INVERTIS
UNIVERSITY BAREILLY
Established by Govt. of U.P. u/s 2F of UGC Act, 1956 vide U.P. Act 22 of 2010.

Scheme of Instructions &

Syllabi

of

Bachelor of Technology

4th Year

(Civil Engineering)

(With effective from session 2021-22)

[Revised after the inclusion of Skill and Entrepreneurship courses effective from the session 2022-23]

(Arvind Kumar)
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Dean Engineering

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INVERTIS UNIVERSITY, BAREILLY

STUDY & EVALUATION SCHEME
B. Tech. Civil Engineering
(w.e.f. the academic session 2022-23)

YEAR IV, SEMESTER-VII

Sl. No.	Category	Course Code	Course title / Subject	Hours per week			Evaluation Scheme		Total	Credits
				L	T	P	CA	EE		
THEORY										
1	Professional Elective courses	BCE-051 to BCE-054	CE Elective V	3	0	0	25	50	75	3
2	Professional Elective courses	BCE-061 to BCE-064	CE Elective VI	3	0	0	25	50	75	3
3	Open Elective courses	BOE-011 to BOE-015	Open Elective II	3	0	0	25	50	75	3
PRACTICAL/DESIGN/DRAWING										
4	Project	BCE-751	Minor Project	0	0	12	50	100	150	6
5	Professional Core Courses	BCE-752	Industrial Training	0	0	2	25	-	25	1
Total				**9**	**0**	**14**	**150**	**250**	**400**	**16**

L-Lecture, **T**- Tutorial , **P**- Practical , **CA**- Continuous Assessment, , **EE** – End Semester Examination

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Sl. No.	Category	Course Code	Course title / Subject	Hours per week			Evaluation Scheme		Total	Credits
				L	T	P	CA	EE		
THEORY										
1	Professional Elective courses	BCE-071 to BCE-074	CE Elective VII	3	0	0	25	50	75	3
2	Professional Elective courses	BCE- 081 to BCE-082	CE Elective VIII	2	0	0	15	35	50	2
3	Open Elective courses	BOE-011 to BOE-015	Open Elective III	3	0	0	25	50	75	3
4	Open Elective courses	BOE-011 to BOE-015	Open Elective IV	2	0	0	15	35	50	2
PRACTICAL/DESIGN/DRAWING										
5	Project	BCE-851	Major Project	0	0	12	50	100	150	6
Total				**10**	**0**	**12**	**130**	**270**	**400**	**16**

L-Lecture, **T**- Tutorial , **P**- Practical , **CA** – Continuous Assessment**, EE** – End Semester Examination

CE ELECTIVE-V

BCE-051	Water Quality Engineering	3L:0T:0P	3 credits

Pre-requisite: No Pre-requisite.

Course Objectives:

CO1	To develop a basic understanding of water/wastewater qualities.
CO2	To develop a familiarity with contemporary issues on water/wastewater and natural water qualities.
CO3	To understand the principles of water chemistry to water/wastewater treatment.
CO4	To understand the function and working principles of treatment units for water/wastewater treatment.

Water Quality Engineering. Fundamental theory underlying the unit processes utilized in the treatment of water for domestic and industrial usage, and in the treatment of domestic and industrial waste waters.

Course Outcomes: After the completion of this course the students will be able to:

CO1	Apply knowledge of basic water chemistry to solve problems associated with water/wastewater treatment.
CO2	Provide solution to the contemporary issues on water/wastewater.
CO3	Determine the concentrations of impurities and accordingly decide the degree of treatment to be provided.
CO4	To design a treatment plant for water/wastewater treatment.

Reference books:

1. Peavy, Rowe and Tchobanoglous: Environmental Engineering

2. Metcalf and Eddy Inc.: Wastewater Engineering

3. Garg: Water Supply Engineering (Environmental Engineering Vol. – I)

4. Garg: Sewage Disposal and Air Pollution Engineering (Environmental Engineering Vol. – II

BCE-052	Surface Hydrology	3L:0T:0P	3 credits

Pre-requisite: No Pre-requisite.

Course Objectives:

CO1	To study occurrence movement and distribution of water in the environment.
CO2	To know the basic principles and movement of ground water and properties of ground water flow.
CO3	To know diverse methods of collecting the hydrological information, which is essential, to understand surface and ground water hydrology.
CO4	To understand the engineering applications of hydrology.

Surface Hydrology. Study of descriptive and quantitative hydrology dealing with the distribution, circulation, and storage of water on the earth's surface; discusses principles of hydrologic processes and presents methods of analysis and their applications to engineering and environmental problems.

Course Outcomes: After the completion of this course the students will be able to:

CO1	Provide a background in the theory of hydrological processes and their measurement.
CO2	Apply hydrologic mass balance and compute water storage in a basin.
CO3	Analyze the hydrological data and accordingly process data to get desired outcomes.
CO4	Use the learning's to solve environmental problems.

Reference Books:

1. K. C. Patra, Hydrology & Water Resources Engg., Narosa Publishing House, New Delhi, 2nd Edition.
2. K. Subramanya, Engineering Hydrology, Tata McGraw Hill, 2nd Edition.

BCE-053	Water Resources Field Methods	3L:0T:0P	3 credits

Pre-requisite: No Pre-requisite.

Course Objectives:

CO1	To learn the techniques involved in field measurement of water resources.
CO2	To develop field scale models for the analysis purpose.
CO3	To learn how the potential for extreme hydrologic events are analyzed and quantified
CO4	To learn statistical analysis used in solving the problems.

Water Resources Field Methods. Scientific principles of measurement technologies and protocols used for water-resources measurements and experimental design of field-scale water-resources and environmental studies. Planning field studies; instruments and protocols for surface-water, ground-water, and water-quality sampling; description of data quality. One-half-day laboratory field trips to stream flow monitoring stations and groundwater monitoring wells nearby.

Course Outcomes: After the completion of this course the students will be able to:

CO1	Apply numerical methods for solution of differential equations in Water Resources and Environmental Engineering
CO2	Apply finite difference schemes for solution of hydraulic and hydrologic models
CO3	Formulate finite element model for solution of flow through porous media
CO4	Perform statistical analysis of water resources and environmental engineering systems

BCE-054	Environmental Fluid Mechanics	3L:0T:0P	3 credits

Pre-requisite: No Pre-requisite.

Course Objectives:

CO1	To familiarize with the properties of fluids and the applications of fluid mechanics.
CO2	To understand the concept of fluid measurement, types of flows and dimensional analysis.
CO3	To analyze engineering problems involving fluids.
CO4	To formulate and analyze problems related to calculation of forces in fluid structure interaction.

Environmental Fluid Mechanics. Incompressible fluid mechanics with particular emphasis on topics in analysis and applications in civil engineering areas; primary topics include principles of continuity, momentum and energy, kinematics of flow and stream functions, potential flow, laminar motion, turbulence, and boundary-layer theory.

Course Outcomes: After the completion of this course the students will be able to:

CO1	Identify and obtain the values of fluid properties and relationship between them.
CO2	Understand the principles of continuity, momentum, and energy as applied to fluid motions.
CO3	Recognize these principles written in form of mathematical equations
CO4	Apply dimensional analysis to predict physical parameters that influence the flow in fluid mechanics.

Reference Books:

1. Bansal R K, "A text book of Fluid mechanics and Hydraulic Machines", 8th Edition, Laxmi Publications (P) Ltd. New Delhi (2002).
2. Dr. Jagdish Lal/ Fluid Mechanics & Machines Prentice Hall of India Private Limited, New Delhi (1996).

CE ELECTIVE-VI

BCE-061	Concrete Materials	3L:0T:0P	3 credits

Prerequisites: None

Course Objectives:

CO1	**To study the basic composition of concrete**
CO2	**To study the properties of cement and aggregate.**
CO3	**To study about the admixtures and its types, workability of concrete.**
CO4	To study about the concrete mix design, hardened concrete, special concrete.

Concrete Materials:- Examines the influence of constituent materials (cements, aggregates and admixtures) on the properties of fresh and hardened concrete; Recycled aggregates recovered from construction and demolition wastes; M-Sand; Light-weight aggregates; Use of Fly Ash in concrete; Fibre-reinforced concrete with various types of metallic and non-metallic fibres; various types of concrete such as Self Compacting Concrete, High Performance Concrete, etc.; mix design; handling and placement of concrete; Effect of revibration of concrete; behavior of concrete under various types of loading and environment; test methods. Laboratory practice is an integral part of the course.

Course Outcomes: After the completion of the course the student will be able to:

CO1	To know the basic properties of ingredients of concrete.
CO2	To know about the different tests of cement and aggregate.
CO3	To know the different type of concrete and mix design.
CO4	To know about the concreting techniques.

BCE-062	Structural Analysis-I	3L:0T:0P	3 credits

Prerequisites: Theory of Structures – I.

Course Objectives:

CO1	**To study the direct stiffness method**
CO2	**To study the analysis of plane trusses and frames**
CO3	**To study about the virtual work don principles**
CO4	To study about the finite elements method

Structural Analysis-I:- Direct stiffness method of structural analysis; fundamentals and algorithms; numerical analysis of plane trusses, grids and frames; virtual work and energy principles; introduction to the finite element method for plane stress and plane strain.

Course Outcomes: After the completion of the course the student will be able to:

CO1	Formulate Equilibrium and compatibility equations for structural members
CO2	Analyze plan trusses and grids
CO3	Analyze virtual work and energy principles
CO4	Analyze finite element method

Reference Books:

1. Vazirani & Ratwani et al," Analysis of Structures " , Khanna Publishers
2. S.S Bhavikatti,''Structural Analysis II'' Vikash publishing house

BCE-063	Structural Analysis-II	3L:0T:0P	3 credits

Prerequisites: Theory of Structures – II.

Course Objectives:

CO1	**To study the direct stiffness method**
CO2	**To study the analysis of plane trusses and frames**
CO3	**To study about the virtual work don principles**
CO4	To study about the finite elements method

Structural Analysis-II:- Analysis of building frames; Kani's, moment distribution and other methods and Approximate methods; Stiffness matrix method; Application to simple problems of beams and frames; Flexibility matrix method; Application to simple problems of beams and frames; Moving loads for determinate beams; Different load cases, Influence lines for forces for determinate beams; Influence lines for pin-jointed trusses; Influence lines for indeterminate beams using Muller Breslau principle. Influence lines for Arches and stiffening girders.

Course Outcomes: After the completion of the course the student will be able to:

CO1	The student will have the knowledge on advanced methods of analysis of structures like flexibity and stiffness method, kanis method, Moment distribution method, Slope and deflection method
CO2	Students are able to do the analysis of beam by using advance method of analysis
CO3	Students are able to do analysis of influence line for trusses
CO4	Students are able to analyze influence lines for arches and stiffening girders

Reference Books:

1. Advanced Structural Analysis by A. K. Jain, Nem Chand & Bros., Roorkee.

2. Structural Analysis by C. S. Reddy, Tata Mc Graw Hill Publishing Company Limited, New Delhi.

BCE-064	Design of Steel Structures	3L:0T:0P	3 credits

Prerequisites: A basic concept of material properties and behavior with basic knowledge of structural analysis and structural elements behavior under different loading pattern. Knowledge of stress and strain with fundamental concept of engineering mechanics.

Course Objectives:

CO1	**Understand various types of design methodology as per limit method**
CO2	**Interpret different type of connections**
CO3	**Design compression, tension and beam members**
CO4	Design beam plate girder, uses of stiffeners

Design of Steel Structures:- Properties of materials; loads and stresses, Design of semi-rigid, rigid and moment resistant connections; Built-up sections Design of tension members subjected to axial tension and bending, splicing of tension member, Design of compression members, Beam-column connections, Design of columns and their bases Design of flexural members and Plate girder; loads, specification and design Industrial buildings; loads, design of purlins, trusses, bracings; gantry girders; Introduction to Plastic analysis; Simple cases of beams and frames; All design steps/process to as per the most recent BIS code of practices.

Course Outcomes: After the completion of the course the student will be able to:

CO1	Students are able to design the connection of steel structure
CO2	Students are able to design the tension and compression members
CO3	Students are able to design the beam and roof truss in steel structure
CO4	Students able to design the plate and gantry design

Reference Books:

1. IS : 800 – 1984.

2. Design of Steel Structures by A. S. Arya & J. L. Ajmani, Nem Chand & Bros., Roorkee.

3. Design of Steel Structures by S. K. Duggal, Tata Mc-Graw-Hill Publishing Company.

CE ELECTIVE-VII

BCE-071	Soil Mechanics-I	3L:0T:0P	3 credits

Prerequisites: None

Course Objectives:

CO1	Identify and classify various types of soils
CO2	Carry out compaction of soils as per density
CO3	Determine shear strength of soil
CO4	Analyze field and laboratory data to determine the strength and deformation properties of cohesive and cohesion less soils

Soil Mechanics-I:- Composition and structure of soil; water flow and hydraulic properties; stress in soil; compaction and compressibility of soils; consolidation characteristics, settlement analysis; shear strength of soils; basics of unsaturated soils; experimental measurements.

Course Outcomes: After the completion of the course the student will be able to:

CO1	Characterize and classify composition of soils
CO2	Identify water flow and hydraulic properties
CO3	Compute and analyze the consolidation settlements
CO4	Students able to experimental measurements

Reference books:

1. Soil Mechanics by Craig R.F., Chapman &Hall
2. Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning

BCE-072	Soil Mechanics-II	3L:0T:0P	3 credits

Prerequisites: None

Course Objectives:

CO1	**Determine earth pressures**
CO2	**Analysis of retaining walls**
CO3	**Determine shear strength of soil**
CO4	Analyze stability of slopes

Soil Mechanics-II:- Application of soil mechanics to determine earth pressures, analysis of retaining walls, cuts & excavations and sheet piles, stability of slopes, instrumentation.

Course Outcomes: After the completion of the course the student will be able to:

CO1	Students able to determine the earth pressure
CO2	Students able to analysis of retaining walls
CO3	Compute and analyze the excavations and sheet piles
CO4	Students able to analyze the stability of slopes

Reference books:

1. Soil Mechanics by Craig R.F., Chapman &Hall
2. Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning

BCE-073	Foundation Engineering	3L:0T:0P	3 credits

Pre requisites: Student should have knowledge about basic of Soil Mechanics.

Course Objectives:

CO1	Design of shallow foundations
CO2	Describe bearing capacity of soil
CO3	Analysis and design of excavations, retaining walls
CO4	Analyze stability of slopes

Foundation Engineering. Analysis and design of foundations, types of foundations, bearing capacity and settlement of foundations; ground movements due to construction; analysis and design of excavations, retaining walls, cuts & excavations and sheet piles, slopes and underground structures.

Course Outcomes: After the completion of the course the student will be able to:

CO1	Students able to analyze the design of foundation
CO2	Analyze shallow and deep foundations
CO3	Calculate the bearing capacity of soils and foundation settlements
CO4	Understand the analysis and design of excavations

Reference books:

1. A. Singh, Modern Geotechnical Engineering, 3rd Ed., CBS Publishers, New Delhi, 1999.
2. B.M. Das, Principles of Foundation Engineering, 5th Ed., Thomson Asia, Singapore, 2003.
3. N. Som, Theory and Practice of Foundation Design, Prentice Hall, New Delhi, 2003.

BCE-074	Geotechnical Design	3L:0T:0P	3 credits

Pre requisites: Student should have knowledge about basic of Soil Mechanics.

Course Objectives:

CO1	To study about Subsurface site evaluation
CO2	Design of retaining walls, foundations, pavements
CO3	To study about materials for airports
CO4	Analyze highways, dams, or other facilities.

Geotechnical Design. Subsurface site evaluation; integrated design of retaining walls, foundations, pavements, and materials for airports, highways, dams, or other facilities.

Course Outcomes: After the completion of the course the student will be able to:

CO1	Students able to evaluate the subsurface site
CO2	Analyze different types of pavements
CO3	Students understand the about the materials
CO4	Understand the about highways, dams

Reference books:

1. Analysis and Design of Substructures: Limit State Design by Swami Saran

CE ELECTIVE-VIII

BCE-081	Earthquake Engineering	2L:0T:0P	2 credits

Pre requisites: Student should have knowledge about basic of Soil Mechanics.

Course Objectives:

CO1	To study about Subsurface site evaluation
CO2	Design of retaining walls, foundations, pavements
CO3	To study about materials for airports
CO4	Analyze highways, dams, or other facilities.

Internal structure of earth, Causes of earthquakes, Seismic waves, Magnitude, Intensity and Energy released, Characteristics of Earthquakes, Response of Structure to Earthquake motion, Modelling of structures, Dynamics of single degree of freedom system,

Dynamics of multi degree of freedom system, Idealization of structures, Dynamics of soils and seismic response, Conceptual design, Introduction to earthquake resistant design, Equivalent lateral force method, Response spectrum method, Time history method, Design of Masonry buildings,

Reinforced Concrete buildings, Steel Buildings, Material Properties, Code provisions. Introduction to machine foundation. Degrees of freedom of a block foundation. I.S. code provisions for design and construction of machine foundations.

Course Outcomes: After the completion of the course the student will be able to:

CO1	Students able to analyze the design of foundation
CO2	Analyze shallow and deep foundations
CO3	Calculate the bearing capacity of soils and foundation settlements
CO4	Understand the analysis and design of excavations

References:

1. *Introduction to Structural Dynamics - J.M. Biggs*
2. *Elements of Earthquake Engineering - Jai Krishna an A.R. Chandrasekaran*
3. *IS: 1983 - 1984 Criterion for Earthquake Resistant Design.*
4. *Structural Dynamics - Theory & cpomputation - Mario Paz.*
5. *Dynamics of Structures Theory and Applicaions to Earhquake Engineering - Anil K.C*
6. *Earthquake Resistant of Design of structures, Agarwal and Srikhande.*
7. *Earthquake Resistant of Design of structures, S.K.Duggal*

BCE-082	Pre-stressed Concrete	2L:0T:0P	2 credits

Pre requisites: Student should have knowledge about Pre- stressed concrete.

Course Objectives:

CO1	**To study about losses in pre-stressed concrete**
CO2	**Design of simply supported beams**
CO3	**To study about stresses**
CO4	Design of reinforcements for shear and torsion

Historical developments, Basic concepts, types, different systems, Materials-Steel, concrete and their properties; losses of pre-stress, design of simply supported beams basic assumptions,

Stress in concrete and steel due to load and pre-stress, pressure line and internal resisting couple, kern distance, cracking moment, general approach for service load design, graphical methods, Lin's method, limit state design as per IS code, partial pre-stressing; Shear and principal stresses in homogenous elastic beams.

Design of reinforcements for shear and torsion: Stress distribution in end block—Design of pipes and tanks, electric posts, composite construction.

Course Outcomes: After the completion of the course the student will be able to:

CO1	Understand the concepts of pre-stressing in concrete structures
CO2	Analyse a Pre-stressed Concrete section & Estimate losses of Pre- stressing
CO3	Calculate the stress in concrete and steel
CO4	Design of pipes and tanks

OPEN ELECTIVES (I to IV)

BOE-011	Airport Planning and Design	3L:0T:0P	3 credits

Pre requisites: None

Course Objectives:

CO1	To study about aircraft characteristics
CO2	Design of airfield
CO3	To study about airport landside planning
CO4	To study about Air traffic control and surveillance facilities

Airport Planning and Design:

Aircraft characteristics; Aircraft performance characteristics: Airport planning and air travel demand forecasting: Airport Site Selection; Geometric Design of the Airfield: Determination of Runway Capacity and Delay - Taxiway and Gate Capacity - Holding Aprons - Terminal Aprons – Airport drainage - Function of Airport Passenger and Cargo Terminal - Design of Air Freight Terminals - Airport access - Airport Landside planning - Capacity; Air Traffic Management: Navigational aids: ground based systems, satellite based systems – Air traffic control and surveillance facilities – Airfield lighting - air traffic management.

Course Outcomes: After the completion of the course the student will be able to:

CO1	In Airport Planning students will get knowledge of Airport planning, layout and runway and taxiway components.
CO2	Students get knowledge of runway capacity and delay
CO3	Design of Air freight Terminals
CO4	students get knowledge regarding Air traffic management

BOE-012	Environmental impact assessment and life cycle analyses	3L:0T:0P	3 credits

Pre requisites: None

Course Objectives:

CO1	To study about concept of EIA
CO2	To study about fault tree analysis & matrix method
CO3	To study about environmental audit and cost benefit analysis
CO4	Life cycle assessment

Environmental impact assessment and life cycle analyses

Evolution of EIA: Concepts of EIA methodologies, Screening and scoping; Rapid EIA and Comprehensive EIA; General Framework for Environmental Impact Assessment, Characterization and site assessment. Environmental Risk Analysis, Definition of Risk, Matrix Method. Checklist method, Fault tree analysis, Consequence Analysis; Socioeconomic aspects, measures of effectiveness of pollution control activities; Environmental Legislation; Introduction to Environmental Management Systems; Environmental Statement - procedures; Environmental Audit: Cost Benefit Analysis; Life Cycle Assessment; Resource Balance, Energy Balance & Management Review; Operational Control; Case Studies on EIA.

Course Outcomes: After the completion of the course the student will be able to:

CO1	Identify environmental problems arising due to engineering and technological activities and the science behind those problems.
CO2	Students get knowledge of general framework for EIA
CO3	Realize the importance of effectiveness of pollution control activities
CO4	Students get knowledge of life cycle

BOE-013	Ground water	3L:0T:0P	3 credits

Pre requisites: None

Course Objectives:

CO1	To study about physical properties of groundwater and aquifers
CO2	To study the principles and fundamental equations of porous
CO3	To study the pumping test analysis
CO4	To Study the groundwater quality and contamination

Groundwater.

Physical properties of groundwater and aquifers, principles and fundamental equations of porous media flow and mass transport, well hydraulics and pumping test analysis, role of groundwater in the hydrologic cycle, groundwater quality and contamination.

Course Outcomes: After the completion of the course the student will be able to:

CO1	Students get knowledge of physical properties of ground water
CO2	Students get knowledge of fundamental equation of mass transport
CO3	Realize the importance role of groundwater in the hydrologic cycle
CO4	Students get knowledge of quality and contamination

BOE-014	Metro Systems and Engineering	3L:0T:0P	3 credits

Pre requisites: None

Course Objectives:

CO1	To study about metro system and planning
CO2	To study the basics of construction planning & management
CO3	To study the electronics and communication engineering in metro system
CO4	To Study the mechanical & TV + AC and electrical in metro system

General: Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials

Civil Engineering- Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management

Electronics and Communication Engineering- Signaling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors.

Mechanical & TV + AC: Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators

Electrical: OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics

Course Outcomes: After the completion of the course the student will be able to:

CO1	Students get knowledge of metro system
CO2	Students get knowledge of basics of civil engineering in metro system
CO3	Students get knowledge of electronics and communication engineering in metro system
CO4	Students get knowledge of mechanical & TV + AC an Electrical in metro system

BOE-015	Solid and hazardous waste management	3L:0T:0P	3 credits

Pre requisites: None

Course Objectives:

CO1	To study sources, types and composition of solid waste with methods of handling, sampling, processing and storage of solid waste and have general idea about disposal
CO2	To study the Processing of the solid waste, disposal methods.
CO3	To study about the hazardous waste management.
CO4	To Study the risk assessment

Solid and hazardous waste management

Solid Wastes: Origin, Analysis, Composition and Characteristics. Integrated Solid Waste Management System: Collection, Storage, and Segregation, Reuse and Recycling possibilities, Transportation, Treatment / Processing and Transformation Techniques, Final Disposal Management of: Municipal, Biomedical, Nuclear, Electronic and Industrial Solid Wastes and the rules and regulations. Introduction to Hazardous wastes, Definition of Hazardous waste, The magnitude of the problem; Hazardous waste: Risk assessment, Environmental legislation, Characterization and site assessment, Waste minimization and resource recovery, Transportation of hazardous waste, Physical, chemical and biological treatment, Ground water contamination, Landfill disposal, Current Management Practices, Environmental audit, Pollution Prevention, Facility Development and operation, Site Remediation: Quantitative risk assessment, site and subsurface characterization, Containment, remedial alternatives.

Course Outcomes: After the completion of the course the student will be able to:

CO1	To know about the solid waste management and disposal techniques.
CO2	To know about the sources and composition of municipal solid waste & collection methods.
CO3	To know the waste management rules to generators of solid wastes and its generation rates.
CO4	To know about quantitative risk assessment