ideal Gas law, Atmospheric Composition, Hydrostatic balance, Derivation of the Potential Temperature, States of stability of the Atmosphere, Parcel Concepts. General Circulation and Geostrophic flows. Quantification of dry and moist adiabatic Lapse Rates. Cloud Formation

Unit - 3	**Number of lectures**	**Title of the unit: Environmental Phenomenon**

Atmospheric Chemical Reactions. Chemical Kinetics, Bimolecular Reactions, Photodissociation. Stratospheric Ozone, Chapman Chemistry, Catalytic Cycles, Homogeneous and Heterogeneous pathways for Ozone destruction. The Antarctic Ozone Hole.

Unit - 4	**Number of lectures**	**Title of the unit: Analytics of Pollutants**

Atmospheric Aerosol: Aerosol size distributions. Continental and Maritime Aerosol. Homogeneous and heterogeneous nucleation. Condensation, Coagulation, Evaporation. Sedimentation and dry deposition. Formation of Cloud droplets. Auto-conversion and Precipitation.

Unit - 5	**Number of lectures**	**Title of the unit: Global environmental activities**

Global Climate Change: Global Temperature Record and Solar Variability. Possible Effects of Global Warming. Aerosol direct, in-direct and semi-direct effects. Climate Response to Anthropogenic Aerosol Forcing. Climate Predictions: Key attributes of Global Climate Models.

12. Books Recommended (1 Books+ 2 References)

1. Introduction to Environmental Engineering and Science. Gilbert M. Masters. Prentice-Hall of India. 2005.
2. Inter-governmental Panel on Climate Change: The Third Assessment Report (2007). Cambridge University Press.

3. Plus, Journal Articles from J. Geophys. Res., Climate Change, Geophysical Res. Letts. Etc.
4. Michael S.

15. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Introduction to Atmosphere & Radiation	1
2	Conceptual Models	4
3	Environmental Phenomenon	3
4	Analytics of Pollutants	5
5	Global environmental activities	2

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Application of Bio-technology in Environmental Engineering**	**L**	**T**		**P**	
3. Course Code	**13160236**	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✔)**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even (✔)**	**Odd ()**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

Environmental biotechnology is a system of scientific and engineering knowledge related to the use of microorganisms and their products in the prevention of environmental pollution through biotreatment of solid, liquid, and gaseous wastes, bioremediation of polluted environments, and biomonitoring of environment

9. Learning objectives:

The course provides the comprehensive knowledge in environmental science, environmental issues and the management.

10. Course Outcomes (COs):

The importance of environmental education, ecosystem and ethics
Knowledge with respect to biodiversity and its conservation
To create awareness on the various environmental pollution aspects and issues
To educate the ways and means to protect the environment.
Important environmental issues and protection

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Enivronment And Ecosystems**
Environmental education: definition - scope - objectives and importance. Concept of an ecosystem – types (terrestrial and aquatic ecosystems) – structure and function – ecological succession - food chains, food webs and ecological pyramids		

Unit - 2	Number of lectures	Title of the unit: Biodiversity
Introduction: definition - genetic, species and ecosystem diversity - value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - threats to biodiversity: habitat loss, poaching of wildlife - endangered and endemic species of India, Conservation of biodiversity: in-situ and ex-situ conservations.		
Unit - 3	**Number of lectures**	**Title of the unit: Pollution And Waste Management**
Air and water pollution – classification of pollutants and their effects – control measures of air pollution. Waste water treatment (general) – primary, secondary & tertiary stages. Solid waste management: causes - effects of municipal waste, hazardous waste, bio medical waste - process of waste management.		
Unit - 4	**Number of lectures**	**Title of the unit: Current Environmental Issues**
Environmental ethics -issues and possible solutions- population explosion, climatic change, ozone layer depletion, global warming, acid rain and green house effect. Sustainable development: definition, objectives and environmental dimensions of sustainable development- environmental audit for sustainable development.		
Unit - 5	**Number of lectures**	**Title of the unit: Environmental Protection**
National and international concern for environment: Important environmental protection acts in India – water, air (prevention and control of pollution) act, wild life conservation and forest act – functions of central and state pollution control boards - international effort – key initiatives of Rio declaration, Vienna convention, Kyoto protocol and Johannesburg summit		
12. Books Recommended (3 Text Books + 2-3 Reference Books)		
i) Sharma.B.K. and Kaur, "Environmental Chemistry"" Goel Publishing House, Meerut, 1994		
ii) De.A.K., "Environmental Chemistry", New Age International (p) lt., , New Delhi, 1996		
iii) Kurian Joseph & R. Nagendran, "Essential of Environmental Studies"" Pearson Education, 2004.		
iv) Dara S.S., A Text Book of Environmental Chemistry and pollution control, S.Chand & Company Ltd., New Delhi, 2004.		
v) Jeyalakshmi.R, Principles of Environmental Science, 1st Edition, Devi Publications, Chennai 2006		

14. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Environment And Ecosystems	3
2	Biodiversity	1

3	Pollution And Waste Management	2
4	Current Environmental Issues	5
5	Environmental Protection	4

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Clean Development Mechanism & Green Technologies**	**L**	**T**		**P**	
3. Course Code	**13160316**	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even ()**	**Odd (✔)**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

The field of Clean Development Mechanism and Green Technologies encompasses a continuously evolving group of methods, materials and processes from environmentally benign techniques for generating energy to its minimal utilization for maximal production of end materials and utilization of waste products when generated. The goals of this rapidly growing highly interdisciplinary field include i) sustainability - meeting the needs of society in ways that without damaging or depleting natural resources, ii) innovation - developing alternatives to technologies to those that have been demonstrated to damage health and the environment and source reduction – and iii) reducing waste and pollution by changing patterns of production and consumption. Thus, Green Technology is a term used to describe production of knowledge-based products or provide services that improve operational performance, productivity or efficiency, while reducing costs, inputs, energy consumption, waste and pollution.

9. Learning objectives:

The course is intended to teach the basics of CDM.To become familiar with CDM processes.

10. Course Outcomes (COs):

At the end of the course, the student will be able to

Well aware of developments in Clean Development Mechanism.

Understanding of Global Warming and Climatic changes.

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Principle of Clean Development Mechanism**

Introduction to Climate Change and Global Warming, International Response to Climate Change & Global Warming		
Unit - 2	**Number of lectures**	**Title of the unit: Kyoto Protocol**
Kyoto Protocol and its mechanism, objectives of Kyoto protocol and details of the agreement, Amendments of Kyoto Protocol.		
Unit - 3	**Number of lectures**	**Title of the unit: Clean Development Mechanism Process**
Overview of Clean Development Mechanism, Administration and Participation, CDM Project Cycle and Financing, Post Kyoto Negotiations and India.		
Unit - 4	**Number of lectures**	**Title of the unit: Sustainable Development in CDM**
CDM, Sustainable Development and its Assessment, The CDM Market, Types of Major CDM Projects, Small Sectors and CDM, preparing CDM project design document (PDD) Course Project		
Unit - 5	**Number of lectures**	**Title of the unit: Case Studies of CDM Projects**
Types of Major CDM Projects, Small Sectors and CDM, Detailed studies of CDM approved projects.		
12. Books Recommended (1 Books)		
Introduction to Environmental Engineering and Science. Gilbert M. Masters. Prentice-Hall of India. 2005.		

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Principle of Clean Development Mechanism	1
2	Kyoto Protocol	2
3	Clean Development Mechanism Process	1
4	Sustainable Development in CDM	1
5	Case Studies of CDM Projects	2

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Design of Wastewater Treatment & Disposal System**	**L**	**T**		**P**	
3. Course Code	**13160232**	**2**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)	**Environmental Quality Monitoring**	**6. Frequency (use tick marks)**	**Even ()**	**Odd (✔)**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

The objective of wastewater treatment is to reduce the concentrations of specific pollutants to the level at which the discharge of the effluent will not adversely affect the environment or pose a health threat. Moreover, reduction of these constituents need only be to some required level. Although water can technically be completely purified by distillation and deionization, this is unnecessary and may actually be detrimental to the receiving water. Fish and other organisms cannot survive in deionized or distilled water.

9. Learning objectives:

To expose the student to various technologies in water treatment in order to make water safe to drink and also various treatment options available in treatment of waste water for recycle and safe disposal

10. Course Outcomes (COs):

At the end of the course, the student will be able to

Understand various unit operations involved in water treatment and design various water treatment units required

Design waste water treatment units for desired treatment

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Municipal Water Supply, Sources Quantity and Quality**

Objectives of water treatment, raw water sources and quality, Drinking Water Quality Standards, Regulations, per capita water demand, Population Estimates-Guide to Selection of Water Treatment Processes, water distribution network		
Unit - 2	**Number of lectures**	**Title of the unit: Conventional Unit Operations used in Water Treatment**
Aeration, types of settling, principal of sedimentation, sedimentation tank design, coagulation, flocculation, filtration, rapid gravity sand filter, multimedia filter, disinfection, mechanism of disinfection, chlorine, other disinfectants		
Unit - 3	**Number of lectures**	**Title of the unit: Wastewater Characterization and Disposal**
Philosophy of wastewater treatment, characteristics of wastewater, discharge standards for aquatic and land disposal, Wastewater Disposal; disposal to inland waters such as lakes reservoirs, rivers and streams, disposal to sea, disposal on Land		
Unit - 4	**Number of lectures**	**Title of the unit: Pre- and Primary Wastewater Treatment**
Quantity of wastewater generated, collection of wastewater, flow variation, design of stabilization plant, preliminary treatment methods		
Unit - 5	**Number of lectures**	**Title of the unit: Secondary Wastewater Treatment**
Attached growth system, design of trickling filter, RBC, Suspended growth system, design of activated sludge process (ACP), variations of ACP, wastewater treatment pond, requirements of tertiary treatment, different advanced wastewater treatments		
12. Brief Description of self learning / E-learning component		
13. Books Recommended (3 Text Books + 2-3 Reference Books)		
i)'Water and Wastewater Engineering: Design Principles and Practice' authored by Mackenzie L. Davis, McGraw-Hill Education (India) Private Ltd., 2015 (ISBN-13: 978-1-25-906483-8).		
ii) 'Water Treatment: Principles and Design' authored by John C. Crittenden, R. Rhodes Trussell, David W. Hand, Kerry J. Howe and George Tchobanoglous, 3rd Edition, John Willey and Sons, 2012 (ISBN: 978-0-470-40539-0).		
iii) Handbook of Water and Wastewater Treatment Plants Operations' authored by Frank R. Spellman, 3rd Edition, CRC Press, 2014 (ISBN-13: 978-1-4665-5338-5).		
iv) 'Water Works Engineering: Planning, Design and Operation' authored by Syed R. Qasim, Edward M. Motley and Guang Zhu, Pearson Prentice Hall, 2011 (ISBN: 978-81-203-2153-3).		

14. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered

1	Municipal Water Supply, Sources Quantity and Quality	1
2	Conventional Unit Operations used in Water Treatment	1
3	Wastewater Characterization and Disposal	2
4	Pre- and Primary Wastewater Treatment	2
5	Secondary Wastewater Treatment	2

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Design of Water Supply Treatment and Treatment Systems**	**L**	**T**		**P**	
3. Course Code	**13160318**	**3**	**0**		**0**	
4. Type of Course (use tick mark)		Core (✔)	PE()		OE()	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even ()**	**Odd (✔)**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

This course provides the fundamentals for the selection and design of the most appropriate, cost-effective and sustainable wastewater or sanitation treatment system. It also provides the basics on technology selection and costing and engineering economics for the analysis, evaluation and comparison of different treatment alternatives. Waste water Treatment is used to convert wastewater into an effluent that can be returned to the water cycle with minimum impact on the environment, or directly reused. By-products from wastewater treatment plants, such as screenings, grit and sewage sludge may also be treated in a wastewater treatment plant.

9. Learning objectives:

To expose the student to various technologies in water treatment in order to make water safe to drinkTo teach various options available in treatment of waste water for recycle and safe disposal.

10. Course Outcomes (COs):

At the end of the course, the student will be able to

Understand various unit operations involved in water treatment and design various water treatment units required. Design waste water treatment units for desire treatment.

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Definitions and Concepts**
Water sources, Philosophy of water treatment, Review of water quality characteristics and potable water standards, Estimation of water quantity, Theory and design of Conventional Unit Operations used in Water Treatment: Screening, Sedimentation, Floatation, coagulation, flocculation, filtration, softening and disinfection processes.		
Unit - 2	**Number of lectures**	**Title of the unit: Theory and Design of Advanced Unit Operations used in Water Treatment**
Membrane processes, Ion Exchange, Aeration/stripping, Precipitation, Adsorption, Oxidation-reduction and advanced oxidation processes; Water Treatment Plant Design; Selection of raw water source, Planning and siting of water treatment plant, Chemical requirement and residuals management.		
Unit - 3	**Number of lectures**	**Title of the unit: Philosophy of Waste water Treatment**
Philosophy of waste water Treatment, Review of Wastewater quality parameters and discharge standards for aquatic and land disposal, Estimation of wastewater quantity; Wastewater Collection; Design of sewers and sewerage systems		
Unit - 4	**Number of lectures**	**Title of the unit: Waste water Disposal**
Disposal to inland waters such as lakes reservoirs, rivers and streams, disposal to sea, disposal on Land. Waste water treatment; Preliminary treatment, Bar-rack, Screens, Grit chamber, Equalization tank, Primary sedimentation		
Unit - 5	**Number of lectures**	**Title of the unit: Secondary treatments**
Aerobic processes, Anaerobic processes. Tertiary treatment, Nutrient removal, Residual management, Design; Planning and siting of Wastewater treatment plant, Chemical requirements and material balance.		

12. Books Recommended (1 Books+ 5 References)

1. Metcalf and Eddy, M.C., "Wastewater Engineering: Treatment, Disposal and Reuse", Tata McGraw-Hill Publications, New Delhi, 2003
2. Benefield, L.D. Judkins J.F. and Weand B.L. (1982). Process Chemistry for Water and Wastewater Treatment, End ed., Prentice-Hall, Inc, New Jersey, USA

3. Benefield L.D. and Randall, C.W. (1980). Biological process design for wastewater treatment. Prentice-Hall. N.J.
4. Pelczar, M.J., Chan ECS and Krieg NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.
5. Talaro K., Talaro A CassidaPelzar and Reid, (1993) Foundations in Microbiology, W.C. Brown Publishers.
6. Sawyer, McCarty, and Parkin, 2003.Chemistry for Environmental Engineers, 5th" McGraw Hill.

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Definitions and Concepts	1
2	Theory and Design of Advanced Unit Operations used in Water Treatment	2
3	Philosophy of Waste water Treatment	1
4	Waste water Disposal	2
5	Secondary treatments	2

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Earth and Environment**	**L**	**T**		**P**	
3. Course Code	**13160229**	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✔)**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even (✔)**	**Odd ()**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

The course brief about the natural environment encompasses all living and non-living things occurring naturally, meaning in this case not artificial. The term is most often applied to the Earth or some parts of Earth. This environment encompasses the interaction of all living species, climate, weather and natural resources that affect human survival and economic activity.

9. Learning objectives:

1. To expose the student to various technologies in water treatment in order to make water safe to drink
2. To teach various options available in treatment of waste water for recycle and safe disposal.

10. Course Outcomes (COs):

At the end of the course, the student will be able to

1. Understand various unit operations involved in water treatment and design various water treatment units required.

2. Design waste water treatment units for desire treatment.

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Definitions and Concepts**
Introduction to Earth and earth systems, atmosphere and processes governing environmental conditions; the biosphere, the atmosphere, climate and climate change, the geologic, tectonic, hydrological and biogeochemical cycles		
Unit - 2	**Number of lectures**	**Title of the unit: Earth Resources**
Earth resources, significance of natural resources; renewable biological resources, wildlife conservation/management, fisheries, forestry, mineral resources, mineral availability and recycling, environmental impacts of use of resources, air, water and soil resources. scarcity and conservation		
Unit - 3	**Number of lectures**	**Title of the unit: Earth's Energy Budget**
Energy resources, energy consumption, energy use and efficiency, current energy sources, energy issues, climate change and energy, and future renewable energy alternatives.		
Unit - 4	**Number of lectures**	**Title of the unit: World Food Supply**
World food supply; traditional agriculture, green revolution, aquaculture, modern agriculture, ecological impacts of modern agriculture, organic farming.		
Unit - 5	**Number of lectures**	**Title of the unit: Major Environmental Concerns**
Natural hazards and processes, dams and environment, global climate and hazards, effect of population increase on environment, historical perspective of growing environmental concerns		

12. Books Recommended (3 Text Books + 2-3 Reference Books)

i) Reshaping Environments - An Interdisciplinary Approach to Sustainability in a Complex World Helena Bender (2012) ISBN-13: 9781107688667

ii) Earth-Evolution of a Habitable World (2013) Jonathan I. Lunine ISBN-13: 9780521615198
iii) Environmental Change- Key Issues and Alternative Perspectives (2005) Frank Oldfield ISBN-13: 9780521536332

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Definitions and Concepts	1,2
2	Earth Resources	1
3	Earth's Energy Budget	1
4	World Food Supply	2
5	Major Environmental Concerns	2

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Environmental Ecology**	**L**	**T**		**P**	
3. Course Code	**13160317**	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even ()**	**Odd (✔)**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

Environmental Ecology deals in the studies of the interactions among organisms and their environment. Objects of study include interactions of organisms with each other and with abiotic components of their environment. It is an interdisciplinary field that deals with both subjects of biology and earth science, however, is separate from the study of the environment, natural history and environmental science. It is environmental science that focused on the interactions between the physical, biological and chemical

environment components that include their effects on different types of organisms. It is the study of distributions, abundance, and relations of organisms as well as the interactions with the environment.

9. Learning objectives:

The main aim is to establish Ecology's credibility in high environmental, ethical and quality standards of goods and services.

Access the market opportunity presented by the 'greenmarket'. Raise consumer awareness and concern for environmental issues, and encourage their support for ecological values in consumer practices. Also to develop a fair and equitable means to link economic and environmental values, through the development of mutually beneficial relationships with all the segments of the community.

10. Course Outcomes (COs):

At the end of the course, the student will be able to

Develop legal and economic structures, which are able to provide reasonable return on investment, financial, or personal effort, dividends, wages and so forth.

Develop ecologically sustainable production and industry through developing the potential of all fibers.

Develop environmentally and socially friendly alternatives to many of the deleterious practices, processes and products currently in use.

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Concepts of Ecology**
Fundamentals of ecology, Natural ecosystem sand their food chains, food webs, bioenergetics, biochemical cycles and ecological succession.		
Unit - 2	**Number of lectures**	**Title of the unit: Biodiversity**
Biological diversity and its importance, reduction in biological diversity by human activities, classes and general effects of physical and Biological interaction with pollutants, lethal and sub-lethal effects.		
Unit - 3	**Number of lectures**	**Title of the unit: Ecosystem Ecology**
Ecosystems responses to deoxygenation nutrient enrichment, pesticides, hydrocarbons, metal and salts, thermal pollution, suspended solids and silt.		
Unit - 4	**Number of lectures**	**Title of the unit: Community Ecology**
Principles of population and community ecology–concepts of systems and models–building and analysis		

of models–environmental systems, structures and interaction between coastal aeolian, glacial, fluvial, weathering, soil and detrital systems		
Unit - 5	**Number of lectures**	**Title of the unit: Integration Ecological Principles**
Integration of classical, agro- and restoration ecological principles and methods, Bio monitoring and its role in the evaluation of aquatic ecosystem, rehabilitation of ecosystem through ecological engineering principles.		
12. Books Recommended (1 Books+ 2 References)		
1.Odum. E. P, "Fundamentals of ecology", W.B. Sanders, Philadelphia, 2002 2. White. I.D., Motters head. D.N., Harrison. S.J, "Environmental Systems – an introductory text", Chapmanandahll ,London,1998. 3. Colinvaux. P.," Introduction to Ecology", John Wiley & sons,Newyork,1973.		

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Concepts of Ecology	1
2	Biodiversity	2
3	Ecosystem Ecology	2
4	Community Ecology	2
5	Integration Ecological Principles	3

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Environmental Economics, Legislation and Management**	**L**	**T**		**P**	
3. Course Code	**13160322**	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even ()**	**Odd (✔)**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						

Lectures	Tutorials	Practical

8. Brief Syllabus

Environmental economics is a sub-field of economics that is concerned with environmental issues. Particular issues include the costs and benefits of alternative environmental policies to deal with air pollution, water quality, toxic substances, solid waste, and global warming. Students in Environmental Economics and Policy study environmental and resource management issues at the local, state, national, and international levels. Course concentrations include law, policy, management, administration, quantitative methods, and sociology, as well as economics. This field of economics helps users design appropriate environmental policies and analyze the effects and merits of existing or proposed policies

9. Learning objectives:

To make the student investigating the causes, consequences and possible solutions to problems associated with degradation of environmental resources and analyses the potential non-sustainability of certain types of economic activities using economic analysis as a tool.

10. Course Outcomes (COs):

At the end of the course, the student will be able to

The economic significance and the economic causes of environmental degradation, including loss of diversity

6. The extent to which market-based mechanisms might provide a solution to the environmental degradation problem in the absence of overt intervention
7. The economic implications of alternative 'intervention' approaches to pollution management, including the use of charges, subsidies and market permits.
8. Alternative methods for valuing environmental resources and environmental damage
9. The economic consequences of policy instrument for biodiversity conservation

11. Unit wise detailed content

Unit-1	Number of lectures	Title of the unit: Introduction to Sustainable Development

Introduction to sustainable development -Economy-Environment inter-linkages -Meaning of sustainable development- Limits to growth and the environmental Kuznets curve -The sustainability debate- Issues of energy and the economics of energy – Non-renewable energy, scarcity, optimal resources, backstop technology, property research, externalities, and the conversion of uncertainty

Unit - 2	Number of lectures	Title of the unit: Economic Significance

Economic significance and causes of environmental degradation - The concepts of policy failure, externality and market failure - Economic analysis of environmental degradation – Equi. marginal principle.		
Unit - 3	**Number of lectures**	**Title of the unit: Economics of Pollution**
Economics of Pollution - Economics of optimal pollution, regulation, monitoring and enforcement - Managing pollution using existing markets: Bargaining solutions - Managing pollution through market intervention: Taxes, subsidies and permits.		
Unit - 4	**Number of lectures**	**Title of the unit: Economic Value of Environmental Resources**
Economic value of environmental resources and environmental damage-Concept of Total Economic Value-Alternative approaches to valuation-Cost benefit analysis and discounting		
Unit - 5	**Number of lectures**	**Title of the unit: Economics of bio-diversity Conservation**
Economics of biodiversity conservation - Valuing individual species and diversity of species - Policy responses at national and international levels		

12. Books Recommended (2 Books+ 4 References)

1. R. K. Turner, D. W. Pearce and I. Bateman (1994), Environmental Economics: An Elementary Introduction, Harvester Wheat sheaft, London.
2. D. W. Pearce and R. K. Turner (1990), Economics of Natural Resources and the Environment, Harvester Wheatsheaf, London.3. Benefield L.D. and Randall, C.W. (1980). Biological process design for wastewater treatment. Prentice-Hall. N.J.
3. D. W. Pearce, A. Markandya and E. B. Barbier (1989), Blue print for a Green Economy, Earthscan, London.
4. Michael S. Common and Michael Stuart (1996), Environmental and Resource Economics : An Introduction, 2nd Edition, Harlow: Longman.
5. Roger Perman, Michael Common, Yue Ma and James Mc Gilvray (2003),Natural Resource and Environmental Economics,3rd Edition, Pearson Education.
6. N. Hanley, J. Shogren and B. White (2001), An Introduction to Environmental Economics, Oxford University Press.

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Introduction to Sustainable Development	1
2	Economic Significance	2

3	Economics of Pollution	4
4	Economic Value of Environmental Resources	3
5	Economics of bio-diversity Conservation	5

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Eco-hydrology & Pollute Transport**	**L**	**T**		**P**	
3. Course Code	**13160320**	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even ()**	**Odd (✔)**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

This course provides insight into the methods involved in the transport of pollutes from source to different destination. This includes the channels flow system, Transport processes, diffusion phenomena etc.

9. Learning objectives:

To expose the student to various methodologies used in Eco-hydrology

To teach various methods adopted in pollute transport.

10. Course Outcomes (COs):

At the end of the course, the student will be able to

10. Formulate momentum, energy and mass transport models.
11. Solve diffusion-dispersion equations.
12. Apply basic flow equations for steady and unsteady flows in open channels.
13. Derive and solve basic equations of flow through porous medium.
14. Formulate forecasting models for operation of hydrologic systems.

11. Unit wise detailed content

Unit-1	Number of lectures	Title of the unit: Introduction
Critical flow, its properties and application; location of critical flow and its computation, Basic concepts of open channel flows, conservation laws, continuity equation, momentum equation.		
Unit - 2	**Number of lectures**	**Title of the unit: Eco-phenomenon**
Uniform flow, flow resistance, equations of flow resistance, computation of normal depth, Gradually varied flow, governing equations classification of water surface profiles		
Unit - 3	**Number of lectures**	**Title of the unit: Transport processes**
Transport processes, diffusion phenomena, Fick's Ist and IInd Laws of diffusion, Advection diffusion equation, Turbulent diffusion and dispersion mixing in rivers		
Unit - 4	**Number of lectures**	**Title of the unit: Flow Basics**
Porous medium flow, Contaminant transport, Saltwater intrusion into aquifers, Non aqueous phase liquid (NAPL) in groundwater, Rapidly varied flow, channel transition, supercritical flow, Hydraulic Jump		
Unit - 5	**Number of lectures**	**Title of the unit: Hydraulic Processes**
Hydrologic cycle and its interaction with human activity, Hydrologic processes, Hydrologic analysis, Hydrologic statistics.		
12. Books Recommended (2 Books)		
1. Kundu and Cohen, Fluid Mechanics, Academic Press, 2012 2. Cussler, E. L, Diffusion: Mass transfer in fluid systems, 3rd Ed., Cambridge University Press, 2007.		

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Introduction	4
2	Eco-phenomenon	1
3	Transport processes	2
4	Flow Basics	3
5	Hydraulic Processes	5

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Environmental Geotechnology**	**L**	**T**		**P**	
3. Course Code	**13160234**	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even ()**	**Odd (✔)**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures =		**Tutorials =**	**Practical =**			

8. Brief Syllabus

Environmental Geotechnics aims to disseminate knowledge and provides a fresh perspective regarding the basic concepts, theory, techniques and field applicability of innovative testing and analysis methodologies and engineering practices in geoenvironmental engineering.

9. Learning objectives:

This course mainly aims to provide the students with exposure to the Geotechnical nature of Environmental problems. Other secondary aims are to

1. Impart knowledge in the selection of sites for waste disposal using current methodologies.
2. Understand transport phenomena in saturated and partially saturated porous mediaof the contaminant.

Obtain knowledge on ground modification techniques in waste remedial measures for contaminated zones.

10. Course Outcomes (COs):

By the end of the course the student will have knowledge of the following topics:

1. To show the application of principles of Geotechnical engineering to design of waste disposal facilities.
2. To familiarize the use of different linear materials for protecting the ground and groundwater from leachates.
3. To expose the student to various ways of soil contamination and their effect on soil properties.
4. Also to familiarize him with methods of redemption of soil contamination.

11. Unit wise detailed content

Unit-1	**Number of lectures =**	**Title of the unit: Introduction to Environmental Geotechniques**

Environmental cycles and their interaction, Soil water environment interaction relating to geotechnical problems, Effect of population on soil, water behaviour, source, production and classification of wastes-environmental considerations in India.

Unit - 2	Number of lectures =	Title of the unit: Selection of Sites
Criteria for selection of sites for wastes disposal current methodologies for waster disposal, Subsurface disposal techniques, Passive contaminantSystems,Leachatecontamination,application of geomembranes and other techniques in solid and liquid waste disposal, Rapid or flexible membrane iners.		
Unit - 3	**Number of lectures =**	**Title of the unit: Transport Phenomena**
Transport phenomena in saturated and partially aturated porous media – contaminant migration and contaminant hydrology, Hydrological design for groundwater pollution control, Ground water pollution downstream of landfills-bearing capacity of compacted fills, foundation for wastefill ground–pollution of aquifers by mining and liquid wastes – protection of aquifers		
Unit - 4	**Number of lectures =**	**Title of the unit: Remediation of Hazardous Waste**
Hazardous waste control and storage system–stabilization/solidification of waste, Monitoring and performance of waste facilities–Environmentally safe disposal of solid and Dynamic response of soil under environmental stress, case studies.		
Unit - 5	**Number of lectures =**	**Title of the unit: Ground Modification Techniques**
Ground modification techniques in waste remedial measures for contaminated grounds, remediation technology, Bio-remediation		

12. Books Recommended (3 Text Books + 2-3 Reference Books)

i) Wentz, C.A.,"Hazardous Waste Management", McGraw Hill, Singapore,1989

ii) Daniel,D.E., "Geotechnicalpracticeforwaste disposal",ChapmanandHall,London,1993

iii) ProceedingsloftheInternationalsymposiumofEnvironmentalGeotechnology(Vol.IandII),Envo, PublishingCompany, 1986and 1989

iv) Ott,W.R., "Environmental Indices", Theoryand Practice, Ann,Arbor, 1978.

v) Friend, J.J., "GroundWater Pollution", Elsevier, 1975.

vi) ASTMSpecialTechnicalPublication 874,hydraulic Barriers in Soil and Rock,1985

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Introduction to Environmental Geotechniques	1
2	Selection of Sites	3

3	Transport Phenomena	2
4	Remediation of Hazardous Waste	3
5	Ground Modification Techniques	4

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Emerging Trends in Waste Treatment**	**L**	**T**		**P**	
3. Course Code	**13160319**	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even ()**	**Odd (✔)**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

This deals in the latest techniques involved in the treatment of hazardous waste. Also, deals in the disposal ways of waste. Waste Characterization and Source Reduction, Storage, Collection and Transport of Wastes are the part of it to gain insight the waste treatment.

9. Learning objectives:

To impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipment's.

10. Course Outcomes (COs):

At the end of the course, the student will be able to

15. Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation.
16. Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste.
17. Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges.

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Sources, Classification and Regulatory Framework**
Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management –- Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes , plastics and fly ash – Elements of integrated waste management and roles of stakeholders - Financing and Public Private Participation for waste management.		
Unit - 2	**Number of lectures**	**Title of the unit: Waste Characterization and Source Reduction**
Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer responsibility - Recycling and reuse		
Unit - 3	**Number of lectures**	**Title of the unit: Storage, Collection and Transport Of Wastes**
Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport		
Unit - 4	**Number of lectures**	**Title of the unit: Waste Processing Technologies**
Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes - Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment		
Unit - 5	**Number of lectures**	**Title of the unit: Waste Disposal**
Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation		

12. Books Recommended (5 References)

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.
2. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York, 2001.

3. CPHEEO, “Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2000.
4. Vesilind P.A., Worrell W and Reinhart, "Solid waste Engineering", Thomson Learning Inc., Singapore, 2002. 5. Paul T Williams, "Waste Treatment and Disposal", Wiley, 2005

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Sources, Classification and Regulatory Framework	1
2	Waste Characterization and Source Reduction	2
3	Storage, Collection and Transport Of Wastes	3
4	Waste Processing Technologies	2
5	Waste Disposal	1

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Fate and Transport of Contaminants in Natural Systems**	**L**	**T**		**P**	
3. Course Code	**13160321**	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even ()**	**Odd (✔)**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

This course deals with the behavior of flow and transport in natural systems such as rivers/lakes/groundwater systems. Water quality in these systems under go changes due to various reasons such as advection, dispersion, chemical and biological reactions. Behavior of all these processes will be dealt with along with their application on several types of problems using modeling approaches using

numerical tools and also analytical tools for simple problems. These types of modeling approaches are required to understand the flow and transport of contaminants.

9. Learning objectives:

1. To learn about physico-chemical and bio transformations of pollutants in natural systems.
2. To study various models of predicting contaminant/ pollutant transport.

10. Course Outcomes (COs):

At the end of the course, the student will be able to

1. Understanding of the natural physico-chemical and bio transformations of pollutants.
2. Knowledge of various models of predicting contaminant/ pollutant transport.

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Introduction**
Objectives of the course, Occurrence and significance, Types of contaminants. Contaminants and their harmful effects, Fate of Contaminants, Transformation of Contaminants, Transport of Contaminants.		
Unit - 2	**Number of lectures**	**Title of the unit: Modelling of Contaminant Transformations**
Volatilization, Sorption / desorption, Chemical Transformations, Photochemical Transformations, Biological Transformations.		
Unit - 3	**Number of lectures**	**Title of the unit: Basics of Contaminant Transport in Natural Systems**
Advection, Molecular Diffusion, Dispersion, Concepts of Scale in Natural Systems, Brief Review of Mass. Momentum and Energy Balance, Governing Equations for Contaminant Fate and Transport.		
Unit - 4	**Number of lectures**	**Title of the unit: Contaminant Transport in Surface Flows**
Rivers, Lakes, Channels, Large Lakes, Sediments, Estuaries, Wetlands.		
Unit - 5	**Number of lectures**	**Title of the unit: Some Special Models**
River Water Quality Modelling, Lake Water Quality Modelling, Groundwater Quality Modelling, Pipe network modelling.		

12. Books Recommended (1 Books+ 6 References)

1. Groundwater, Freeze, R.A. and Cherry. J. A., Prentice hall.
2. Steven C Chapra, Surface Water Quality Modeling, McGraw Hill International Edition 1997.

3. Drinking Water Distribution Systems, The National Academies Press, Washington DC.
4. Rossman, L A, EPANET2, Users Manual, Risk Reduction Engineering laboratory, USEPA, Cincinnati, 2000.
5. Freez A R and Cherry J A, Groundwater, Prentice Hall, 1979.
6. Marc B Parlange and Jan W Hopmans, Vadosezone Hydrology, Oxford University Press, 1999.
7. John S. Selker, C. Kent Keller and James T. Mccord, Vadose Zone Processes, Lewis Publishers, 1999.

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Introduction	1
2	Modelling of Contaminant Transformations	2
3	Basics of Contaminant Transport in Natural Systems	2
4	Contaminant Transport in Surface Flows	2
5	Some Special Models	1

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Hazardous Waste Management and Risk Assessment**	**L**	**T**		**P**	
3. Course Code	**13160231**	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✔)**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even (✔)**	**Odd ()**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

Applications of risk assessment techniques to hazardous waste management are briefly discussed in terms of selecting appropriate waste management technologies, assessing operating sites, setting

priorities for clean up of problem sites, determining the appropriate level of clean up and planning new facilities.

9. Learning objectives:

1. To gain insight into collection, transfer and transport of hazardous waste
2. Understand the design and operation of hazardous waste landfill
3. Understand the design and operation of resource recovery methods
4. Understand the design and operation of waste to energy facility

10. Course Outcomes (COs):

At the end of the course, the student will be able to

1. Understand hazardous waste and its composition
2. Understand various processes involved in hazardous waste collection, segregation and transportation.
3. Understand the regulatory requirements pertaining to hazardous waste

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Hazardous Waste- Introduction, Sources & Impacts: Legal Aspects & Characterization**
Definition of hazardous,waste generation-Study of the source, generation rates, impacts on human health, bios and environmental –major legislation, monitoring responsibilities, sources and types of hazardous waste, international and national Legal aspects, health issues involved.		
Unit - 2	**Number of lectures**	**Title of the unit: Characterization of Hazardous Waste and Sampling Aspects**
Hazardous waste: sampling and characterization — storage and handling of hazardous waste – collection systems, analysis of collection system- Challenges and emerging concepts Waste– alternative techniques. Need for transfer operation, transport means and methods and design requirements		
Unit - 3	**Number of lectures**	**Title of the unit: Treatment and Resources Recovery From Hazardous Waste**
Unit operationsfor separationandprocessing, treatment methods –unit operations, precious resources recovery techniques, Energy and health aspects,methodsformaterialsrecoveryandtreatments techniques		
Unit - 4	**Number of lectures**	**Title of the unit: Disposal of Solid Wastes**
Disposal aspects, Selections of disposal methodologies, types of disposal techniques- deep well injections. Landfills: Design and operation including: ite selection, Geoenvironmental investigations,engineered sites, liners and covers and treatment, Requirementsandtechnicalsolution,designatedlandfillremediation–Integrated waste management facilities. Economics and future risks involved		

Unit - 5	Number of lectures	Title of the unit: Hazardous Waste Management-Risk Assessment
Minimization of Hazardous Waste, Regulatory requirements for identification risks involved, Simple methods for impact identification –matrices, networks and checklists, Risk analysis, Life cycle analysis, Risk management, Case studies various industrial and development projects.		
12. Brief Description of self learning / E-learning component		
13. Books Recommended (3 Text Books + 2-3 Reference Books)		
i) Evan. K. Paleologos and IanLerche,Environmental Risk Analysis, McGraw Hill Inc., 2001		
ii) Bartell,S.,Kolluru, R., Pitblado, R., and Stricoff,S., RiskAssessment and Management Handbook ForEnvironmental, Health and Safety Professionals. McGraw Hill, 1996.ISBN: 0070359873		
iii) Lerch,I.AndPaleologos, E., Environmental RiskAnalysis. McGraw Hill, 2001. ISBN:0071372660		
iv) JudithPetts(1999),Hand book ofEnvironmentalImpactAssessment, Vol.I&II, Blackwell Science		
v) Hazardous Waste Management, Michael LaGrega, Phillip L. Buckingham, Jeffrey C. Evans, and The Environmental Resources Management Group. McGraw-Hill Book Company (1994)		

14. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Hazardous Waste- Introduction, Sources & Impacts: Legal Aspects & Characterization	1, 3
2	Characterization of Hazardous Waste and Sampling Aspects	2
3	Treatment and Resources Recovery From Hazardous Waste	2
4	Disposal of Solid Wastes	3
5	Hazardous Waste Management-Risk Assessment	3

1. Name of the Department: Civil Engineering Department				
2. Course Name	**Mathematical Modeling in**	**L**	**T**	**P**

	Environmental Engineering					
3. Course Code	**13160238**	**2**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even ()**	**Odd (✔)**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures =		**Tutorials =**	**Practical =**			

8. Brief Syllabus

Basic modeling approaches and techniques for the simulation of environmental engineering systems. Model development, system conceptualization and analysis, mathematical representation, solution and simulation, as well as model calibration and verification, are discussed. Problems such as simulation of biochemical reactors and behavior of toxic chemicals in groundwater are drawn from the literature. Ongoing research projects are discussed

9. Learning objectives:

To enable a comprehensive understanding of:

1. The Scope and extent of mathematical modeling
2. The basic tenets of mathematical modelling and its application to Environmental Processes
3. Mathematical modelling techniques

10. Course Outcomes (COs):

Upon completion of the course, the students shall be able to:

1. Acquire a basic understanding of how mathematical models can be used to solve environmental problems
2. Set up material balance models for conservative and non-conservative systems
3. Formulate and solve Boundary value problems 4. Formulate, Set-up, and solve complex Environmental Problems

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Fundamental of Mathematical modeling**
Terminology - Formulation and analysis – Steps in developing – computational methods		
Unit - 2	**Number of lectures**	**Title of the unit: Environmental process and systems**

Phase equilibrium – transport process – reactive and non reactive process – reactors – homogeneous and heterogeneous reactors		
Unit - 3	**Number of lectures**	**Title of the unit: Modeling of homogeneous reactors**
Classification – mixed batch reactors – sequencing batch reactor – mixed flow reactors – plug flow reactors		
Unit - 4	**Number of lectures**	**Title of the unit: Modeling of reactors**
Fluid-solid systems – slurry reactor – fluid- fluid system – columns – sparged tanks		
Unit - 5	**Number of lectures**	**Title of the unit: Subsurface environmental system**
Fundamental of modeling soil systems – flow of water through saturated zone – groundwater flow nets – flow of contaminants through saturated and unsaturated zone. Introduction to MODFLOW and ANSYS models		
12. Books Recommended (3 Text Books + 2-3 Reference Books)		
i John Wainwright and Mark Mulligan, (2013), "Environmental Modelling Finding Simplicity in Complexity", 2 nd edition, John Wiley and sons Ltd, USA.		
ii) Steven C.Chapra, (2009), Surface Water Quality Modeling, The McGraw-Hill Companies,Inc., New York.		
iii) Deaton and Wine Brake, (2002), "Dynamic Modeling of Environmental Systems", Wiley & sons.		

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Fundamental of Mathematical modeling	1
2	Environmental process and systems	2
3	Modeling of homogeneous reactors	2
4	Modeling of reactors	3
5	Subsurface environmental system	1`

1. Name of the Department: Civil Engineering Department

2. Course Name	**Remote Sensing & GIS Applications**	**L**	**T**		**P**	
3. Course Code	**13160235**	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✔)**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even (✔)**	**Odd ()**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials**	**Practical**			

8. Brief Syllabus

Remote sensing is the science and art of acquiring information (spectral, spatial, and temporal) about material objects, area, or phenomenon, without coming into physical contact with the objects, or phenomenon under investigation. Remote Sensing means sensing of the earth's surface from space by making use of the properties of electromagnetic wave emitted, reflected, or diffracted by the sensed objects for the purpose of improving natural resource management land and the protection of the environment. Without direct contact, some means of transferring information through space must be utilized. In remote sensing information transfer is accomplished by use of electromagnetic radiation (EMR).

9. Learning objectives:

This subject explains the basic concepts of Remote Sensing and Geographic Information Systems with its applications

10. Course Outcomes (COs):

By the end of the course the student will have knowledge of the following topics:

1. the basic remote sensing concepts and its characteristics
2. GIS and its requirements
3. data management with GIS
4. carry out analysis and interpretation of GIS results

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Basic concepts of Remote Sensing**

Basic concepts of Remote Sensing – Introduction to remote sensing – Electromagnetic radiation - Characteristic of real remote sensing systems–Platforms–Satellite-Indian remote sensing satellite-Sensors		
Unit - 2	**Number of lectures**	**Title of the unit: Image processing**
Image processing - Elements of image interpretation –Concepts of digital image processing		
Unit - 3	**Number of lectures**	**Title of the unit: Basic concepts of GIS**
Basic concepts of GIS – Introduction to GIS-History of development of GIS- Elements of GIS-Computer hardware and software		
Unit - 4	**Number of lectures**	**Title of the unit: Map Overlay**
Map overlay-Vector and raster data model-Mapping concept-Data storage and data base management-Development of map overlay – Overlay operation		
Unit - 5	**Number of lectures**	**Title of the unit: Applications of GIS and Remote Sensing**
Applications of GIS and remote sensing in resource management		
12. Books Recommended (3 Text Books + 2-3 Reference Books)		
i) A.N. Patel and Surendra Singh (1999), Remote Sensing Principles and Applications, Scientific Publisher, Jodpur		
ii) P.A. Burrough (2000), Principle of Geographical Information Systems for Land Resources Assessment, Clarendon Press ,Oxford.		
iii) T.M.LillesandandR.W.Kiefer(1999),RemoteSensingandImageInterpretation,JohnWiley& Sons, New York		
iv) KeithC.Clarke,BradO.Parks,MichaelP.Crane(2005),GeographicInformationSystemsand Environmental Modeling ,Prentice-Hall of India.		

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Basic concepts of Remote Sensing	2
2	Image processing	1

3	Basic concepts of GIS	3
4	Map Overlay	4
5	Applications of GIS and Remote Sensing	3

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Risk Assessment & Disaster Management**	**L**	**T**		**P**	
3. Course Code	**13160237**	**2**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even ()**	**Odd (✔)**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		Tutorials	Practical			

8. Brief Syllabus

Concepts of Hazard, Vulnerability, Risks, Natural Disasters (earthquake, Cyclone, Floods, Volcanoes), and Man Made Disaster (Armed conflicts and civil strip, Technological disasters, Human Settlement, Slow Disasters (famine, draught, epidemics) and Rapid Onset Disasters(Air Crash, tidal waves, Tsunami) Risks, Difference between Accidents and Disasters, Simple and Complex Disasters, Refugee problems, Political, Social, Economic impacts of Disasters, Gender and Social issues during disasters, principles of psychosocial issues and recovery during emergency situations, Equity issues in disasters, Relationship between Disasters and Development and vulnerabilities, different stake holders in Disaster Relief. Refugee operations during disasters, Human Resettlement and Rehabilitation issues during and after disasters, Inter-sectoral coordination during disasters, Models in Disasters.

9. Learning objectives:

1. The overall aim of this is to provide broad understanding about the basic concepts of Disaster Management
2. To Understand basic concepts in Disaster Management
3. To Understand Definitions and Terminologies used in Disaster Management
4. To Understand Types and Categories of Disasters
5. To Understand the Challenges posed by Disasters

6. To understand Impacts of Disasters

10. Course Outcomes (COs):

1. Application of Disaster Concepts to Management
2. Analyze Relationship between Development and Disasters.
3. 3. Ability to Categories Disasters

11. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: Approaches To Disaster Risk Reduction**

Disaster Risk Reduction Strategies, Disaster Cycle, Phases of Disaster, Preparedness Plans, Action Plans and Procedures, Early warning Systems Models in disaster preparedness, Components of Disaster Relief- (Water, food, sanitation, shelter, Health and Waste Management), Community based DRR, Structural non structural measures in DRR, Factors affecting Vulnerabilities, , Mainstreaming disaster risk reduction in development, Undertaking risk and vulnerability assessments, Policies for Disaster Preparedness Programs, Preparedness Planning, Roles and Responsibilities, Public Awareness and Warnings, Conducting a participatory capacity and vulnerability analysis, , Sustainable Management, Survey of Activities Before Disasters Strike, Survey of Activities During Disasters, DRR Master Planning for the Future, Capacity Building, Sphere Standards. Rehabilitation measures and long term reconstruction. Psychosocial care provision during the different phases of disaster.

Unit - 2	**Number of lectures**	**Title of the unit: Prinicples Of Disaster Medical Management**

Introduction to disaster medicine, Various definitions in disaster medicine, Disaster life cycle, Disaster planning, Disaster preparation, Disaster recovery in relation to disaster medical management, Medical surge, Surge capacity, Medical triage, 275 National Assessing the nature of hazardous material - Types of injuries caused, Self protection contaminated area and decontaminated area – Pre hospital medical management of victims – Triaging medical & psychosocial identification of hospitals and other medical facilities to offer efficient disastrous medical service – Safe patient transportation –Identification of valuable groups.

Unit - 3	**Number of lectures**	**Title of the unit: Public Health Response And International Cooperation**

Principles of Disaster Epidemiology, Rapid Health Assessment, Rapid Health needs assessment. Outbreak Investigation Environment health hygiene and sanitation issues during disasters, Preventive and prophylactic measures including Measles immunization, ORS, water, supply, chemoprophylaxis, food fortification, food supplements, MISP-Reproductive Health Care, International cooperation in funding on public health during disaster.

Unit - 4	**Number of lectures**	**Title of the unit: Disaster Risk Management In India**

Hazard and Vulnerability Profile India,, Disaster Management Indian scenario, India's vulnerability profile, Disaster Management Act 2005 and Policy guidelines, National Institute of Disaster Management, , National Disaster Response Force (NDRF)National Disaster Management Authority, States Disaster

Management Authority, District Disaster Management Authority Cases Studies : Bhopal Gas Disaster, Gujarat Earth Quake, Orissa Super-cyclone, south India Tsunami, Bihar floods, PlagueSurat, Landslide in North East, Heat waves of AP& Orissa, 278 Cold waves in UP
12. Books Recommended (3 Text Books + 2-3 Reference Books)
iDisaster Management Guidelines. GOI-UNDP Disaster Risk Reduction Programme (2009-2012
ii) Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003
iii) Guerisse P. 2005 Basic Principles of Disaster Medical Management. Act Anaesth. Belg;56:395-401

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Approaches To Disaster Risk Reduction	1
2	Prinicples Of Disaster Medical Management	2,3
3	Public Health Response And International Cooperation	4
4	Disaster Risk Management In India	4

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Solid Waste Management**	**L**	**T**		**P**	
3. Course Code	**13160230**	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✔)**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even (✔)**	**Odd ()**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures =		**Tutorials =**	**Practical =**			

8. Brief Syllabus

Solid-waste management, the collecting, treating, and disposing of solid material that is discarded because it has served its purpose or is no longer useful. Improper disposal of municipal solid waste can create unsanitary conditions, and these conditions in turn can lead to pollution of the environment and to outbreaks of vector-borne disease—that is, diseases spread by rodents and insects. The tasks of solid-waste management present complex technical challenges. They also pose a wide variety of administrative, economic, and social problems that must be managed and solved.

9. Learning objectives:

1. To gain insight into collection, transfer and transport of municipal solid waste
2. Understand the design and operation of municipal solid waste landfill
3. Understand the design and operation of resource recovery facility
4. Understand the design and operation of waste to energy facility

10. Course Outcomes (COs):

At the end of the course, the student will be able to

1. Understand solid waste and its composition
2. Understand various processes involved in solid waste collection, segregation and transportation.
3. Design solid waste disposal facility

11. Unit wise detailed content

Unit-1	**Number of lectures =**	**Title of the unit: Municipal Solid Waste Management**

Legal and Organizational foundation: Definition of solidwaste–waste generation–major legislation, monitoring responsibilities, sources and types of solidwaste – sampling and characterization – Determination of composition of MSW–storage and handling of solid waste – Future changes in waste composition.

Unit - 2	Number of lectures =	Title of the unit: Collection and Transportation of Solid Waste
Waste collection systems, analysis of collection system–alternative techniques for collection system. Need for transfer operation, transport means and methods, transfer station types and design requirements.		
Unit - 3	**Number of lectures =**	**Title of the unit: Process of Solid Waste and Energy recovery**
Unit operations for separation and processing, Materials Recovery facilities, Waste transformation through combustion and aerobic composting, anaerobic methods for materials recovery and treatment – Energy recovery – Incinerators		
Unit - 4	**Number of lectures =**	**Title of the unit: Disposal of Solid Wastes**
Land farming, deep well injections. Landfills: Design and operation including: site selection, Geo-environmentalinvestigations,engineeredsites,linersandcovers,leachatecontrolandtreatment,gas recovery and control, including utilization of recovered gas (energy), and landfill monitoring and reclamation,,Requirementsandtechnicalsolution,designatedwastelandfillremediation–Integrated waste management facilities. TCLP tests and leachate studies. Economics of the on-site v/s offsite waste management options. Natural attenuation process and its mechanisms.		
Unit - 5	**Number of lectures**	**Title of the unit: Household Hazardous Waste Management**
Design practices of solid wastes. Definition and identification of hazardous wastes-sources and characteristics – hazardous wastes in Municipal Waste – Hazardous waster regulations – minimization of Hazardous Waste-compatibility, handling and storage of hazardous waste-collection and transport. Regulatory requirements for identification, characterization and disposal of hazardous, nonhazardous and domestic wastes		

12. Books Recommended (3 Text Books + 2-3 Reference Books)

i) HandbookofSolidWasteManagementbyFrankKreith,GeorgeTchobanoglous,McGrawHill Publication

ii) Bagchi, A., Design,Construction, andMonitoring ofLandfills,(2ndEd). WileyInterscience, 1994.ISBN: 0-471-30681-9.

iii) Sharma,H.D.,andLewis,S.P.,WasteContainmentSystems,WasteStabilization,andLandfills: DesignandEvaluation.Wiley Interscience,1994.ISBN: 0471575364.

iv) GeorgeTechobanoglous et al," IntegratedSolid WasteManagement ", McGraw-HillPublication, 1993.

v) CharlesA.Wentz; "HazardousWaste Management ", McGraw-Hill Publication, 1995

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Municipal Solid Waste Management	1
2	Collection and Transportation of Solid Waste	3
3	Process of Solid Waste and Energy recovery	2
4	Disposal of Solid Wastes	1,2
5	Household Hazardous Waste Management	2

1. Name of the Department: Civil Engineering Department						
2. Course Name	**Urban EnvironmentalQualityManagement**	**L**	**T**		**P**	
3. Course Code	**13160233**	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✔)**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	**Even (✔)**	**Odd ()**	**Either Sem (✔)**	**Every Sem ()**
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures		**Tutorials =**	**Practical =**			

8. Brief Syllabus

Solid-waste management, the collecting, treating, and disposing of solid material that is discarded because it has served its purpose or is no longer useful. Improper disposal of municipal solid waste can create unsanitary conditions, and these conditions in turn can lead to pollution of the environment and to outbreaks of vector-borne disease—that is, diseases spread by rodents and insects. The tasks of solid-waste management present complex technical challenges. They also pose a wide variety of administrative, economic, and social problems that must be managed and solved.

8. **Learning objectives:**

Understand the design and operation of municipal solid waste landfill
Understand the design and operation of resource recovery facility
Understand the design and operation of waste to energy facility

9. Course Outcomes (COs):

By the end of the course the student will have knowledge of the following topics

1. Have knowledge of the nature and effects of environmental pollutants and energies
2. Have a detailed knowledge of the techniques involved in the efficient management of the environment
3. Have an awareness of the need for integrated pollution control
4. Have the skills to plan and to execute monitoring programmes for the detection and control of environmental pollutants, including water, air and noise terrestrial pollution

10. Unit wise detailed content

Unit-1	**Number of lectures =**	**Title of the unit: Urbanization & Pollution**

Consequences of urbanization, demand of resources by the public - Sources of Pollution to the urban environment: Status of pollution levels in major cities- Slum formation: Impact of slum on general quality of life on Urban elite – status of slum settlements in major cities.

Unit - 2	Number of lectures =	Title of the unit: Air & Noise Pollution in Urban Environment
Air Pollution Sources: Nature of air pollution in the Urban environment due to human activities of industrialization, effect of air pollution on Urban Environment. Air pollution Indices for Assessment of status of Urban air quality.-Sources of noise pollution in Urban areas, effect of noise pollution on Urban environment, status of noise pollution in major cities.		
Unit - 3	**Number of lectures =**	**Title of the unit: Water and Land pollution in Urban Environment**
Water Demands and Pollution in Urban areas: Nature of water pollutants and assimilative capacity of natural Urban aquatic systems. Urban water quality indices-Sources of land pollution in urban areas: Impact of urban soil pollution on quality of living system– prediction of soil pollution indices.		
Unit - 4	**Number of lectures =**	**Title of the unit: Management of Urban Environment Quality**
Land use planning– traffic management. Safe municipal water supply and planning of safe municipal water supply and drainage system–solid waste management including disposal–abatement of noise pollution – Provision of zones – regulation of settlements.		
Unit - 5	**Number of lectures**	**Title of the unit: Conservation and Disaster Management**
Natural Conservation: Planning of urbanization one cological basis,preservation nd development of green recovery areas.- Urban Disaster Management: Management of Industrial explosions, landslides, earthquakes, Floods and Management of epidemics		
11. Brief Description of self learning / E-learning component		
12. Books Recommended (3 Text Books + 2-3 Reference Books)		
vi) HandbookofSolidWasteManagementbyFrankKreith,GeorgeTchobanoglous,McGrawHill Publication		
vii) Bagchi, A., Design,Construction, andMonitoring ofLandfills,(2ndEd). WileyInterscience, 1994.ISBN: 0-471-30681-9.		
viii) Sharma,H.D.,andLewis,S.P.,WasteContainmentSystems,WasteStabilization,andLandfills: DesignandEvaluation.Wiley Interscience,1994.ISBN: 0471575364.		
ix) GeorgeTechobanoglous et al," IntegratedSolid WasteManagement ", McGraw-HillPublication, 1993.		
x) CharlesA.Wentz; "HazardousWaste Management ", McGraw-Hill Publication, 1995		

13. Tutorial / Extended Tutorial /presentation/Case study components

Sr. No.	Title	CO covered
1	Urbanization & Pollution	1
2	Air & Noise Pollution in Urban Environment	3
3	Water and Land pollution in Urban Environment	4
4	Management of Urban Environment Quality	1,2
5	Conservation and Disaster Management	2