Department of Civil and Environmental Engineering

Birla Institute of Technology, Mesra, Ranchi - 835215 (India)

Institute Vision

To become a Globally Recognized Academic Institution in consonance with the social, economic and ecological environment, striving continuously for excellence in education, research and technological service to the National needs.

Institute Mission

To educate students at Undergraduate, Postgraduate, Doctoral, and Post-Doctoral levels to perform challenging engineering and managerial jobs in industry.

- To provide excellent research and development facilities to take up Ph.D. programmes and research projects.
- To develop effective teaching and learning skills and state of art research potential of the faculty.
- To build national capabilities in technology, education and research in emerging areas.
- To provide excellent technological services to satisfy the requirements of the industry and overall academic needs of society.

Department Vision

To develop quality intellectuals through education, research and motivation so that they can bring a positive contribution to the society in area of Civil and Environmental Engineering

Department Mission

- To develop professional skills through quality education & research.
- To outreach various sectors of society through interdisciplinary programmes and practical oriented approach.
- To create dynamic, logical and effective leaders with inspiring mindsets.

Programme Educational Objectives (PEOs)

B. Tech. (Civil Engineering)

PEO 1: Attain the analytical expertise to create, analyse, formulate, and solve challenging problems in the field of Civil Engineering; and recognize and develop the necessary and suitable tools for the same.

PEO 2: Develop technical and management flair to take responsibility for engineering projects and research programs significantly.

PEO 3: Uncover multidisciplinary approach and co-relate engineering issues to social and human background in broader sense, in which their engineering helping hand will be utilised.

PEO 4: Develop attitude of lifelong learning for becoming successful civil engineers.

PEO 5: Implant sensitivity towards ethics, public policies and their responsibilities towards the society.

Programme Outcomes (POs)

B. Tech. (Civil Engineering)

(A) Program Outcomes (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

(B) Program Specific Outcomes (PSOs)

Engineering Graduates will be able to:

1. Plan, analyse, and design infrastructural projects and its components in various areas of Civil Engineering like Structural Engineering, Geotechnical Engineering, Water Resources Engineering, Environmental Engineering, and Transportation Engineering.
2. Execute the construction of buildings and other components of various projects in Civil Engineering including its layout, management, and quality control.
3. Implement the provisions made in Indian Standard Codes/ other relevant codes/ specifications/ guidelines and applicable laws including labour laws and environmental laws.

COURSE INFORMATION SHEET

Course code: CE101
Course title: ENVIRONMENTAL SCIENCE
Pre-requisite(s): NA
Co- requisite(s): NA
Credits: L:2 T:0 P:0
Class schedule per week: 02
Class: B.Tech
Semester / Level: 03/01
Branch: All
Name of Teacher:

Course Objectives

This course enables the students:

1	To develop basic knowledge of ecological principles and their applications in environment. (K_1,K_2)
2	To identify the structure and composition of the spheres of the earth, the only planet sustaining life. (K_1,K_2)
3	To analyse, how the environment is getting contaminated and probable control mechanisms for them. (K_1,K_2)
4	To generate awareness and become a sensitive citizen towards the changing environment. (K_1,K_2)

Course Outcomes

After the completion of this course, students will be:

1	Able to explain the structure and function of ecosystems and their importance in the holistic environment. (K_1,K_2)
2	Able to identify the sources, causes, impacts and control of air pollution. (K_1,K_2)
3	Able to distinguish the various types of water pollution happening in the environment and understand about their effects and potential control mechanisms. (K_1,K_2)
4	Able to judge the importance of soil, causes of contamination and need of solid waste management. (K_1,K_2)
5	Able to predict the sources of radiation hazards and pros and cons of noise pollution. (K_1,K_2)

Syllabus

Module 1. Ecosystem and Environment

Concepts of Ecology and Environmental science, ecosystem: structure, function and services, Biogeochemical cycles, energy and nutrient flow, ecosystem management, fate of environmental pollutants, environmental status and reports on climate change.

Module 2: Air Pollution

Structure and composition of unpolluted atmosphere, classification of air pollution sources, types of air pollutants, effects of air pollution, monitoring of air pollution, control methods and equipment for air pollution control, vehicular emissions and control, indoor air pollution, air pollution episodes and case studies.

Module 3: Water Pollution
Water Resource; Water Pollution: types and Sources of Pollutants; effects of water pollution; Water quality monitoring, various water quality indices, water and waste water treatment: primary, secondary and tertiary treatment, advanced treatments (nitrate and phosphate removal); Sludge treatment and disposal.

Module 4: Soil Pollution and Solid Waste Management
Lithosphere – composition, soil properties, soil pollution, ecological & health effects, Municipal solid waste management – classification of solid wastes, MSW characteristics, collection, storage, transport and disposal methods, sanitary landfills, technologies for processing of MSW: incineration, composing, pyrolysis.

Module 5: Noise pollution & Radioactive pollution
Noise pollution: introduction, sources: Point, line and area sources; outdoor and indoor noise propagation, Effects of noise on health, criteria noise standards and limit values, Noise measurement techniques and analysis, prevention of noise pollution; Radioactive pollution: introduction, sources, classification, health and safety aspects, Hazards associated with nuclear reactors and disposal of spent fuel rods-safe guards from exposure to radiations, international regulation, Management of radioactive wastes.

Text books:

1. A, K. De. (3rd Ed). 2008. Environmental Chemistry. New Age Publications India Ltd.
2. R. Rajagopalan. 2016. Environmental Studies: From Crisis to Future by, 3rd edition, Oxford University Press.
3. Eugene P. Odum. 1971. Fundamentals of Ecology (3rd ed.) -. WB Sunders Company, Philadelphia.
4. C. N. Sawyer, P. L. McCarty and G. F. Parkin. 2002. Chemistry for Environmental Engineering and Science. John Henry Press.
5. S.C. Santra. 2011. Environmental Science. New Central Book Agency.

Reference books:

1. D.W. Conell. Basic Concepts of Environmental Chemistry, CRC Press.
2. Peavy, H.S, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw - Hill International
3. G.M. Masters & Wendell Ela. 1991. Introduction to Environmental Engineering and Science, PHI Publishers.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz (s) (1 & 2)	10+10
Teacher's assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid sem exam	✓	✓	✓		
End Sem Examination Marks	✓	✓	✓	✓	✓
Quiz 1	✓	✓			
Quiz 2			✓	✓	✓
Assignment	✓	✓	✓	✓	✓

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Graduate Attributes

Course Outcome #	Program outcomes												Program specific outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		1	3			1	3						1		
2		1	3			1	3						1		

3		**1**	**3**			**1**	**3**						**1**		
4		**1**	**3**			**1**	**3**						**1**		
5		**1**	**3**			**1**	**3**						**1**		

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2, CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2, CD8
CD3	Seminars		CO3	CD1, CD2, CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 201
Course title: Solid Mechanics
Pre-requisite(s): NA
Co- requisite(s): NA
Credits: 3 L:3 T:0 P:0
Class schedule per week: 03
Class: B.Tech.
Semester / Level: 3 / 2
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students to:

1	Develop basic knowledge of strength of material so that the students can solve and design real engineering problems. (K_1,K_2)
2	Understand behaviour of different materials subjected to simple and complex mechanical stresses. (K_1,K_2)
3	Analyse and design safe and sound civil engineering structures. (K_3,K_4)

Course Outcomes

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

1.	Evaluate the stresses and strains in members subjected to axial, flexural, torsional and combined loading. (K_1, K_2, K_3)
2.	Suggest suitable material from among the available in the field of construction and manufacturing. (K_4)
3.	Evaluate the behaviour and strength of structural elements under the action of compound stresses. (K_1, K_2, K_3, K_4)
4.	Determine the deflections and rotations produced by the three fundamental types of loads: axial, torsional, and flexural. (K_3)
5.	Design simple bars, beams, columns and circular shafts for allowable stresses and loads. (K_3, K_4)

Syllabus

Module 1: Simple Stresses and Strain
Introduction, Definition and concept of stress and strain (Normal & Shear Stress and strain; and Bearing Stress). Stress at a point under general loading (Stress components). Axial loading: Hooke's law, Stress-Strain diagrams for ferrous and non-ferrous material, proof stress, normal and engineering strain. Elongation of bars due to self-weight. Saint Venant's principle. Poisson's ratio. Generalized Hooke's law. Temperature stresses. Shear loading: state of simple shear, Hooke's law. Elastic constants and their relationship.

Module 2: Bending and Shear Stresses in Beams

Relationship between load intensity, bending moment and shear force (differential equations). Shear force and bending moment diagrams for statically determinate beams subjected to points load, uniformly distributed loads, uniformly varying loads, couple and their combinations. Pure bending theory, Assumptions, derivation of bending equation, section modulus, flexural rigidity. Expression for transverse shear stress in beams, Bending and shear stress distribution. Shear centre.

Module 3: Torsion in Circular Shaft
Introduction, pure torsion, Assumptions, derivation of torsion equation for circular shafts, torsional rigidity and polar section modulus. Power transmitted by a shaft.

Module 4: Transformation of stress and strains.
Stress/Strain matrix for general state of loading under equilibrium. Plane stress and plane strain problems: Transformation of stress/strain, Principal stresses/strains and maximum shear stress, Mohr's circle.
Theories of Failure
Introduction, Maximum principal stress theory (Rankine's theory), Maximum shearing stress theory (Tresca's theory), Maximum strain energy theory (Beltrami and Haigh), Maximum shear strain energy theory (Mises-Henky theory), and maximum strain theory (St. Venant's theory).

Module 5: Columns and Struts
Introduction, short and long columns. Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory.

Text books:
1. Introduction to text book of Strength of materials by R.K.Bansal, Laxmi publications Pvt. Ltd., New Delhi.
2. Mechanics of materials, by Ferdinand P. Beer and others, Tata McGraw Hill Publications.
3. Strength of materials by R. Subramanian, Oxford university press, New Delhi

Reference books:
1. Introduction to text book of Strength of Material by U.C. Jindal, Galgotia publications.
2. Strength of Materials by Schaum's outline series, Mc Graw Hill International Edition
3. Elements of Strength of Materials, D.H. Young, S.P. Timoshenko East West Press Pvt. Ltd., 5th Edition (Reprint 2014)

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓

Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz (s) (1 & 2)	10+10
Teacher's assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	✓	✓	✓		
End Sem Examination Marks	✓	✓	✓	✓	✓
Quiz 1	✓	✓	✓		
Quiz 2			✓	✓	✓
Assignment	✓	✓	✓	✓	✓

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Graduate Attributes

Course Outcome #	Program outcomes												Program specific outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	2								3	1	
2	3	2	3	2	2								3	1	
3	3	2	3	2	2								3	1	
4	3	2	3	2	2								3	1	
5	3	2	3	2	2								3	1	

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2 and CD8
CD2	Tutorials/Assignments		CO2	CD1, CD4 and CD8
CD3	Seminars		CO3	CD1, CD2 and CD8
CD4	Mini projects/Projects		CO4	CD1, CD2 and CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2 and CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 202
Course title: STRUCTURAL ANALYSIS -I
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: 3RD SEMESTER/ LEVEL 2
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students to:

1	Develop basic knowledge of structural analysis so that the students can solve real engineering problems. (K_1, K_2)
2	Understand behaviour of different kinds of determinate structures subjected to simple and complex mechanical loadings. (K_1, K_2)
3	Analyse and design safe and sound civil engineering structures. (K_3, K_4)

Course Outcomes

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

1.	Evaluate the stability and determinacy of a given structure. (K_1, K_2, K_3)
2.	Evaluate safety of a proposed determinate structure before construction and manufacturing. (K_4)
3.	Evaluate the behaviour of determinate structures under the action of complex static loads. (K_1, K_2, K_3, K_4)
4.	Evaluate the behaviour of determinate structures under the action of moving loads. (K_1, K_2, K_3, K_4)
5.	Evaluate deflections in a given determinate structure. (K_3, K_4)

Syllabus

Module 1: Introduction
Structure. Structural Elements, Types of structures: Truss, Frame, Cable, Arch and Surface Structures. Idealized structure. Principle of superposition. Equilibrium Equation. Determinacy and stability.

Module 2: Analysis of statically determinate trusses and beams.
Trusses: Method of joints, Method of sections. Zero force members.
Beams: SF and BM diagrams.

Module 3: Analysis of statically determinate cables and arches
Cables subjected to concentrated loads and cables entirely loaded by UDL. Catenary curve.
Three hinged arch: Eddy's theorem; BMD, Normal thrust and Radial shear at any c/s.

Module 4: Deflection and Influence line diagrams for beams:

Deflection of determinate beams: Elastic curve, double integration method and moment area method. ILD for reaction, SF and BM for determinate beams.

Module 5: Energy methods
External work: Force and Moment, Strain energy: Axial, Shear, Bending and Torsion.
Principle of virtual work and Castiglano's Theorems: Application to determinate structures.

Text books:

1. Theory of Structures by Timoshekno S. P. & Young
2. Structural Analysis by Hibbeler R.C.

Reference books:

1. Mechanics of Structures by Junnarkar S.
2. Mechanics of materials, by Ferdinand P. Beer and others, Tata McGraw Hill Publications

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz (s) (1 & 2)	10+10

Teacher's assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	✓	✓	✓		
End Sem Examination Marks	✓	✓	✓	✓	✓
Quiz 1	✓	✓	✓		
Quiz 2			✓	✓	✓
Assignment	✓	✓	✓	✓	✓

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Graduate Attributes

Course Outcome #	Program outcomes												Program specific outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	2								3	1	
2	3	2	3	2	2								3	1	
3	3	2	3	2	2								3	1	
4	3	2	3	2	2								3	1	
5	3	2	3	2	2								3	1	

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2 and CD8
CD2	Tutorials/Assignments		CO2	CD1, CD4 and CD8
CD3	Seminars		CO3	CD1, CD2 and CD8
CD4	Mini projects/Projects		CO4	CD1, CD2 and CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2 and CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 203
Course title: FLUID MECHANICS
Pre-requisite(s):
Co- requisite(s):
Credits: 4 L:4 T:0 P:0
Class schedule per week: 4
Class: B.Tech.
Semester / Level: 3rd SEMESTER/LEVEL 2
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students:

A.	To get introduced about the concepts of fluid mechanics useful for civil engineering applications. (K1, K2)
B.	To apply the concepts of fluid mechanics to analyse and solve engineering problems involving fluids such as flow in pipes, open channels, jets, turbines and pumps, hydraulic structures, rivers and in sub-surface both at static and dynamic conditions. (K3, K4, K5)
C.	To understand and analyse various types of flows in open channels. (K3, K4, K5)
D.	To design pumps and hydraulic turbines. (K3, K4, K5)

Course Outcomes

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

1.	Examine and interpret the behaviour of fluids using its properties. (K1, K2)
2.	Solve the engineering problems using principles of fluid statics and kinematics. (K3, K4, K5)
3.	Understand and analyse the dynamic behaviour of fluids using concepts of fluid dynamics. (K2, K3, K4)
4.	Apply the principles of fluid mechanics to investigate open channel flows. (K2, K3, K4, K5)
5.	Analyse and design hydraulic pumps and turbines. (K3, K4, K5)

Syllabus

Module I: Basic Concepts and Definitions
Distinction between fluid and solid, Fluid properties, Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity, Newton's law of viscosity, Variation of fluid properties with temperature and pressure, Surface tension, Capillarity, Bulk modulus of elasticity, Compressibility, Vapour pressure, Boiling point, and Cavitation.

Module II: Fluid Statics and Kinematics
Fluid Statics: Fluid Pressure, Pascal's law, Pressure variation with temperature, density and altitude.
Pressure Measurement: Pressure gauges, Manometers, Hydrostatic pressure and forces.
Buoyancy: Buoyant force, Stability of floating and submerged bodies, Meta-center.
Fluid Flows: Continuum, & free molecular flows, Steady and unsteady, uniform and non-uniform, laminar and turbulent, rotational and irrotational, compressible and incompressible, One-, two- and three-dimensional flows, Continuity equation, Streamlines, Stream function and Velocity potential.

Module III: Fluid Dynamics

Surface and body forces, Equations of motion, Euler's equation.

Energy Principle: Bernoulli's equation, Applications of Bernoulli's equation, Venturimeter, Orificemeter and Pitot tube.

Momentum Principle: Forces exerted by flowing fluid, Vortex flow.

Boundary Layer Theory: Laminar and turbulent boundary layer, Laminar sub-layer, Separation and its control, Drag and lift, Magnus effect.

Dimensional Analysis and Dynamic Similitude: Reynolds number, Froude number, Mach number, Weber Number and Euler Number, Buckingham's π-Theorem.

Module IV: Open Channel Flow

Open Channel Flow: Difference between open channel flow and pipe flow, Geometrical parameters of open channels, Continuity equation.

Uniform Flow: Chezy's and Manning's equation, Velocity distribution, Most-efficient channel section.

Energy and Momentum Principles: Critical depth, Specific energy, Specific force.

Non-uniform Flow: Gradually varied flow (GVF), Equation of GVF and its limitations, Flow classification and surface profiles, Integration of varied flow by analytical, graphical and numerical methods.

Hydraulics jump, Surge, and Water waves: Classical hydraulic jump, Evaluation of the jump elements in rectangular and non-rectangular channels on horizontal and sloping beds, Open channel surge, Celerity of gravity wave, Deep and Shallow water waves.

Module V: Hydraulic Pumps and Turbines

Rotodynamic Pumps: Classification of pumps on different basis, Basic equations, Velocity triangles, Different heads and efficiencies, Cavitation, Characteristic curves.

Rotodynamic Machines: Pelton turbine, Reaction turbine, Francis and Kaplan turbine, Unit quantities, Similarity laws, Specific speed, Cavitation, Characteristic curves.

Textbooks:

1. Fluid Mechanics and Hydraulic Machines, R. K. Bansal, Laxmi Publications.
2. Hydraulics and Fluid Machines, P. N. Modi and S. H. Seth, Standard Book House.
3. Flow in Open Channels, K. Subramanya, Tata McGraw Hills.
4. Hydraulic Machines, Dr. Jagdish Lal, Metropolitan Book Company.
5. Fluid Mechanics, V. L. Streeter and E. B. White, McGraw Hill, New York.
6. Experimental Fluid Mechanics, Vol. 1, G. L. Asawa, Nemchand and Bros, Roorkee.
7. Flow through Open Channels, K.G. Ranga Raju, Tata McGraw Hills.

Reference books:

1. Open Channel Hydraulics, V. T. Chow McGraw Hill.
2. Open Channel Hydraulics, French, McGraw Hill.
3. Fluid Machines through Problems, R. J. Garde, New Age International.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10+10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination	✓	✓			
End Sem Examination	✓	✓	✓	✓	✓
Quiz 1	✓	✓			
Quiz 2			✓	✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓	✓

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes												Program Specific Outcome	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3	3	2	1	1	1	3	2	1	3	2	3
2	3	3	3	3	3	3	2	1	3	2	1	3	3	2
3	3	3	3	3	3	3	2	1	3	2	1	3	3	2
4	3	3	3	3	3	3	2	1	3	2	1	3	3	3
5	3	3	3	3	3	3	2	1	3	2	1	3	3	3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD 1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2, CD4, CD5, CD8
CD 2	Tutorials/Assignments		CO2	CD1, CD2, CD4, CD5, CD8
CD 3	Seminars		CO3	CD1, CD2, CD4, CD5, CD8
CD 4	Mini projects/Projects		CO4	CD1, CD2, CD4, CD5, CD8
CD 5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD4, CD5, CD8
CD 6	Industrial/guest lectures			
CD 7	Industrial visits/in-plant training			
CD 8	Self- learning such as use of NPTEL materials and internets			
CD 9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 204
Course title: BUILDING MATERIALS AND CONSTRUCTION
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: 3RD SEMESTER/ LEVEL 2
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students:

A.	To know the various types of building materials used in current construction practices and their associated manufacturing processes and properties (K1).
B.	To understand the choices designers make in choosing building materials based on properties of these materials (K1, K2)
C.	To get exposed to various quality control aspects of the civil engineering materials by performing different lab test on materials (K1, K2)
D.	To understand the construction methodology of different substructure and superstructure components using various building materials (K1, K2)

Course Outcomes

After the completion of this course, students will be:

1.	Able to explain the manufacturing process, physical and chemical properties and uses of various building materials (K1).
2.	Able to analyze the suitability of different building materials and significance in using those materials in relation with building's function (K1, K2).
3.	Able to perform quality control tests on different construction materials (K1, K2).
4.	Able to plan and execute construction of various components of substructure and superstructure (K1, K2).

Syllabus

Module I: Building Stones, Bricks
Classification of rocks, Varieties of Indian stones, Quarrying blasting, Dressings of stones, Characteristics of good building stones, uses, Testing and Preservation of stones, Constituents of brick earth and their properties, Manufacture of bricks, clamps & kilns, types of brick, defects in bricks, tests on bricks.

Module II: Limes, Cements, Mortar, Timber
Lime – Types, properties and uses. Cement – Composition, Varieties, Properties, Methods of manufacture; Tests on cement. Mortar-Lime mortar, Cement mortar, Surkhi mortar, Mud mortar, Gypsum and Plaster of Paris, Varieties of Indian timber, Characteristics and suitability for different

uses, Defects in timber, Diseases and decay in timber, Preservation and Seasoning, Veneers, Fiber boards, Block boards; modern materials like fibre-reinforced plastics and introduction to composites.

Module III: Foundation, Masonry
Foundations: functions and different types, basic terminologies associated with stone and brick masonry, types of stone masonry and brick masonry bonds, brick laying, types of walls, load bearing walls, design considerations; cavity walls: general features and construction; partition walls: brick, concrete and glass partitions.

Module IV: Concrete Technology, DPC and anti-termite works
Concrete constituents, properties of concrete, batching, mixing, transporting, placing, compacting, curing of concrete; tests for quality control, different concrete mixes and uses; reinforcements in RCC; Design of Concrete Mixes: proportioning of aggregates and methods of mix design.
Damp proofing: cause and effects of damping; materials and methods for damp proofing – D P C treatment.
Anti-termite treatment.

Module V: Plastering and pointing, plumbing types
Types of mortar for plastering, terminology, tools, methods of plastering, defects in plastering; methods of pointing.
Plumbing - water supply service connection for buildings, different types of traps, types of drainage pipes and systems of plumbing for wastewater drainage.

Text books:

1. Duggal S. K. : Building Materials (New Age International Publishers)
2. Punmia B.C., Jain A.K. and Jain A.K.: Building Construction (Laxmi Publications Pvt. Ltd)
3. Arora S.P. and Bindra S.P.: A Text Book of Building Construction (Dhanpat Rai Publications)

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10 + 10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4
Mid Sem Examination	✓	✓	✓	
End Sem Examination	✓	✓	✓	✓
Quiz 1	✓	✓	✓	
Quiz 2			✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓

Indirect Assessment –

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Course Outcome	Program Outcomes												Program Specific Outcome		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1			1	2	2				2		2	2	3
2	2					2	2			1	2		3	3	3
3					1	2				1			3	3	3
4	2		2	1			2			2			3	3	3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2 and CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2 and CD8
CD3	Seminars		CO3	CD1, CD2, CD5 and CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, CD6, CD7 and CD8
CD5	Laboratory experiments/teaching aids			
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 207
Course title: STRUCTURAL ANALYSIS -II
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: 4TH SEMESTER / LEVEL 2
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students to:

1	Develop basic knowledge of structural analysis so that the students can solve real engineering problems. (K_1, K_2)
2	Understand behaviour of different kinds of indeterminate structures subjected to simple and complex mechanical loadings. (K_1, K_2)
3	Analyse and design safe and sound civil engineering structures. (K_3, K_4)

Course Outcomes

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

1.	Evaluate the stability and determinacy of a given structure. (K_1, K_2, K_3)
2.	Evaluate safety of a proposed indeterminate structure before construction and manufacturing. (K_4)
3.	Evaluate the behaviour of indeterminate structures under the action of complex static loads. (K_1, K_2, K_3, K_4)
4.	Evaluate the behaviour of indeterminate structures using advanced numerical techniques (K_1, K_2, K_3, K_4)
5.	Evaluate deflections in a given indeterminate structure. (K_3, K_4)

Syllabus

Module I: Introduction
Indeterminate structures: Advantages and disadvantages. Force and displacement method of analysis.

Module II: Force method of analysis for indeterminate structures.
Method of consistent deformations/compatibility method: Beams, frames and trusses.
Muller-Breslau principle: ILD for reactions, SF and BM for indeterminate beams/continuous beams.

Module III: Displacement method of analysis for indeterminate structures.
Degrees of freedom. Slope-deflection method: Beams and frames (with or without sway).
Moment distribution method: Beams and frames (with or without sway).

Module IV: Matrix method of analysis
Introduction: Flexibility and Stiffness matrix method.

Truss and beam member: Stiffness matrix; Displacement and force transformation matrix; Global stiffness matrix.

Module V: Indeterminate Arches
Analysis of symmetrical 2-hinged and fixed arches.

Text books:

1. Theory of Structures by Timoshenko & Young
2. Structural Analysis by Hibbeler R.C.

Reference books

1. KINNEY: Statically Indeterminate Structures

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz (s) (1 & 2)	10+10
Teacher's assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Mid Sem Examination Marks	✓	✓	✓		
End Sem Examination Marks	✓	✓	✓	✓	✓
Quiz 1	✓	✓	✓		

Quiz 2			✓	✓	✓
Assignment	✓	✓	✓	✓	✓

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Graduate Attributes

Course Outcome #	Program outcomes												Program specific outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	2								3	1	
2	3	2	3	2	2								3	1	
3	3	2	3	2	2								3	1	
4	3	2	3	2	2								3	1	
5	3	2	3	2	2								3	1	

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2 and CD8
CD2	Tutorials/Assignments		CO2	CD1, CD4 and CD8
CD3	Seminars		CO3	CD1, CD2 and CD8
CD4	Mini projects/Projects		CO4	CD1, CD2 and CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2 and CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 208
Course title: SURVEYING
Pre-requisite(s):
Co- requisite(s): Performance of laboratory experiments involving survey work
Credits: L: 4 T: 0 P: 0
Class schedule per week: 4
Class: B,Tech.
Semester / Level: 4th Semester/ Level 2
Branch: Civil Engineering
Name of Teacher:

Course Objectives
This course enables the students to:

A.	Obtain knowledge about uses and applications of chain, compass, and plane table survey. (K1, K2)
B.	Learn about levelling, theodolite. (K2, K4)
C.	Know about different types of curves. (K3)
D.	Learn triangulation, and geodetic levelling. (K2, K4)
E.	Learn modern surveying instruments and astronomy. (K2, K4)

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

1.	Perform chain, compass, and plane table survey. (K1, K2)
2.	Carry out levelling, measurement of angles with theodolite. (K2, K4)
3.	Set different types of curves in the field. (K3)
4.	Perform triangulation survey, and geodetic levelling. (K2, K4)
5.	Handle modern instruments like Total station, Auto level, GPS and explain basic astronomical terms. (K2, K4)

Syllabus

Module 1. Chain, Compass and Plane Table Survey:
Introduction, Principle of survey, Errors and Obstacles in chain survey; Bearings, Traversing, Local attraction, Magnetic declination; Methods of plane table survey.

Module 2. Levelling, Theodolite:
Principle of Levelling, Curvature and Refraction corrections, Reciprocal levelling; Contouring; Measurement of angles with theodolite

Module 3. Curves and Curve Setting:
Types of curves, Simple curves – Chain & Tape methods, Rankine's method' Obstacles in curve setting, Compound curve, Reverse curve, Introduction to Transition curve and Vertical curve.

Module 4. Triangulation, Geodetic Levelling:
Scope and classification of triangulation, Satellite station; Corrections to geodetic levelling, Single angle and reciprocal observations.

Module 5. Introduction to Modern surveying equipment and Astronomy:
Total station, Auto level, GPS; Introduction to astronomy and different astronomical terms.

Text books:

1. Punmia, B.C., Jain, A.K., Jain, A.K. "Surveying" – Vol. 1 and 2, Laxmi Publications (P) Ltd.
2. Kanetkar, T.P., Kulkarni S.V. "Surveying and Levelling." – Part 1 and 2, Pune Vidyarthi Griha Prakashan.

Reference books:

1. Duggal, S.K. "Surveying" – Vol. 1 and 2, The McGraw-Hill Companies, New Delhi.
2. Arora, K.R. "Surveying" – Vol. 1 and 2, Standard Book House, New Delhi.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	√
Tutorials/Assignments	√
Seminars	√
Mini projects/Projects	√
Laboratory experiments/teaching aids	√
Industrial/guest lectures	√
Industrial visits/in-plant training	√
Self- learning such as use of NPTEL materials and internets	√
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Mid Sem Examination Marks	25
End SemExamination Marks	50
Quiz	10 + 10
Assignment	5

AssessmentCompoents	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Mid Sem Examination Marks	√	√			
End Sem Examination Marks	√	√	√	√	√
Quiz 1	√	√			
Quiz 2			√	√	√
Assignment	√	√	√	√	√

Indirect Assessment –

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Course Outcome #	Program Outcomes												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	1	3	2				3	3	2	3	3	3	2
2	3	3	1	3	2				3	3	2	3	3	3	2
3	3	3	1	3	2				3	3	2	3	3	3	2
4	3	3	1	3	2				3	3	2	3	3	3	2
5	3	3	1	3	2				3	3	2	3	3	3	2

Mapping Between COs and Course Delivery (CD) methods

CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2, CD3, CD5, CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2, CD3, CD5, CD8
CD3	Seminars		CO3	CD1, CD2, CD3, CD4, CD5, CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, CD3, CD5, CD6, CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD3, CD4, CD5, CD6, CD7, CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

COURSE INFORMATION SHEET

Course code: CE 209
Course title: Construction Engineering and Management
Pre-requisite(s):
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B,Tech.
Semester / Level: 4th Semester/ Level 2
Branch: Civil Engineering
Name of Teacher:

Course Objectives

This course enables the students to:

A.	Obtain knowledge about basics of construction project management and ethical conduct for engineers.
B.	Learn about construction economics.
C.	Know about construction planning.
D.	Learn construction contracts, and construction quality management.
E.	Learn project management information system.

Course Outcomes

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

1.	Explain about construction project management and its relevance as well as ethical conduct of engineers.
2.	Make about economics of the construction project.
3.	Work with techniques like PERT and CPM.
4.	Prepare contract documents, carry out quality control of the project.
5.	Work with IT enabled Project Management Information System (PMIS).

Syllabus

Module 1. Introduction:

Phases of a construction project, Construction project management and its relevance, Stakeholders of a construction project, Forms of business organizations, Important traits of a project coordinator, Ethical conduct for engineers.

Module 2. Construction Economics:

Economic decision making, Time value of money, Cash-flow diagrams, Using interest tables, Present worth comparison, Future worth comparison, Annual cost and Worth comparison, Rate of return method, Effect of taxation on comparison of alternatives, Effect of inflation on cash flow.

Module 3. Construction Planning:

Types of project plans- Time/ Manpower/ Material/ Construction equipment/ Finance plans.Work-Breakdown structure, Event and activity, Dummy activity, Fulkerson's rule, PERT- Time computations, Earliest expected time, Latest allowable time, Slack, Critical path; CPM – Networks, Time estimates, Start and Finish times of activity, Floats, Super critical activity, Critical activity, Sub critical activity, critical path.

Module 4. Construction Contract, Construction Quality Management:

Contract document – Contract drawings, Specifications, General / Special conditions of contract, Bill of quantities; Classification of contracts - Separated/ Management/ Integrated/ Discretionary contracts; Bidding process – Pre- qualification, Notice inviting tender, Bid submission, Letter of intent, Work order, Agreement; Subcontracting. Construction quality, Inspection, Quality control and Quality Assurance in projects.

Module 5. Project Management Information System (PMIS):

Importance of information in project context, PMIS framework, Project data structuring, Codification, Performance reporting, Trend analysis, Information communication /retrieval using IT applications, Project documents management, Factors affecting PMIS success.

Text books:

3. Construction Project Management – Theory and Practice – Kumar Neeraj Jha, Pearson

4. Project Planning and Control with PERT and CPM – B.C. Punmia & K.K. Khandelwal, Laxmi Publications (P) Ltd

5. Construction Project Management – Planning, Scheduling and Controlling – K.K. Chitkara, McGraw Hill Education (India) Private Limited

Reference books:

3. Construction Management and Machinery – B.L. Gupta & Amit Gupta, Standard Publishers Distributors.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	√
Tutorials/Assignments	√
Seminars	√
Mini projects/Projects	√
Laboratory experiments/teaching aids	
Industrial/guest lectures	√
Industrial visits/in-plant training	√
Self- learning such as use of NPTEL materials and internets	√
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End SemExamination Marks	50
Quiz	10 + 10
Assignment	5

AssessmentCompoents	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√			
End Sem Examination Marks	√	√	√	√	√
Quiz 1	√	√			
Quiz 2			√	√	√
Assignment	√	√	√	√	√

Indirect Assessment –

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Course Outcome #	Program Outcomes												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2		1	3			2	2	3	2	3	3		1
2	3	3		1	3				2	2	3	3	3		
3	3	3		1	3				2	2	2	3	3	2	
4	2	2		1	2				2	2	2	3	2	2	2
5	3	3		1	3				2	2	2	3	3		

Mapping Between COs and Course Delivery (CD) methods

CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2, CD3, CD4, CD6, CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2, CD3, CD4, CD6, CD8
CD3	Seminars		CO3	CD1, CD2, CD3, CD4, CD6, CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, CD3, CD4, CD6, CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD3, CD4, CD6, CD7, CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 210
Course title: EARTHQUAKE ENGINEERING AND DISASTER MANAGEMENT
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: 4TH SEMESTER/ LEVEL 2
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students:

A.	To understand basic principles for structural dynamics and earthquake resistant design for construction of earthquake resistant structures. (K1, K2, K3, K4)
B.	To understand basic concepts in Disaster Management (K1, K2)
C.	To learn the disaster preparedness as well as mitigating the damages. (K1, K2)

Course Outcomes

After the completion of this course, students will be able:

1.	To develop dynamic equations of motion and perform analysis for dynamic systems. (K1, K2, K3, K4)
2.	To apply the basic principles for seismic design and construction of structures. (K3)
3.	Apply the concepts of Earthquake Resistant Design to real life structures. (K1, K3)
4.	Understand the concepts of disaster management. (K1, K2)

K1- Remember; K2- Understand; K3- Apply; K4- Analyse; K5- Evaluate; K6- Create

Syllabus

Module I:
Concepts and definitions: disaster, disaster, hazard, vulnerability, risks severity, frequency and details, capacity, impact, prevention, mitigation.
Plate Tectonics and related Hazards, Earthquakes and their causes, Measurement of Earthquakes.

Module II:
Equations of Motion for SDOF and MDOF Systems; Undamped Free Vibration of SDOF and MDOF Systems, Mode Shapes and Frequencies of MDOF System

Module III:
Concept of earthquake Resistant design, design philosophy, Four virtues of EQRD: Stiffness, Strength, ductility and Configurations, Introduction to Capacity design concepts.
Module IV:
Natural disasters, manmade disasters, hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

Module V:
Disaster Preparedness, monitoring of phenomena triggering a disaster, Evaluation of risk.

Text books:

1. Pankaj Agarwal and Manish Shrikhande, 'Earthquake Resistant Design of Structures', PHI, 2008
2. S.K.Duggal; Earthquake resistance design of structures; Oxford University Press, New Delhi.
3. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company.
4. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
5. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
6. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).

Reference books:

1. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication
2. Ellis L. Krinitzsky, J.M. Gould and Peter H. Edinger, 'Fundamentals of Earthquake Resistant Construction', John Wiley, 1993
3. Newmark N.M. and Rosenblueth E., 'Fundamentals of Earthquake Engg.,' Prentice Hall, 1971.

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	
Mini projects/Projects	✓
Laboratory experiments/teaching aids	
Industrial/guest lectures	
Industrial visits/in-plant training	
Self- learning such as use of NPTEL materials and internets	✓
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz (s) (1 &2)	10+10
Teachers assessment	5

Assessment Compoents	CO1	CO2	CO3	CO4
Mid Sem Examination Marks	✓	✓		✓
End Sem Examination Marks	✓	✓	✓	✓
Quiz 1	✓			✓
Quiz 2		✓	✓	
Assignment	✓	✓	✓	✓

Indirect Assessment –

1.Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program outcomes												Program specific outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	1									1	2		
2	3	3	1			2						1	2	2	
3	3	3	1			2		2				1	3	2	2
4						3	2					1			2

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2 and CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2 and CD8
CD3	Seminars		CO3	CD1, CD2 and CD8
CD4	Mini projects/Projects		CO4	CD1, CD2 and CD8
CD5	Laboratory experiments/teaching aids			
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 301
Course title: STRUCTURAL DESIGN – I
Pre-requisite(s):
Co- requisite(s):
Credits: 4 L:4 T:0 P:0
Class schedule per week: 4
Class: B. Tech
Semester / Level: 5TH SEMESTER / LEVEL 3
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students to:

A.	Know and understand materials, loads and design philosophy for designing reinforced concrete structures. (K1, K2)
B	Apply knowledge of limit state design method in addressing design problems of structural engineering. (K1, K2, K2, K4)

Course Outcomes

After the completion of this course, students will be to:

1.	Identify and apply appropriate parameters, assumptions and design criteria. (K1, K2, K3, K4)
2.	Design a simple reinforced concrete structural system. (K1, K2, K4)
3.	Have familiarity with the IS456:2000 code of practice. (K1, K2)

Syllabus

Module I: Introduction to Limit State Design of RCC
Design Loads, Materials for Reinforced Concrete and Code requirements, Factor of Safety, Characteristic and design loads, Characteristic and design strength, Design Philosophy, Principles of limit states, Stress block parameters for limit state of collapse.

Module II: Design of Beams
Design of beams for rectangular and flanged sections for moment and shears, Reinforcement requirements Anchorages of bars, check for development length, Design of RC members for combined bending shear and torsion

Module III: Design of Slabs
General consideration of design of slabs, Rectangular slabs spanning one direction, Rectangular slabs spanning in two directions for various boundary conditions. Design of flat slab – direct method; Circular slab; Slab type staircase.

Module IV: Design of Columns
General consideration of design of column, Columns with uni-axial and bi-axial bending, use of design charts.

Module V: Design of Footings
Loads on footing, Design basis for limit state method, Design of wall footing, Design of isolated rectangular footing for axial load and uniaxial moment, design of pedestal.

Text books:

1. Subramanian,N.,"Design of Reinforced Concrete Structures",Oxford University Press, New Delhi, 2013.
2. Punmia.B.C., Ashok Kumar Jain, Arun Kumar Jain, "Limit State Design of Reinforced Concrete",Laxmi Publication Pvt. Ltd., New Delhi, 2007.
3. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, Pvt. Ltd., New Delhi, 2002.
4. Gambhir.M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi, 2006.

Reference books:

1. IS456:2000, Code of practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi, 2000
2. SP16, IS456:1978 "Design Aids for Reinforced Concrete to Bureau of Indian Standards, New Delhi, 1999

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	
Mini projects/Projects	✓
Laboratory experiments/teaching aids	
Industrial/guest lectures	
Industrial visits/in-plant training	
Self- learning such as use of NPTEL materials and internets	✓
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz (s) (1 &2)	10+10
Teachers assessment	5

Assessment Components	CO1	CO2	CO3
Mid Sem Examination Marks	✓	✓	✓
End Sem Examination Marks	✓	✓	✓
Quiz 1	✓	✓	✓
Quiz 2	✓	✓	✓
Assignment		✓	✓

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program outcomes												Program specific outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	1	2				1		3	2		
2	3	3	3	2	1	2				2		3	3		
3						3		3							3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2, CD4, CD8
CD3	Seminars		CO3	CD2, CD4, CD8
CD4	Mini projects/Projects			

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD5	Laboratory experiments/teaching aids			
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 302
Course title: WATER RESOURCES ENGINEERING
Pre-requisite(s):
Co- requisite(s):
Credits: 4 L: 4 T: 0 P: 0
Class schedule per week: 4
Class: B. Tech
Semester / Level: 5th SEMESTER / LEVEL 3
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students:

A.	To acquire the knowledge of hydrology that deals with the occurrence, distribution and movement of water on the earth. (K1, K2)
B.	To understand the concepts of surface water and groundwater hydrology. (K2)
C.	To know about water distribution systems and their designing aspects. (K2)
D.	To analyse and design the dams and spillways. (K3, K4, K5)

Course Outcomes

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

1.	Understand the interaction among various processes in the hydrologic cycle. (K1, K2)
2.	Investigate various processes of surface water hydrology. (K3, K4, K5)
3.	Understand and analyse the sub-surface hydrology and well hydraulics. (K2, K3, K4)
4.	Grasp the knowledge of water distribution systems and their various design aspects for an irrigation channel. (K2, K3, K4, K5)
5.	Analyse and design various dams, spillways and reservoirs. (K3, K4, K5)

Syllabus

Module I: Introduction
Hydrologic cycle, water-budget equation, history of hydrology, world water balance, applications in engineering, sources of data.

Module II: Surface-Water Hydrology
Precipitation: Forms of precipitation, Characteristics of precipitation in India, Measurement of precipitation, Rain gauge network, Mean precipitation, Depth-area-duration relationships, Maximum intensity/Depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), Rainfall data in India.
Abstractions from Precipitation: Evaporation and methods for its reduction, Evaporimeters, Evaporation estimation, Evapotranspiration, Measurement of evapotranspiration, Potential evapotranspiration, Actual evapotranspiration, Interception, Depression storage, Infiltration, Infiltration capacity, Measurement of infiltration, Infiltration indices.
Runoff: Runoff volume, SCS-CN method of estimating runoff, Flow duration curve, Flow-mass curve, Hydrograph, Base flow separation, Effective rainfall, Unit hydrograph, Surface water resources of India.

Module III: Groundwater and Well Hydrology

Groundwater: Forms of subsurface water, Saturated formation, Aquifers, Geologic formations of aquifers.

Well Hydraulics: Steady state flow in wells, Equilibrium equations for confined and unconfined aquifers, Aquifer tests.

Water Withdrawals and Uses: Water for energy production, agriculture and hydroelectric generation; flood control, Analysis of surface water supply,

Water requirement of crops, Crops and crop seasons in India, Cropping pattern, Duty and Delta, Quality of irrigation water, Soil-water relationships, Root zone soil water, Infiltration, Consumptive use, Irrigation requirement,

Methods of Applying Water to the Fields: Surface, sub-surface, sprinkler and trickle / drip irrigation.

Module IV: Distribution Systems

Water Distribution Systems: Canal systems, Alignment of canals, Canal losses, Estimation of design discharge.

Design of Channels: Rigid boundary channels, Alluvial channels, Kennedy's and Lacey's theory of regime channels.

Canal Outlets: Non-modular, semi-modular and modular outlets.

Water logging: Causes, effects and remedial measures. Lining of canals, Types of lining.

Drainage of irrigated lands: Necessity, Methods.

Module 5: Dams and Spillways

Embankment Dams: Classification, Design considerations, Estimation and control of seepage, Slope protection.

Gravity Dams: Forces on gravity dams, Causes of failure, Stress analysis, Elementary and practical profile.

Arch and Buttress Dams.

Spillways: Components of spillways, Types of gates for spillway crests;

Reservoirs: Types, Capacity of reservoirs, Yield of reservoir, Reservoir regulation, Sedimentation, Economic height of dam, Selection of suitable site.

Text/Reference books:

1. Engineering Hydrology, K. Subramanya, Tata McGraw Hill.
2. Applied Hydrology, K. N. Muthreja, Tata Mc-Graw Hill.
3. Water Resources Engineering through Objective Questions, K. Subramanya, Tata McGraw Hill.
4. Irrigation Engineering, G. L. Asawa, Wiley Eastern.
5. Water Resources Engineering, L. W. Mays, Wiley.
6. Irrigation, J. D. Zimmerman, John Wiley & Sons.
7. Engineering Hydrology, C. S. P. Ojha, R. Berndtsson and P. Bhunya, Oxford.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10+10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination	✓	✓			
End Sem Examination	✓	✓	✓	✓	✓
Quiz 1	✓	✓			
Quiz 2			✓	✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓	✓

Indirect Assessment –

3. Student Feedback on Faculty
4. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes												Program Specific Outcome	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	2	2	2	3	1	3	1	3	3	2	3	2	1
2	3	3	3	3	3	3	3	2	3	2	2	3	3	2
3	3	3	3	3	3	3	3	2	3	2	3	3	3	3
4	3	3	3	3	3	3	3	2	3	2	3	3	3	3
5	3	3	3	3	3	3	3	2	3	2	3	3	3	3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2, CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2, CD5, CD8
CD3	Seminars		CO3	CD1, CD2, CD4, CD5, CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, CD4, CD5, CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD4, CD5, CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE303
Course title: GEOTECHNICAL ENGINEERING
Pre-requisite(s): None
Co- requisite(s):
Credits: L: 4 T: 0 P: 0 C: 4
Class schedule per week: 4
Class: B. Tech
Semester / Level: 3
Branch: Civil
Name of Teacher:

Course Objectives

This course enables the students:

1.	To understand the importance of soil as an engineering material and to acquire knowledge on the index properties of soil and their relationships which helps to classify and characterize soil and also to study the determination of these properties in the laboratory. (K2, K3)
2.	To estimate the various properties of soils such as permeability, seepage, compaction and consolidation parameters as a result of soil water interaction. (K3, K4)
3.	To study the shear strength parameters and its calculation from laboratory tests. (K4, K5)
4.	To identify the fundamental concept & theories used for foundation bearing capacity analysis. (K4, K5)
5.	To recognise the principle types of foundation (shallow & pile) and the factors governing the choice of a suitable type of foundation for specific projects. (K3, K4, K5)

Course Outcomes

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

CO1.	Classify soil from its index properties.
CO2.	Solve practical problems related to permeability and seepage, evaluate settlement problems due to consolidation and appreciate the importance of soil water interaction.
CO3.	Compute soil shear strength parameters for different field conditions.
CO4.	Estimate bearing capacity of foundations.
CO5.	Select suitable foundation types as per requirement & perform basic analysis for foundation systems including understanding their limitations together with proportioning different shallow foundations & estimate pile load carrying capacity.

Syllabus

Module 1 Fundamentals of Soil Mechanics -Introduction: Three-phase system : – soil solids, water and air; Basic definitions and functional relationships : -Specific gravity; Void ratio; Porosity; water content; Unit Weights & Density : -bulk, dry, saturated, submerged and natural; Degree of saturation & Density index ; Structure of soil; soil texture:- Size, range and shapes of individual soil particles; field identification of soils, Particles size distribution: Sieve

analysis; distribution curve characteristics; grain size analysis for fine-grained and mixed soils; use of hydrometer; Consistency limits and indices; Activity and Sensitivity of clays. Classification of Soils: based on soil type; by origin; by structure; Textural, Unified and Indian Standard Classifications 8 Lectures

Module II Soil Moisture Relationships - Capillarity in soils; Free and adsorbed water; Permeability of soils: Darcy's Law; Determination of coefficient of permeability by constant head & falling head tests, Permeability of stratified soil deposits. Factors affecting permeability; Seepage Analysis: Head, Gradient & Potential, Seepage pressure. Two dimensional flow -Laplace equation; Phreatic line in Earth dams; Graphical method of flow net construction: for flow below sheet piles, earth dams with or without core / filter; Seepage discharge across hydraulic structures; Flow net – electrical analogy; Pore water pressure and the concept of effective stress; Quick sand condition, Difference between Compaction and Consolidation; Compaction tests : Standard and Modified Proctor ; Factors affecting compaction; Field compaction; One-dimensional consolidation –spring analogy; Terzaghi's theory of one-dimensional consolidation; Consolidation of undisturbed & remoulded soils; Laboratory consolidation test –analysis and results; Coefficient of volume change, Coefficient of consolidation, Compression index, Degree of consolidation; Secondary consolidation 8 Lectures

Module III Shear Strength
Measurement of shear strength –Unconfined strength test; Direct shear tests; Vane shear test and Triaxial tests –strain-controlled tests; Concepts of both Unconsolidated and Consolidated specimens subjected to shear without drainage (with or without pore water pressure measurement); drained shear; Mohr strength envelopes for Total and Effective stresses; Mohr-Coulomb failure theory 8 Lectures

Module IV. Bearing capacity:
Terminology: Ultimate and Safe Bearing Capacities; Allowable Bearing Pressure Gross and Net Bearing Capacities; Net Soil pressure for a specified settlement; Bearing capacity from equations of Terzaghi, Skempton, and Meyerhoff; I. S. Code of Practice; Bearing capacity from N-values; Effect of ground water table, Plate Load test: Procedure& Limitations, determination of permissible bearing capacity for footings in sand and clay soils, Eccentrically loaded footings – useful width concept 8 Lectures

Module V. Shallow Foundations & Pile Foundation
Type of foundations: Isolated and combined footings; Rafts foundations Proportioning of footings for even settlement, Types of piles; Pile construction; Load carrying capacity of piles : Dynamic and static formulae; Group action and efficiency; Under-reamed piles; Negative skin friction – cause and prevention of n s f effect on piles; factor of safety of pile subjected to negative skin friction, Pile load tests 8 Lectures

Text books:
Soil Mechanics and Foundations by Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain
Geotechnical Engineering by C. Venkataramaiah

Reference books:
Soil Mechanics and Foundation Engineering by Santhosh Kumar Garg
Basic & Applied Soil Mechanics by Ranjan Gopal and A. S. R. Rao
Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	√
Seminars/Assignments	√
Laboratory experiments/teaching aids	√
Industrial/guest lectures	√
Industrial visits/in-plant training	√
Self- learning such as use of NPTEL materials and internets	√
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10 + 10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination	✓	✓	✓		
End Sem Examination	✓	✓	✓	✓	✓
Quiz 1	✓	✓	✓		
Quiz 2			✓	✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓	✓

Indirect Assessment –

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes												Program Specific Outcome		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	1	2	1	1	1	2	2	1	3	3	3	3
CO2	3	3	2	1	2	1	1	1	2	2	1	3	3	3	3
CO3	3	3	2	1	2	1	1	1	2	2	1	3	3	3	3
CO4	3	3	2	1	2	1	1	1	2	2	1	3	3	3	3
CO5	3	3	2	1	2	1	1	1	2	2	1	3	3	3	3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1 to CO5	CD1 to CD8
CD2	Tutorials/Assignments			
CD3	Seminars			
CD4	Mini projects/Projects			
CD5	Laboratory experiments/teaching aids			
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE304
Course title: ENVIRONMENTAL ENGINEERING
Pre-requisite(s):
Co- requisite(s):
Credits: 4 L:4 T:0 P:0
Class schedule per week: 4
Class: B.Tech.
Semester / Level: 5th SEMESTER/LEVEL 3
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students to:

A.	describe the importance of water quality and quantity and interpret the design water supply systems (K1, K2)
B.	apply the appropriate technologies for water treatment (K3)
C.	explain the impacts of sewage and select design conveyance systems for sewage and storm water (K2, K4)
D.	identify and apply appropriate process for the sewage treatment and sludge management (K2, K3)

Course Outcomes

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

1.	examine and explain various sources of water, water quality and quantity estimation (K1, K2)
2.	analyse appropriate water treatment technology (K3)
3.	interpret the concepts of water supply systems designing and management (K2, K4)
4.	understand and explain the fundamentals of wastewater generation, conveyance system, wastewater quality and different discharge standards (K2, K3)
5.	explain and illustrate various methods of wastewater and sewage sludge treatment (K2, K3)

Syllabus

Module I: Water
Sources of water, water quality requirement for different applications, water quality standards, water quality indices, water demand, population forecasting methods.

Module II: Water Treatment Processes
Aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes.

Module III: Water Supply Systems
Components of water supply system, conveyance of water, distribution system, water supply appurtenances, service reservoirs and design.

Module IV: Sewage
Need for conveyance and treatment of sewage, domestic wastewater and storm water estimation, conveyance of sewage - sewers, shapes design parameters, operation and maintenance of sewers, sewage pumping, sewer appurtenances, design of sewerage systems.

Module V: Sewage treatment
Physico-chemical and biological treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, sewage sludge management

Text books:

1. Water Supply Engineering: Environmental Engineering - Vol. I, S.K. Garg, Khanna Publishers, New Delhi
2. Sewage Disposal and Air Pollution Engineering: Environmental Engineering - Vol. II, S.K. Garg, Khanna Publishers, New Delhi
3. Introduction to Environmental Engineering and Science, G.M. Masters & Wendell Ela, PHI Publishers
4. Environmental Engineering, Peavy, H., Rowe, D.R, Tchobanoglous, G. Mc-Graw - Hill International

Reference books:

1. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.
2. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.
3. Metcalfe and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi.
4. Water and Wastewater Engineering – designs, principle and practice, Mackenzie L. Davis. McGraw-Hill Education

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10 + 10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination	✓	✓			
End Sem Examination	✓	✓	✓	✓	✓
Quiz 1	✓	✓			
Quiz 2			✓	✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓	✓

Indirect Assessment

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Course Outcome #	Program Outcomes												Program Specific Outcome	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		1	1	2			3						2	2
2		1	3	2			3						3	3
3	1	1	3	2			3						3	3
4	1	1	3	2			3						3	3
5	1	1	3	2			3						3	3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1
CD2	Tutorials/Assignments		CO2	CD1, CD2, CD3
CD3	Seminars		CO3	CD1
CD4	Mini projects/Projects		CO4	CD1
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD3
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 305
Course title: TRANSPORTATION ENGINEERING
Pre-requisite(s):
Co- requisite(s):
Credits: 4 L: 4 T: 0 P: 0
Class schedule per week: 4
Class: B. Tech
Semester / Level: 5TH SEMESTER/ LEVEL 3
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students:

A.	To understand the fundamentals of highway planning, highway alignment and concepts of geometric design of highways (K1, K2, K3, K4, K6).
B.	To analyse traffic flow fundamentals and plan traffic management (K2, K4).
C.	To design flexible and rigid pavements and execute construction and maintenance of highways (K2, K4, K6).
D.	To understand the various components of railway and fundamentals of railway engineering (K1, K2, K3)
E.	To study the concepts of geometric design of railway track and design of turn out , cross-overs and crossings (K4)

Course Outcomes

After the completion of this course, students will be:

1.	Able to execute highway planning, alignment and design highway geometrics (K1, K2, K3, K4, K5, K6).
2.	Able to understand traffic flow fundamentals and plan traffic management and control (K2, K4).
3.	Able to design flexible and rigid pavements and apply quality control in construction / maintenance works (K2, K4, K6).
4.	Able to understand the various components in railway engineering and its maintenance (K1, K2, K3).
5.	Able to design curves, crossings and turn-overs (K4).

Syllabus

Module I: Highway Planning, Highway Alignment and Geometric Design of Highways
Road pattern, Preparation of master-plan for highways and its phasing, Fundamental Principles of Highway Alignment, Factors controlling the selection of alignment, Engineering Surveys for a Highway Project; Road Cross-sectional Elements: Width of Carriageway, Formation Width, Right of Way, Camber, Shoulder, Kerb, Road Margins, Design Speed, Sight Distances, Design of Horizontal curves,

Super elevation, Extra widening on Horizontal curves, Transition curves, Set back distance at curves, Gradient, Design of Vertical curves – Summit and Valley curves

Module II: Traffic Engineering
Traffic Volume and Speed Studies, peak hour factor, Travel Time and Delay Studies, O-D studies, Statistical analysis of traffic data, Traffic flow elements and their inter-relationship, Traffic Capacity and LOS concept, PCU concept, Traffic Control Devices, Parking Studies, Accident studies, Intersections — At grade and Grade Separated Intersections and channelization, Traffic Control Devices, Traffic Signs, Traffic Signal Systems (Trail Cycle Method and Webster's Method), Traffic Islands, Road Markings; Trip generation, Trip distribution and Modal Split.

Module III: Pavement Design and Construction
Types of Pavements, Flexible and Rigid pavement, Pavement composition, Stresses in flexible pavements, concept of ESWL, EAL, VDF, Flexible Pavement Design as per IRC, Stresses in Concrete Pavements, Modulus of subgrade reaction, Design of rigid pavements as per IRC; Desirable properties and quality control tests of highway materials, bituminous mix design; constructions of cement concrete pavement and their joints (brief); Distresses in flexible and rigid pavements; Structural evaluation of flexible pavement by Benkelman Beam Method and overlay design by IRC method.

Module IV: Fundamentals of Railway Engineering
Common terminologies, Permanent way, Gauge, Stresses in Railway Track, Traction and Tractive Resistances, Coning of Wheels, Function of Rails, Type of rail sections, wear on rails, rail failures, Rail flaw detection, Creep of rails, Rail Joints, Function of sleepers, Types of sleepers, sleeper density, Ballast, Rail fixtures and fastenings, Formation and subgrade, Failures in rail embankment and measures, Location surveys and alignment, Signaling and interlocking

Module V: Geometric Design of Railway Tracks, Points and Crossings and Junctions
Cross-sectional Elements of a railway track, Horizontal curves, Super elevation or Cant, Equilibrium Cant, Cant deficiency, Cant excess, Negative superelevation, Gradients, Vertical curves, Turnouts, Points and switches, Crossings, Type of Crossings, track junctions, Design of a turnout, Design of diamond crossing and cross-over.

Text books:

1. Khanna S. K., Justo C. E. G., and Veeraraghavan A.: Highway Engineering (Nem Chand & Bros.)
2. Garber N. J. and Hoel L.: Traffic & Highway Engineering (Cengage Learning)
3. Chandra S. and Agrawal M.M. : Railway Engineering (Oxford University Press)
4. Saxena S.C. and Arora S.P.: A Text Book of Railway Engineering (DhanpatRai Publications)

Reference books:

1. Yoder, E. J., Witczak, M.W.: Principles of Pavement Design (Wiley)
2. Ministry of Road Transport and Highways (5^{th} Rev):Specifications for Road and Bridge Works (Indian Road Congress)

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10 + 10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination	✓	✓			
End Sem Examination	✓	✓	✓	✓	✓
Quiz 1	✓	✓			
Quiz 2			✓	✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓	✓

Indirect Assessment –

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Course Outcome	Program Outcomes												Program Specific Outcome		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	2	2	1	1			2	3		3	3	3
2	3	3	2	1	2	1				2	2		3	3	3
3	3	3	3	3	1	2				1	2		3	3	3
4	3	3	1	1	2	2	1			2	2		3	3	3
5	3	3	3	2	2	2				1	2		3	3	3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2 and CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2 and CD8
CD3	Seminars		CO3	CD1, CD2, CD4, CD5 and CD8
CD4	Mini projects/Projects		CO4	CD1, CD2 and CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2 and CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 308
Course title: STRUCTURAL DESIGN II
Pre-requisite(s): CE 201/AR 2004
Co- requisite(s):
Credits: 4 L: 4 T: 0 P: 0
Class schedule per week: 4
Class: B.Tech.
Semester / Level: 6TH SEMESTER/LEVEL 3
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students to:

1	Discuss the behaviour and design principles of various structural steel elements in accordance to IS 800:2007. (K1, K2, K3, K4)

Course Outcomes

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

1.	Enhance confidence on designing abilities for steel structures. (K1, K2, K3, K4)
2.	Apply IS 800:2007 provisions to design various structural steel elements. (K3, K4)
3.	To design primary steel structural elements and their connections. (K3, K4)
4.	Self-motivated inquiry. (K5)

K1- Remember; K2- Understand; K3- Apply; K4- Analyse; K5- Evaluate; K6- Create

Syllabus

Module I: Structural Steel and Design Approaches
Engineering properties and characteristics of structural steel, Types of sections, Rolling process – necessity and importance. Loads and loading standards, assessment of lateral loads as per IS codes. Introduction to Plastic analysis, Methods of design – working stress, LRFD and Limit state design,

Module II: Connections
Bolted connections - Design of bolted connections subjected to direct and eccentric loadings.
Welded connections - Design of welded connections subjected to direct and eccentric loadings.

Module III: Design of Tension Members
Types of tension members, sectional areas, types of failure, design strength, design of tension members, lug angles and splices.

Module IV: Compression Members and foundation design
Types of section, section classification, column formulae, buckling classification. Design strength of simple members and struts, Design of built up and compound members including splicing, lacing and battening, Design of column bases and foundation.

Module V: Design of Flexural Members
Concept of lateral restraint, laterally supported and unsupported beams, section classification, Elastic and plastic sections modulus, Determination plastic section modulus of sections, IS criteria for design, Design of simple and plated beams.

Text books:

1. Design of Steel Structures, N. Subramanyam, Oxford University Press, New Delhi, india, 2008
2. Limit State Design of Steel Structures, S. K. Duggal, Tata McGraw Hill Education Private Limited, New Delhi, India, 2015
3. Design of Steel Structures, P. Dayarathnam, Prentice Hall India, New Delhi, India, 2011

Reference books:

1. IS : 800 – 2007 Code of Practice for General Construction in Steel
2. SP : 6(1) – 1964 Handbook for Structural Engineers : I. Structural Steel Sections
3. Teaching Resources for Structural Steel Design – Vol. I & II, INSDAG, Kolkatta.
4. Gaylord, E.H., Gaylord, N.C., and Stallmeyer, J.E., Design of Steel Structures, 3rd edition, McGraw-Hill Publications

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	
Mini projects/Projects	✓
Laboratory experiments/teaching aids	
Industrial/guest lectures	
Industrial visits/in-plant training	
Self- learning such as use of NPTEL materials and internets	✓
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz (s) (1 &2)	10+10
Teachers assessment	5

Assessment Compoents	CO1	CO2	CO3	CO4
Mid Sem Examination Marks	✓	✓	✓	
End Sem Examination Marks	✓	✓	✓	
Quiz 1	✓	✓	✓	
Quiz 2	✓	✓	✓	
Assignment				✓

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program outcomes												Program specific outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	1		2		2		2			3		
2	3	3	3	1		3		3		1			3		3
3	3	3	3	1		3		3					3		
4	3	3	3	2	2	2		2				3		2	

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1 and CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2 and CD8
CD3	Seminars		CO3	CD1, CD2 and CD8
CD4	Mini projects/Projects		CO4	CD4
CD5	Laboratory experiments/teaching aids			
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 401
Course title: Professional Practice Law & Ethics
Pre-requisite(s):
Co- requisite(s):
Credits: L: 2 T: 0 P: 0
Class schedule per week: 2
Class: B,Tech.
Semester / Level: 7th Semester/ Level
Branch: Civil Engineering
Name of Teacher:

Course Objectives
This course enables the students to:

A.	Obtain knowledge about Professional Practice (K1, K2)
B.	Learn about Professional Ethics. (K2, K4)
C.	Know about General Principles of Contract Management (K3)
D.	Learn Method of engaging Labour. (K2, K4)
E.	Learn about laws relating to Intellectual property (K2, K4)

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

1.	Explain respective roles of various stakeholders: Government (constituting regulatory bodies (K1, K2)
2.	Explain Professional Ethics (K2, K4)
3.	Explain Indian contract act, 1972 and general principles of contracting (K3)
4.	Explain method of engaging labour (K2,K4)
5.	Explain laws relating to intellectual property (K2, K4)

Syllabus
Module 1. Professional Practice – :
Respective roles of various stakeholders: Government (constituting regulatory bodies and standardization organizations, prescribing norms to ensure safety of the citizens); Developers (role governed by regulations such as RERA); Consultants (role governed by bodies such as CEAI); Contractors (role governed by contracts and regulatory Acts and Standards); Manufacturers/ Vendors/Service agencies (role governed by contracts and regulatory Acts and Standards)

Module 2. Professional Ethics – :
Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in the website of Institution of Engineers (India).

Module 3. General Principles of Contracts Management: -
Indian Contract Act, 1972 and amendments covering General principles of contracting; Contract Formation & Law; Privacy of contract; Various types of contract and their features; Valid & Voidable Contracts; Prime and Sub contracts; Joint Ventures & Consortium; Complex contract terminology; Tenders, Request For Proposals, Bids & Proposals; Bid Evaluation; Contract Conditions & Specifications.

Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system: Arbitration –meaning, scope and types

Module 4. Engagement of Labour

Role of Labour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piece rate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing
Orders) Act,1946; Workmen's Compensation Act, 1923; Building & Other Construction Workers.

Module 5. Laws relating to Intellectual property:

Meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright –computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India.

Text books:

1. Legal Aspects of Building and Engineering Contracts, 1974 - B.S. Patil,
2. Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset - Meena Rao (2006)
3. Construction Project Management – Planning, Scheduling and Controlling – K.K. Chitkara, McGraw Hill Education (India) Private Limited

Reference books:

a. The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai - Neelima Chandiramani (2000).

2. Law of Contract, Eastern Book Co - Avtar Singh (2002).

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	√
Tutorials/Assignments	√
Seminars	√
Mini projects/Projects	√
Laboratory experiments/teaching aids	√
Industrial/guest lectures	√
Industrial visits/in-plant training	√
Self- learning such as use of NPTEL materials and internets	√
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10 + 10
Assignment	5

AssessmentComponents	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√			
End Sem Examination Marks	√	√	√	√	√
Quiz 1	√	√			
Quiz 2			√	√	√
Assignment	√	√	√	√	√

Indirect Assessment –

1.Student feedback on teaching quality and teaching methods adopted

2. Student feedback on course syllabus and course outcome

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Course Outcome #	Program Outcomes												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2		1	3			2	2	3	2	3	3		1
2	3	3		1	3				2	2	3	3	3		
3	3	3		1	3				2	2	2	3	3	2	
4	2	2		1	2				2	2	2	3	2	2	2
5	3	3		1	3				2	2	2	3	3		

Mapping Between COs and Course Delivery (CD) methods

CD	Course Delivery methods		Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2, CD3, CD4, CD6, CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2, CD3, CD4, CD6, CD8
CD3	Seminars		CO3	CD1, CD2, CD3, CD4, CD6, CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, CD3, CD4, CD6, CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD3, CD4, CD6, CD7, CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

ELECTIVES

COURSE INFORMATION SHEET

Course code: CE 411
Course title: ADVANCED STRUCTURAL ANALYSIS
Pre-requisite(s): CE202 Structural Analysis – I and CE207 Structural Analysis - II
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students to:

1	Develop basic knowledge of structural analysis so that the students can solve real engineering problems. (K_1, K_2)
2	Understand behaviour of different kinds of framed structures subjected to simple and complex mechanical loadings. (K_1, K_2)
3	Analyse and design safe and sound civil engineering structures. (K_3, K_4)

Course Outcomes

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

1.	Evaluate the stability and determinacy of a given structure. (K_1, K_2, K_3)
2.	Evaluate safety of a proposed framed structure before construction and manufacturing. (K_4)
3.	Evaluate the behaviour of framed structures under the action of complex static loads. (K_1, K_2, K_3, K_4)
4.	Evaluate the behaviour of framed structures using advanced numerical techniques. (K_1, K_2, K_3, K_4)
5.	Evaluate deflections in a given framed structure. (K_3, K_4)

Syllabus

Module I: Introduction
Static and Kinematic Indeterminacy, Stability of Structures, Flexibility and Stiffness Matrix Methods. Matrix Algebra and Guass Jordan Elimination Method.

Module II: Matrix Method of Analysis
Coordinate Systems; Degree of freedom; Displacement and Force Transformation Matrices;

Module III: Stiffness Matrix Method for Trusses
Member stiffness relations: local and global. Structural stiffness relation. Analysis of trusses.

Module IV: Stiffness Matrix Method for Beams

Conventional and reduced Beam Element Stiffness relations (4 and 2 DOF);
Structural stiffness relation. Analysis of beams and continuous beams.

Module V: Stiffness Matrix Method for Plane Frames
Beam Element Stiffness relations (6 DOF): local and global;
Structural stiffness relation. Analysis of plane frames.

Text books:

1. Devdas Menon, "Advanced Structural Analysis", Narosa Publishing House, 2009.
2. Asslam Kassimali, "Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 1999.
3. Amin Ghali, Adam M Neville and Tom G Brown, "Structural Analysis: A Unified Classical and Matrix Approach", Sixth Edition, 2007, Chapman & Hall.

Reference books:

1. Matrix analysis of framed structures, Weaver and Gere.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz (s) (1 & 2)	10+10
Teacher's assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	✓	✓	✓		
End Sem Examination Marks	✓	✓	✓	✓	✓
Quiz 1	✓	✓	✓		
Quiz 2			✓	✓	✓
Assignment	✓	✓	✓	✓	✓

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Graduate Attributes

Course Outcome #	Program outcomes												Program specific outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	2								3	1	
2	3	2	3	2	2								3	1	
3	3	2	3	2	2								3	1	
4	3	2	3	2	2								3	1	
5	3	2	3	2	2								3	1	

Mapping Between COs and Course Delivery (CD) methods

CD	Course Delivery methods		Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2 and CD8
CD2	Tutorials/Assignments		CO2	CD1, CD4 and CD8
CD3	Seminars		CO3	CD1, CD2 and CD8
CD4	Mini projects/Projects		CO4	CD1, CD2 and CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2 and CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 412
Course title: STRUCTURAL DYNAMICS
Pre-requisite(s): CE 202, CE 206
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students:

A.	To study dynamic performance of a structure with idealization of structure as single degree of freedom, multiple degree of freedom system and to determine the response to free and forced vibrations. (K2, K3, K4)
B.	To analyse structural behaviour subjected to earthquake loading. (K3, K4)

Course Outcomes

After the completion of this course, students will be:

1.	Able to calculate response of SDOF and MDOF system. (K2, K3, K4)
2.	Able to find out mode shape, frequencies and amplitude for motion of two/three DOF systems. (K2, K3, K4)
3.	Able to solve problem on earthquake steeping loading by Cauchy Euler and Trapezoidal method. (K2, K3, K4)
4.	Able to analyse structure for earthquake forces according to IS code provisions. (K2, K3, K4)

K1- Remember; K2- Understand; K3- Apply; K4- Analyse; K5- Evaluate; K6- Create

Syllabus

Module I:
Introduction: Overview of Structural Dynamics, Single Degree of Freedom Systems – Analysis of Free Vibrations – undamped and damped systems, estimation of damping by logarithmic decrement method.

Module II:
Formulation of equation of motion for generalized SDOF dynamic problems using virtual work method, Response of SDOFS systems to Harmonic, Periodic, Impulse Loads.

Module III:
Formulation of equation of motion for two/three DOF systems, finding mode shapes and frequencies by solving the determinantal equation and iterative techniques, use of sweeping matrices for obtaining higher modes, Proof of Convergence, Modal superposition and Response Spectrum Methods.

Module IV:
Response of single and multiple DOFS systems to Earthquake Loading using Time-Stepping Methods based on Forward Cauchy Euler, Backward Cauchy Euler and Trapezoidal Rule, Accuracy, stability and algorithmic damping in step-by-step methods.

Module V:
Earthquake response analysis of Multi-DOF systems subjected to earthquake ground motion, Concept of modal mass and mode participation factors, Newark & Hall's linear and inelastic response spectra for earthquakes, Introduction to IS code provisions regarding earthquake.

Text books:

1. Chopra, A.K., "Dynamics of Structures – Theory and Applications to earthquake Engineering", Second Edition, Pearson Education, 2003.
2. Patrick Paultre, "Dynamics of Structures", John Willey & Sons, 2008.
3. Paz, M., "Structural Dynamics – Theory & Computation", CSB Publishers & Distributors, Shahdara, Delhi, 1985

Reference books:

1. Ray W. Clough &Penzien, "Dynamics of Structures", McGraw Hill, 1993.

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	
Mini projects/Projects	
Laboratory experiments/teaching aids	
Industrial/guest lectures	
Industrial visits/in-plant training	
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**			
Mid Sem Examination Marks	25			
End Sem Examination Marks	50			
Quiz (s) (1 &2)	10+10			
Teachers assessment	5			
Assessment Compoents	**CO1**	**CO2**	**CO3**	**CO4**
Mid Sem Examination Marks	✓	✓		
End Sem Examination Marks	✓	✓	✓	✓
Quiz 1	✓	✓		
Quiz 2		✓	✓	✓
Assignment	✓	✓	✓	

Indirect Assessment –

1.Student Feedback on Faculty

2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program outcomes												Program specific outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	1	1		1						2	2		
2	3	3	1	1								2			
3	3	3	1	2								2			
4	3	3	2	1		3		3							3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2 and CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2 and CD8
CD3	Seminars		CO3	CD1, CD2 and CD8
CD4	Mini projects/Projects		CO4	CD1, CD2 and CD8
CD5	Laboratory experiments/teaching aids			
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 413
Course title: CONCRETE TECHNOLOGY
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L: 3 T: 0 P:0
Class schedule per week: 3
Class: B.Tech.
Semester / Level: LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students to:

1	Familiarize concrete, its ingredients and its properties in fresh and hardened state. (K1, K2)
2	Perform mix design of concrete and to conduct NDT testing on concrete. (K3, K4, K5)

Course Outcomes

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

1.	Select ingredients of concrete such that the concrete achieves desirable quality. (K3)
2.	Conduct various tests needed to ascertain concrete quality. (K2, K3, K4)
3.	Design concrete as per Indian Standard code of practice. (K3, K4)
4.	Make decision for conducting suitable NDT tests on hardened concrete. (K3, K4)

K1- Remember; K2- Understand; K3- Apply; K4- Analyse; K5- Evaluate; K6- Create

Syllabus

Module I: Concrete ingredients
Cement- chemical composition, manufacture of OPC by wet and dry process, hydration of cement, types of cement. Testing of cement. Fine aggregate- grading analysis, specific gravity, bulking, moisture content, deleterious materials. Coarse aggregate- Importance of size, shape and texture. Grading of aggregates. Fineness modulus. Water- qualities of water. Use of sea water for mixing concrete. Admixtures – chemical admixtures- Plasticizers, accelerators, retarders and air entraining agents. Mineral admixtures- Fly ash, silica fumes and rice husk ash.

Module II: Fresh Concrete
Workability – factors affecting workability, Measurement of workability – slump, compaction factor, vee-bee and flow tests. Segregation and bleeding. Process of manufacturing of concrete – Batching, Mixing, transporting, Placing and compaction. Curing – methods of curing- Water curing, membrane curing, steam curing. Accelerated curing; Ready Mix Concrete.

Module III: Hardened concrete
Factors affecting strength, w/c ratio, gel-space ratio. Maturity concept Effect of aggregate properties, Relations between compressive strength, tensile strength and bond strength and modulus of rupture. Elasticity – Relation between modulus of elasticity and strength, Factors affecting modulus of elasticity,

Poison's ratio. Creep – measurement of creep, factors affecting creep, effect of creep Shrinkage of concrete- plastic shrinkage and drying shrinkage, factors affecting shrinkage, moisture movement. Durability – definition and significance of durability. Permeability. Sulphate attack, chloride attack, carbonation, freezing and thawing.

Module IV: Concrete Mix Design
Concept of Mix design, Variables in proportioning and exposure conditions. Procedure of mix design as per IS 10262-2009. Numerical examples of Mix design

Module V: Non-Destructive Testing of Concrete
Penetration and pull out test, rebound hammer test, ultrasonic pulse velocity – Principles, applications and limitations.

Text books:

1. Properties of Concrete, Neville, A.M., (2011), Pearson Education Ltd., England.
2. Concrete Technology (Theory and Practice), Shetty, M.S. (1982), S. Chand and company, New Delhi.
3. Concrete Technology, Gambhir, M.L. (2004), Tata McGraw-Hill Education, New Delhi.

Reference books:

1. Concrete Technology, Neville, A.M. and Brooks J.J. (2010), Prentice Hall, England.
2. Concrete Manual, Gambhir, M.L. (1992), Dhanpat Rai& Sons, New Delhi.
3. IS: 10262-2009: Indian Standard Concrete Mix Proportioning-Guidelines, BIS, New Delhi.
4. SP 23 (1982), Handbook on Concrete Mixes, BIS, New Delhi.
5. Manual of Concrete Practice (2015), ACI, USA.

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	
Mini projects/Projects	
Laboratory experiments/teaching aids	
Industrial/guest lectures	
Industrial visits/in-plant training	
Self- learning such as use of NPTEL materials and internets	✓
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz (s) (1 &2)	10+10
Teachers assessment	5

Assessment Compoents	CO1	CO2	CO3	CO4
Mid Sem Examination Marks	✓	✓		
End Sem Examination Marks	✓	✓	✓	✓
Quiz 1	✓	✓		
Quiz 2		✓	✓	✓
Assignment	✓	✓	✓	✓

Indirect Assessment –

1.Student Feedback on Faculty

2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program outcomes												Program specific outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1		2	2	2				2		3	2
2	2	1	1	1		3	2	3		2		2		3	2
3	2	2	1	1		3	2	3				2	2	3	3
4	2	3	1	1		3	2	3		1		2		2	2

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2 and CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2 and CD8
CD3	Seminars		CO3	CD1, CD2 and CD8
CD4	Mini projects/Projects		CO4	C CD1, CD2 and CD8
CD5	Laboratory experiments/teaching aids			
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 414
Course title: PRE-STRESSED CONCRETE
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students to:

1	Develop basic knowledge of prestressed concrete so that the students can solve real engineering problems. (K_1, K_2)
2	Understand behaviour of prestressed concrete structures subjected to simple and complex mechanical loadings. (K_1, K_2)
3	Analyse and design safe and sound prestressed concrete civil engineering structures. (K_3, K_4)

Course Outcomes

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

1.	Evaluate the feasibility of using prestressed concrete for a given structure. (K_1, K_2, K_3)
2.	Evaluate safety of a proposed prestressed concrete structure before construction and manufacturing. (K_4)
3.	Evaluate the behaviour of prestressed concrete structures under the action of complex static loads keeping in mind the losses in prestress. (K_1, K_2, K_3, K_4)
4.	Design or propose new prestressed concrete structures for solving real problems. (K_1, K_2, K_3, K_4)
5.	Evaluate serviceability of a given prestressed concrete structure. (K_3, K_4)

Syllabus

Module I: Introduction to Prestressed Concrete
Brief History, Advantages of Prestressing, Limitations of Prestressing, Types of Prestressing, Prestressing Systems and Devices, Properties of Hardened Concrete and Prestressing Steel.

Module II: Analysis of Members
Analysis of Members Under Axial Load, Analysis of Member Under Flexure, Cracking moment, Kern point, Pressure line, Analysis for Shear and Torsion

Module III: Losses in Prestress
Elastic Shortening, Friction, Anchorage Slip, Creep of Concrete, Shrinkage of Concrete, Relaxation of Steel.

Module IV: Design of Members
Design for Axial Tension, Design for Flexure, Design for Shear and Torsion.

Module V: Calculations of Deflection and Crack Width
Deflection due to Gravity Loads and Prestressing Force, Limits of Deflection, Limits of crack width and its calculation.

Text books:

1. Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981.
2. Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955.

Reference books:

1. Limited State Design of Prestressed Concrete, Guyan Y., Applied Science Publishers, 1972.
2. IS 1343- Code of Practice for Prestressed Concrete.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25

End Sem Examination Marks	50
Quiz (s) (1 & 2)	10+10
Teacher's assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Mid Sem Examination Marks	✓	✓	✓		
End Sem Examination Marks	✓	✓	✓	✓	✓
Quiz 1	✓	✓	✓		
Quiz 2			✓	✓	✓
Assignment	✓	✓	✓	✓	✓

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Graduate Attributes

Course Outcome #	**Program outcomes**												**Program specific outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	**3**	**2**	**3**	**2**	**2**								**3**	**1**	**3**
2	**3**	**2**	**3**	**2**	**2**								**3**	**1**	**3**
3	**3**	**2**	**3**	**2**	**2**								**3**	**1**	**3**
4	**3**	**2**	**3**	**2**	**2**								**3**	**1**	**3**
5	**3**	**2**	**3**	**2**	**2**								**3**	**1**	**3**

Mapping Between COs and Course Delivery (CD) methods

CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2 and CD8
CD2	Tutorials/Assignments		CO2	CD1, CD4 and CD8
CD3	Seminars		CO3	CD1, CD2 and CD8
CD4	Mini projects/Projects		CO4	CD1, CD2 and CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2 and CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 415
Course title: FLUID DYNAMICS
Pre-requisite(s): CE 203
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students:

A.	To acquire knowledge of the principles and applications of fluid dynamics. (K1, K2)
B.	To gain idea of the concepts of computational fluid dynamics. (K3, K4, K5)

Course Outcomes

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

1.	Understand the physical and mathematical description of continuum fluids including conservation laws and governing equations. (K2)
2.	Analyse various types of flows and apply exact solution of Navier-stokes equations. (K3, K4, K5)
3.	Deal with turbulent flows occurring in pipe and free surface flows. (K3, K4, K5)
4.	Investigate different types of compressible flows. (K2, K3, K4)
5.	Formulate and discretize flow problems using the concepts of computational fluid dynamics. (K3, K4, K5)

Syllabus

Module I: Basic Concepts and Fundamentals
Definitions and properties of fluids: Fluid as continuum, Langragian and Eulerian description, Velocity and stress field, Fluid statics, Fluid Kinematics.
Governing Equations of Fluid Motion: Reynolds transport theorem, Integral and differential forms of governing equations, Mass, momentum and energy conservation equations, Navier-Stokes equations, Euler's equation, Bernoulli's Equation.

Module II: Exact Solutions of Navier-Stokes Equations
Couette flows, Poiseuille flows, Fully developed flows in non-circular cross-sections, Unsteady flows, Creeping flows.
Potential Flows: Stream and velocity potential function, Circulation, Irrotational vortex, Plane potential flows, Uniform stream, Source and sink, Vortex flow, Doublet, Superposition of basic plane potential flows, Flow past a circular cylinder, Magnus effect, Kutta-Joukowski lift theorem, Concept of lift and drag.

Laminar Boundary Layer: Boundary layer equations, Boundary layer thickness, Boundary layer on a flat plate, Similarity solutions, Integral form of boundary layer equations, Approximate methods, Flow separation, Entry flow into a duct.
Elements of Stability Theory: Concept of small-disturbance stability, Orr-Sommerfeld equation, Inviscid stability theory, Boundary layer stability, Thermal instability, Transition to turbulence.

Module III: Turbulent Flow
Introduction, Fluctuations and time-averaging, General equations of turbulent flow, Turbulent boundary layer equation, Flat plate turbulent boundary layer, Turbulent pipe flow, Prandtl mixing hypothesis, Turbulence modeling, Free turbulent flows.

Module IV: Compressible Flows
Speed of sound and Mach number, Basic equations for one dimensional flows, Isentropic relations, Normal-shock wave, Rankine-Hugoniot relations, Fanno and Rayleigh curve, Mach waves, Oblique shock wave, Prandtl-Meyer expansion waves, Quasi-one dimensional flows, Compressible viscous flows, Compressible boundary layers.

Module V: Introduction to Computational Fluid Dynamics (CFD)
Boundary conditions, Basic discretization - Finite difference method, Finite volume method and Finite element method.

Text/Reference books:

1. Introduction to Fluid Mechanics, W. Robert Fox and T. Alan McDonald, 4th Edition, John Wiley & Sons, 1995.
2. Fluid Mechanics, Frank M. White, 6th Edition, Tata McGraw Hill, Singapore, 2008.
3. Advanced Engineering Fluid Mechanics, K. Muralidhar K. and G. Biswas, 2nd Edition, Narosa, 2005.
4. Fluid Mechanics, Pijush K. Kundu and Ira M. Cohen, 4th Edition, Academic Press (ELSEVIER), 2008.
5. Boundary Layer Theory, H. Schlichting, Springer, Verlag, 2000.

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10+10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination	✓	✓			
End Sem Examination	✓	✓	✓	✓	✓
Quiz 1	✓	✓			
Quiz 2			✓	✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓	✓

Indirect Assessment –

5. Student Feedback on Faculty
6. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes												Program Specific Outcome	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2	3	1	1	1	2	2	2	2	3	2	1
2	3	3	3	3	3	3	2	2	3	2	2	3	3	2
3	3	3	3	3	3	2	2	2	2	2	2	3	3	3
4	3	3	3	3	3	3	2	2	3	2	2	3	3	3
5	3	3	3	3	3	3	3	2	2	2	2	3	3	3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2, CD5, CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2, CD5, CD8

CD3	Seminars		CO3	CD1, CD2, CD5, CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD4, CD5, CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 416
Course title: OPEN CHANNEL FLOW
Pre-requisite(s): CE 203
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech.
Semester / Level: LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students:

A.	To understand the basic concepts of the movement of water in open channels. (K1, K2)
B.	To identify the characteristics of the flow and distinguish different kinds of flow in open channels. (K2, K3)
C.	To develop necessary knowledge, skills and techniques for analysis of practical channel flow problems. (K2, K3)
D.	To analyse the hydrodynamic aspects of water flow in natural or artificial channels. (K3, K4)
E.	To apply the knowledge of fluid mechanics and hydraulics to analyse and predict the behaviour of flow in natural bodies of water. (K3, K4, K5)

Course Outcomes

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

1.	Acquire knowledge to distinguish different types of flow and their variation in open channels. (K2, K3)
2.	Measure flow rate and discharge in rivers/channels. (K3, K4, K5)
3.	Analyse flow of fluids in open channels. (K3, K4, K5)
4.	Investigate rapidly varying flows for real life applications. (K3, K4, K5)
5.	Formulate and discretize flow problems using the concepts of computational fluid dynamics. (K3, K4, K5)

Syllabus

Module I: Introduction

Open channel flow, Geometrical parameters of a channel, Classification of open channels, Classification of open channel flow, Velocity distribution, Resistance relationships, Energy depth relationships, Specific energy and specific force, Normal and critical depths, Pressure, velocity and discharge measurements.

Module II: Uniform Flow
Continuity equation, Energy and momentum equation, Characteristics of uniform flow, Chezy's formula, Manning's formula, Factors affecting manning's roughness coefficient, Computation of uniform flow, Most efficient channel section.

Module III: Non-Uniform Flow in Open Channel
Specific energy curve, Discharge curve, Specific force curve, Specific depth, Critical flow, Critical depth, Measurement of discharge and velocity.
Gradually varied flow: Equation of gradually varied flow, Classification of channel bottom slopes, Classification of surface profiles, Characteristics of surface profiles, Computation of water surface profiles by graphical, numerical and analytical methods, Direct step method, Standard step method, Graphical integration method and direct integration method.

Module IV: Hydraulic Jump, Surges and Water Waves
Elements and characteristics of hydraulic jump, Classical hydraulic jump, Length, height and location of jump, Types of hydraulic jump, Applications and use of hydraulic jump, Energy dissipation, Evaluation of the jump elements in rectangular and nonrectangular channels, Open channel surge, Positive and negative surges, Celerity of gravity wave, Deep and shallow water waves, Hydraulic jump in channel transitions, Control of hydraulic jump, Momentum principle and its applications.

Module V: Unsteady Flows
Saint Venant's equations, Basics of Finite Difference Method, Solution of Saint Venant's equations using method of characteristics and finite difference schemes, Dam break problem, Hydraulic flood routing.

Text books:

1. Open Channel Flow by K. Subramanya, Tata McGraw Hill.
2. Open Channel Flows by M. H. Choudhary, Prentice-Hall.
3. Open Channel Hydraulics by Ven Te Chow, Tata McGraw Hill.

Reference books:

1. Flow through Open Channels by K. G. Ranga Raju, Tata McGraw Hill.
2. The Hydraulics of Open Channel Flow: An Introduction by H. Chanson, Elsevier.
3. Open Channel Hydraulics by R. H. French, McGraw Hill.

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓

Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10+10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination	✓	✓			
End Sem Examination	✓	✓	✓	✓	✓
Quiz 1	✓	✓			
Quiz 2			✓	✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓	✓

Indirect Assessment –

7. Student Feedback on Faculty
8. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes												Program Specific Outcome	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2	2	2	2	2	2	3	2	2	3	2	2
2	3	3	3	3	2	3	2	2	3	2	2	3	3	2
3	3	3	3	3	3	2	3	2	3	2	2	3	3	3
4	3	3	3	3	3	3	3	2	3	2	2	3	3	3
5	3	3	3	3	3	2	2	2	3	2	2	3	3	3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**

CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD5, CD8
CD2	Tutorials/Assignments		CO2	CD1, CD5, CD8
CD3	Seminars		CO3	CD1, CD2, CD5, CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, CD5, CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD4, CD5, CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 417
Course title: DESIGN OF HYDRAULIC STRUCTURES
Pre-requisite(s): CE 203
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students:

A.	To know about different types of hydraulic structures. (K1, K2)
B.	To analyse the forces acting on the hydraulic structures. (K2, K3, K4)
C.	To design hydraulic structures. (K3, K4, K5)
D.	To ensure fulfilment of societal requirements and environmental sustainability while designing the hydraulic structures. (K3, K4, K5, K6)

Course Outcomes

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

1.	Acquire knowledge of various types of dams. (K1, K2)
2.	Analyse the forces acting on a hydraulic structure, causes of their failure and their remedial measures. (K2, K3, K4)
3.	Analyse the requirement and design of a canal fall. (K2, K3, K4)
4.	Analyse and design cross-drainage works. (K3, K4, K5)
5.	Design and investigate various types of canal outlets and escapes. (K3, K4,K5)

Syllabus

Module I: Gravity Dams
Types of dams, Forces acting on a gravity dam, Modes of failure, Stability requirements, Principal and shear stress, Elementary Profile of a Gravity Dam, High and low gravity dams, Design of gravity dams.

Module II: Diversion Headworks
Component of diversion headworks Causes of failure of weirs and their remedies, Design of impervious floor, Design of vertical drop weir.

Module III: Canal Falls and Canal Regulators
Necessity of canal falls, Classification of falls, Cistern design, Design of Sarda type falls, Head regulators and cross regulators, Design of cross regulators and distributary head regulators.

Module IV: Cross Drainage Works
Types of cross drainage works, Selection of suitable type of cross drainage works, Classification of aqueducts and syphon aqueducts, design of cross drainage works.

Module V: Canal Outlets and Escapes
Types of canal outlets, Non-modular outlets, Flexible module, Rigid module, Canal escape

Text books:

1. Irrigation and Water Power Engineering by B.C. Punmia, Pande, B.B. Lal, Laxmi Publications.
2. Irrigation Engineering and Hydraulic Structures by S. K. Garg, Khanna Publishers.

Reference books:

1. Irrigation and Water Resource Engineering by G.L. Asawa, New Age Publishers.

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10+10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination	✓	✓			

End Sem Examination	✓	✓	✓	✓	✓
Quiz 1	✓	✓			
Quiz 2			✓	✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓	✓

Indirect Assessment –

9. Student Feedback on Faculty
10. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes												Program Specific Outcome	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3	3	2	2	3	2	3	2	2	3	3	3
2	3	3	3	3	2	2	3	2	3	2	2	3	3	3
3	3	3	3	3	3	2	3	2	3	2	2	3	3	3
4	3	3	3	3	3	2	3	2	3	2	2	3	3	3
5	3	3	3	3	2	2	3	2	3	2	2	3	3	3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD5, CD8
CD2	Tutorials/Assignments		CO2	CD1, CD5, CD8
CD3	Seminars		CO3	CD1, CD5, CD8
CD4	Mini projects/Projects		CO4	CD1, CD5, CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD5, CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 418
Course title: GROUNDWATER ENGINEERING
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L: 3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students:

A.	To understand concepts of hydrogeology and groundwater flow. (K1, K2)
B.	To measure and improve the quality of groundwater. (K2, K3, K4)
C.	To investigate the available of groundwater resources. (K3, K4, K5)
D.	To design groundwater flow models. (K3, K4, K5)

Course Outcomes

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

1.	Understand the aquifer parameters for estimation of groundwater resources at different geological conditions. (K1, K2)
2.	Understand well hydraulics and analyse the flow. (K2, K3, K4)
3.	Model the groundwater flow and design the artificial groundwater recharge. (K3, K4, K5)
4.	Investigate the ground water resources using different techniques. (K2, K3, K4, K5)
5.	Measure and analyse the groundwater quality. (K3, K4, K5)

Syllabus

Module I: Hydrogeology
Introduction: Groundwater development in India, Conjunctive use of groundwater, Groundwater in the hydrologic cycle, Vertical distribution of Groundwater, Geologic formations of aquifers, Types of aquifers, Storage Coefficient.
Groundwater Movement: Darcy's law, Permeability, Hydraulic Conductivity, Anisotropic Aquifers, Groundwater Flow rates and flow directions, General flow equations.

Module II: Well Hydraulics
Steady unidirectional flow, Steady radial flow in a well, Well in a uniform flow, Unsteady radial flow in confined and unconfined aquifers, Well flow near aquifer boundaries, Characteristic well losses, Specific capacity, Recharge methods, Artificial recharge, Water spreading, Wastewater Recharge, Recharge mounds.

Module III: Groundwater Modeling Techniques
Groundwater models, Porous media models, Analog models, Electrical analog models, Digital computer models.

Module IV: Groundwater Geophysical Investigations
Surface geophysical techniques, Electrical resistivity, Seismic refraction and reflection, Remote Sensing application.

Module V: Groundwater Quality
Water sampling, Groundwater quality standards, Potable water standards of WHO, Geotechnical survey of groundwater for various requirements.

Text/Reference books:

1. Ground Water Engineering, D. K. Todd, John Wiley.
2. Ground Water, H. M. Raghunath, New Age International.
3. Ground Water Hydrology, H. Bowner, McGraw Hill.

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10+10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination	✓	✓			
End Sem Examination	✓	✓	✓	✓	✓

Quiz 1	✓	✓			
Quiz 2			✓	✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓	✓

Indirect Assessment –

11. Student Feedback on Faculty
12. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes												Program Specific Outcome	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3	3	2	2	3	2	3	2	2	3	3	2
2	3	3	3	3	3	2	3	2	3	2	2	3	3	2
3	3	3	3	3	3	2	3	2	3	2	3	3	3	3
4	3	2	2	3	3	3	3	2	3	2	3	3	3	3
5	3	2	2	2	3	3	3	2	3	2	2	3	3	3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD5, CD8
CD2	Tutorials/Assignments		CO2	CD1, CD5, CD8
CD3	Seminars		CO3	CD1, CD2, CD5, CD8, CD9
CD4	Mini projects/Projects		CO4	CD1, CD5, CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD5, CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE419
Course title: ADVANCED GEOTECHNICAL ENGINEERING
Pre-requisite(s): CE303 Geotechnical Engineering
Co- requisite(s): None
Credits: L: 3 T: 0 P: 0 C: 3
Class schedule per week: 3
Class: B. Tech
Semester / Level: 04
Branch: Civil
Name of Teacher:

Course Objectives
This course enables the students:

1.	To familiarize with the procedures involved in a geotechnical site investigation. (K3)
2.	To estimate stress distribution & settlement in soil media. (K3, K4, K5)
3.	To understand the earth pressure theory. (K3, K4, K5)
4.	To study stability of slopes. (K3, K4)
5.	To comprehend the basics of machine & well foundations. (K4, K5)

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

CO1.	Perform soil investigation for common civil engineering works.
CO2.	Determine stress distributions in soils & estimate different types of settlement.
CO3.	Calculate earth pressure for the design of earth retaining Structures.
CO4.	Perform stability analysis of slopes.
CO5.	Analyse SDOF systems & understand the basic concept of machine & well foundations.

Syllabus

Module I. Site Investigation and subsoil exploration:
Methods of soil exploration; Planning a subsoil exploration: Number of boreholes and depths of exploration for various types of works; Field Tests: Standard penetration test; Dynamic and Static cone penetration tests; Vane shear test; Geophysical Exploration; Soil samplers & collection of soil samples 8 Lectures

Module II. Stress Distribution in Soil Media and Settlement:
Stress Distribution: Boussinesq's and Westergaard's equations, Pressure distribution diagram, Newmark's influence chart; Contact pressure below foundations –Steinbrenner's coefficients; Settlement of foundations : Elastic, Consolidation and Creep settlements; Total and Differential settlements; Rate of settlement, I. S. Code limitations for different structures Settlement calculation from consolidation characteristics and using N-values 8 Lectures

Module III Earth Pressure Theory
Plastic equilibrium in soil – active & passive cases. Active earth pressure –Rankine's Theory; Active & passive earth pressure of cohesive & cohesion-less soil; Rankine's active thrust by trial wedge; Coulomb's wedge theory – Rebhann's construction & Culmann's construction
8 Lectures

Module IV Stability of Slopes
Stability analysis of finite & infinite slopes; Types of slope failures; Methods of analysis for slope stability –method of slices; Bishop's simplified method; Friction circle method; Stability Number; Stability of slopes of Earth dams 8 Lectures

Module V. Introduction to Machine Foundations & Well Foundations
Soil dynamics, Mass-spring system with & without damping; Machine Foundations: Types of Machines and Machine Foundations, Vibration isolation: Types and Methods of Isolation, Shapes and Types of wells or caissons, their advantages and disadvantages; components of a well foundation; Depth of well foundation and bearing capacity; Forces acting on a well foundation. Well sinking: operation and problems 8 Lectures

Text books:
1. Geotechnical Engineering by C. Venkatramiah
2. Soil Mechanics & Foundations by B.C. Punmia, A.K. Jain & A. K. Jain

Reference books:
1. Soil Mechanics & Foundation Engg. by S. K. Garg
2. Basic & Applied Soil Mechanics by G. Ranjan & A.S.R. Rao

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	√
Seminars/Assignments	√
Laboratory experiments/teaching aids	√
Industrial/guest lectures	√
Industrial visits/in-plant training	√
Self- learning such as use of NPTEL materials and internets	√
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10 + 10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination	✓	✓	✓		
End Sem Examination	✓	✓	✓	✓	✓
Quiz 1	✓	✓	✓		
Quiz 2			✓	✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓	✓

Indirect Assessment –

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

Mapping between Course Outcomes and Program Outcomes

Course Outcome	Program Outcomes												Program Specific Outcome		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	2	2	2	1	2	2	2	3	3	3	3
CO2	3	3	3	2	2	2	2	1	2	2	2	3	3	3	3
CO3	3	3	3	2	2	2	2	1	2	2	2	3	3	3	3
CO4	3	3	3	2	2	2	2	1	2	2	2	3	3	3	3
CO5	3	3	3	2	2	2	2	1	2	2	2	3	3	3	3

Mapping Between COs and Course Delivery (CD) methods				
CD	Course Delivery methods		Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1 to CO5	CD1 to CD8
CD2	Tutorials/Assignments			
CD3	Seminars			
CD4	Mini projects/Projects			
CD5	Laboratory experiments/teaching aids			
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 420
Course title: AIR POLLUTION AND CONTROL
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B.Tech.
Semester / Level: LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students:

A.	To understanding the basic notions of air pollution. (K1, K2)
B.	To plan air pollution sampling and monitoring in industry. (K3)
C.	To describe the role of meteorology in air pollutant dispersal. (K1, K2)
D.	To identify appropriate air pollution control devices. (K3)
E.	To interpret the causes of vehicular pollution and devise control methods. (K3, K4)

Course Outcomes

After the completion of this course, students will be:

1.	Able to identify air pollution problems and interpret air quality data and design an air pollution sampling and monitoring plan. (K3)
2.	Able to analyze various meteorological condition and their effects in air pollutant dispersal. (K1, K2)
3.	Able to identify control equipment usage for air pollution control. (K1, K3)
4.	Able to monitor and suggest control of air pollutants. (K2, K3)
5.	Able to understand the causes of vehicular emission and the need for technological advancement for control. (K2)

Syllabus
Module 1
Introduction to air pollution and pollutants
Sources of ambient and indoor air pollution; types of air pollutants, fate of air pollutants, effects of air pollution in regional and global scale.
Module 2
Sampling and Monitoring of Air Pollutants
Objectives, ambient air sampling methods and devices, stack monitoring, and interpretation of air pollution data, air pollution standards and indices.
Module 3
Factors affecting dispersion of air pollutants
Temperature lapse rates and atmospheric stability, inversions, wind profiles, wind velocity and turbulence, plume behaviour, estimation of plume rise, dispersion equations, box model, gaussian plume model.

Module 4

Control technologies for control of air pollution

Control methods for air pollution, factors affecting selection of control equipment, working principle, design, operational considerations, process control and monitoring of particulate matter and gaseous pollutant control equipment, legislations, policies and guidelines for air pollution control.

Module 5

Control of vehicular emissions

Internal combustion engines, technological improvements of engines for reduction of vehicular emissions, after exhaust treatments, alternative transportation fuels, emission measurement and testing, regulation to control vehicular emission.

Textbooks:

i. Environmental Engineering- Peavy & Rowe. Prentice Hall Pub.
ii. Air Pollution Control – Rao and Rao
iii. Environmental Pollution and Control – C.S. Rao

Reference books:

i. Noel de Nevers, Air Pollution Control Engineering, Mc Graw Hill, New York.
ii. Arthur C. Stern, Air Pollution (Vol.I – Vol.VIII), Academic Press
iii. Introduction to Environmental Engineering and Science, Gilbert M Masters
iv. CPCB manual for Guidelines for ambient air quality monitoring. Published By: Dr. B. Sengupta, Member Secretary, Central Pollution Control Board

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10 + 10
Assignment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**

Mid Sem Examination	✓	✓			
End Sem Examination	✓	✓	✓	✓	✓
Quiz 1	✓	✓			
Quiz 2			✓	✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓	✓

Indirect Assessment

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes												Program Specific Outcome		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1		1	2	2		3	3		1			1	2		
2		2	3	2		2	3					1	1		
3	2	2	3	2	2	3	3	2	1		1	1	3		1
4	2	2	3	3	2	3	3	1	2		2	2	3		1
5	1	2	3	2	3	2	3	1				1	2		3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2
CD2	Tutorials/Assignments		CO2	CD1, CD2, CD3
CD3	Seminars		CO3	CD1, CD2
CD4	Mini projects/Projects		CO4	CD1, CD2, CD3
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD3
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 421
Course title: SOLID WASTE MANAGEMENT
Pre-requisite(s): CE 101 ENVIRONMENTAL SCIENCE
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: 7TH SEMESTER/ LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students:

A.	To understand the components of solid waste management system (K1).
B.	To study and understand the collection, transfer and transport options of a municipal solid waste system (K1, K2).
C.	To examine the various processing/treatment options and study operations of various material recovery, resource recovery and energy recovery facility (K1, K2, K3, K4, K6).
D.	To study the design and operation of a municipal solid waste landfill (K1, K2, K3, K4)
E.	To learn the different technologies of landfill site reclamation and remediation (K1, K2, K4)

Course Outcomes

After the completion of this course, students will be:

1.	Able to review the components and characteristics of a solid waste management system (K1).
2.	Able to identify the various collection, transfer and transport mechanisms of municipal solid waste management (K1, K2).
3.	Able to design and operate various processing, material and energy recovery facilities (K1, K2, K3, K4, K6).
4.	Able to design and operate solid waste landfill (K1, K2, K3, K4).
5.	Able to understand the various methods of post-closure monitoring and landfill site reclamation (K1, K2, K4).

Syllabus

Module I: Fundamentals of Solid Waste Management and ISWM system
Sources and types of Municipal Solid Waste, waste generation rates, factors affecting generation, composition, characteristics, methods of sampling, effects of improper disposal of solid waste, functional elements of solid waste management, Municipal Solid Waste Rules; concept of ISWM system, source reduction of waste — reduction, reuse, recycling, onsite storage methods, handling and segregation of wastes at source.

Module II: Waste collection and transportation
Methods of collection of municipal solid wastes, collection vehicles, primary and secondary collection, manpower, collection routes, vehicle routing, transfer station – location and operation.

Module III: Waste processing techniques
Objectives of waste processing, component separation and volume reduction, various processing technologies — biological and chemical conversion methods, resource and energy recovery from composting, biomethanation, thermal processing methods.

Module IV: Landfill design and operation
Various disposal methods, landfills — site selection, site infrastructure, essential components of landfill; types of landfilling methods, landfill planning – phased operation, leachate management and gas control.

Module V: Landfill closure and post-closure
Environmental monitoring systems for landfill sites, closure and post-closure plans for landfills, landfill site rehabilitation, reclamation and remediation.

Text books:

1. CPHEEO, Ministry of Urban Development: Manual on Municipal Solid Waste Management 2016
2. CPHEEO, Ministry of Urban Development: Manual on Municipal Solid Waste Management 2000
3. Tchobanoglous G., Theisen H., Vigil S.: Integrated Solid Waste Management Engineering Principles and Management Issues. Mc-Graw Hill

Reference books:

1. Khan Iqbal H., Ahsan, N.: Testbook of Solid Waste Management. CBS Publisher and Distributors (P) Ltd.

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10 + 10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination	✓	✓			
End Sem Examination	✓	✓	✓	✓	✓
Quiz 1	✓	✓			
Quiz 2			✓	✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓	✓

Indirect Assessment –

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Course Outcome	Program Outcomes												Program Specific Outcome		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2				2	2	3							2	3
2	2	2	2	2	2	2	3			1	2		3	3	3
3	3	3	3	3	2	2	3			1	2		3	3	3
4	3	3	3	2		2	3			1	2		3	3	3
5	3	3	3	2	1	2	3				1		2	2	2

Mapping Between COs and Course Delivery (CD) methods				
CD	Course Delivery methods		Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2, CD6,CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2, CD6,CD8
CD3	Seminars		CO3	CD1, CD2, CD6,CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, CD6,CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD6, CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			

CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 422
Course title: ISO 14000 AND ENVIRONMENTAL MANAGEMENT SYSTEM
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students

A.	To develop an understanding of international environmental standards
B.	To develop basic knowledge on components of ISO 14000
C.	To develop and apply ISO 14000 for Environmental Management.

Course Outcomes

On completion of this course, students should be able to:

1.	Understand the need and origin of Environmental Management Standards(K1,K2)
2.	Identify environmental aspects and impacts (K2,K3,K4)
3.	Prepare audit checklist and conduct mock auditing (K3, K5)
4.	Identify global and national eco labels(K1)
5.	Assess and understand product life cycle and their environmental management (K6,K5,K4)

Syllabus

Module I: History and Origin
Industrial Pollution and need for pollution management, The evolution of environmental management standard, Technical Committee 207, ISO 14000 series, applicability of ISO 14000, legal considerations and requirements of ISO 14000.

Module II: Basic Concept
ISO 14000 based Environmental Management System: definition, principle, structure and benefits of Environmental Management System, Aspects and impacts, Preparation of documents for ISO 14000, ISO 14000 compliance.

Module III: Environmental Auditing
ISO 14010: EMS Audit-definition, objective, general principles, scope, types and guidelines of environmental auditing process. Registration process for implementing ISO 14000, registration problems.

Module IV: Eco Labels
ISO 14024: Eco-labelling communication to the public. Types of ecolabels, benefits of ecolabelling. Global and Indian ecolabels. Case study.

Module V: LCA and Performance Evaluation
ISO 14031: Evaluating the organization environmental performance. ISO 14020: Guidelines & standards on environmental claims & declarations. Case study.ISO 14040: Guidelines, general principle of conducting life cycle assessment (LCA), definition, stages and scope of LCA, Case Study.

Text Books:

1. Environmental Audit: A.K. Shrivastava. APH Pub Corp. New Delhi.
2. ISO 14000: Environmental Management 1st Edition, David L. Goetsch , Stanley Davis. ISBN-13: 978-0130812360. Jenson Books Inc.
3. ISO 14000 Environmental Management Standards: Engineering and Financial Aspects. Alan S. Morris. ISBN: 9780470851289 |Online ISBN:9780470090787 . John Wiley & Sons, Ltd

Reference Books:

1. Global Green standards: ISO 14000 and Sustainable Development. IISD pub. Minitoba.
2. ISO 14000 Answer Book: Environmental Management for the World Market (Wiley Quality Management) 1st Edition. by Dennis R. Sasseville W. Gary Wilson, Robert W. Lawson . ISBN-13: 978-0471179337. John Wiley and sons. Canada.

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	60
Assignment / Quiz (s)	15

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√			
End Sem Examination Marks	√	√	√	√	√
Assignment	√	√	√	√	√

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping Course Outcome with Programme Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1		1	2	2	1	1	1	2	1	1	1
2	3	2	1	1	1	2	3	2	2	2	1	2	1	3	3
3	3	3	2	2	2	3	4	3	3	2	2	2	3	2	3
4	2	1	1	1	1	2	2	3	2	3	1	2	1	1	1
5	2	3	1	2	2	3	3	3		`1	1	2	2	2	1

Mapping Between COs and Course Delivery (CD) methods

CD	Course Delivery methods		Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2, CD8,CD6
CD2	Tutorials/Assignments		CO2	CD1,CD2,CD8
CD3	Seminars		CO3	CD1,CD2,CD6,
CD4	Mini projects/Projects		CO4	CD1,CD2,CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1,CD2,CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 423
Course title: HARBOUR AND AIRPORT ENGINEERING
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L:3 T: 0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students:

A.	To have basic knowledge on ports, harbor and about various structures in a port and to study about the meteorological factors which affect a port/harbor (K1,K2)
B.	To study the maintenance of a port and to know about navigational aids and lock gates (K2,K3)
C.	To study about the planning of an airport, and zoning laws(K1,K2,K3)
D.	To have basic Knowledge on various components of airport engineering like runway, taxiway, apron, control tower, terminal building, aircraft parking system (K2,K3,K4)
E.	To study air traffic control and visual aids (K4,K5)

Course Outcomes

After the completion of this course, students will be:

1.	Able to understand the functions of various structures in a port/ harbor
2.	Having knowledge on dredging and the navigational aids which help a ship to take berth in a port.
3.	Having knowledge on the components and parts of an airport, aircraft and aircraft characteristics
4.	Able to Solve problems on runway length correction & its orientation by wind rose diagram, design of taxiways, terminal building
5.	Having knowledge on different landing aids and landing systems

Syllabus

Module I: Introduction -Ports and Harbours

History and development of water transportation; Types of water transportation; Advantages and disadvantage; Classification; Differences between port and harbour and their requirements; Site selection; Essential features of a good harbour- size, depth, turning basin, harbour entrances

Module II: Meteorological Parameters, Components of a harbour, Navigational aids

Natural phenomena –Tides, Wind and Waves, Littoral drift, Harbour works – Breakwaters, Wharves, Piers, Jetties, Quays, Berthing structures –Dolphins, Trestles, Moles, Mooringaccessories. Apron; Transit sheds; Warehouses Dredging –Different types and their operation. Navigational aids – Necessity, different types and requirements

Module III: Docks, Introduction to Airways
Types –Wet docks, Tidal basins, Repair docks, Dry docks, Floating docks, Marine railway; Locks and lock gates; Introduction –History & development of air transport, Advantages and disadvantages Airport Planning –Regional planning, Factors affecting site selection, Surveys; Airport classification. Airport obstructions –Zoning laws, Classification of obstructions, Imaginary surfaces, Approach zone, Turning zone

Module IV: Runway
Orientation –Wind rose diagram, Basic runway length, Corrections for elevation, temperature and gradient, Geometric design, Cruising speed, Air speed, Beaufortscale, Different types of runway; Airport capacity

Module V: Terminals, Air Traffic Control and Visual Aids.
Terminal area –Functions, Apron, Hangar, Aircraft parking system, Airport layouts; Airport markings and landings; Landing aids Landing systems – Instrumental landing system

Text books:

1. S.C. Rangwala: Airport Engineering
2. Srinivasan R: Harbour, Dock & Tunnel Engineering

Reference books:

1. Bindra S.P.: A Course in Docks & Harbour Engineering
2. Oza H.P.: Dock & Harbour Engineering
3. Vaswani N. K.: Airport Engineering
4. Khanna S.K. &Arora M.G.: Airport Planning & Design
5. Subhash C. Saxena: Airport Engineering Planning and Design

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	√
Tutorials/Assignments	√
Seminars	√
Mini projects/Projects	√
Laboratory experiments/teaching aids	√
Industrial/guest lectures	√
Industrial visits/in-plant training	√
Self- learning such as use of NPTEL materials and internets	√
Simulation	√

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50

Quiz	10+10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√			
End Sem Examination Marks	√	√	√	√	√
Quiz 1	√	√			
Quiz 2			√	√	√
Assignment	√	√	√	√	√

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes												PSOs		
	3	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	2	2	3	2	2	L	3	1	2	3	3	3
2	3	3	3	2	2	3	2	2	L	3	1	2	3	3	3
3	3	3	3	2	2	3	2	2	L	3	1	2	3	3	3
4	3	3	3	2	2	3	2	2	L	3	1	2	3	3	3
5	3	3	3	2	2	3	2	2	L	3	1	2	3	3	3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2, CD7, CD8
CD2	Tutorials/Assignments		CO2	CD, CD2, CD7, CD8
CD3	Seminars		CO3	CD1, CD2, CD7, CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, CD7, CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD7, CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 424
Course title: ADVANCED SURVEYING
Pre-requisite(s): CE 208 SURVEYING
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: 7TH SEMESTER/ LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students:

A.	To learn calculation of area and volume by different methods (K1, K2, K3).
B.	To learn the principles of tacheometric surveying (K1, K2, K3)
C.	To get the knowledge of photogrammetric surveying (K1, K2, K3).
D.	To know about the applications of remote sensing in surveying (K1, K2, K3).
E.	To learn the uses of GIS and GPS (K1, K2, K3).

Course Outcomes

After the completion of this course, students will be:

1.	Able to calculate the area and volume by different methods (K1, K2, K3).
2.	Able to perform tacheometric surveying (K1, K2, K3).
3.	Capable of conducting photogrammetric surveying (K1, K2, K3).
4.	Able to use remote sensing as a tool in civil engineering applications (K1, K2, K3)
5.	Able to apply GIS and GPS in the field of civil engineering (K1, K2, K3)

Syllabus

Module I: Calculation of Area and Volume
Areas computed by sub-division into triangles, areas from offsets to a base line, offsets at regular intervals, area by double meridian distances, area by co-ordinates, area computed from map measurements, planimeter. Measurement of volume from cross-sections, Prismoidal formula, Trapezoidal formula, prismoidal correction, curvature correction. Volume from spot levels, Volume from contour plan.

Module II: Tacheometric Surveying
Instruments involved, types of telescopes and stadia diaphragm, tacheometric constant; anallactic Lens, different systems of tacheometric measurements; Subtense Bar; field work in tacheometry.

Module III: Photogrammetric Surveying
Introduction, Definitions and nomenclatures, Photographic measurements, Aerial camera, Vertical photograph, Tilted photograph, Tilt and Relief, Parallax, Rectification and enlargements of photographs, Mosaics.

Module IV: Remote Sensing
Electromagnetic spectrum, Interaction of electromagnetic energy with matter, Remote-sensing sensor systems, Platforms, Ideal and Real remote-sensing systems, Applications of remote sensing, Land use/ Land cover analysis.

Module V: GIS and GPS
Data for GIS, Capabilities/ Functionalities of GIS, Map overlay analysis, Data quality, Sources of Errors in GIS, Applications of GIS; Satellite constellation, Operational control segment, Equipment segment, Determining satellite-to-user range, Calculation of user position, accuracy, Uses and applications of GPS.

Text books:

4. Punmia, B.C., Jain, A.K., Jain, A.K. "Surveying" – Vol. 1 and 2, Laxmi Publications (P) Ltd.
5. Duggal, S.K. "Surveying" – Vol. 1 and 2, McGraw-Hill Education (India) Pvt. Ltd.

Reference books:

1. Subramanian, R. "Surveying and Levelling" – Oxford University Press, New Delhi.

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10 + 10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination	✓	✓			
End Sem Examination	✓	✓	✓	✓	✓

Quiz 1	✓	✓	✓		
Quiz 2			✓	✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓	✓

Indirect Assessment –

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Course Outcome	**Program Outcomes**												**Program Specific Outcome**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	1	1	1			2	1	1		3	3	
2	3	3	3	1	1	1			2	1	1		3	3	
3	3	3	3	1	2	1			2	1	1		3	3	
4	3	3	3	1	3	1			2	1	1		3	3	
5	3	3	3	1	3	1			2	1	1		3	3	

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2 and CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2 and CD8
CD3	Seminars		CO3	CD1, CD2, and CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, and CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2 and CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 425
Course title: REMOTE SENSING IN CIVIL ENGINEERING
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives
This course enables the students:

A.	To develop basic understanding of remote sensing
B.	To interpret and develop understandings on satellite image interpretation
C.	To assess the application of RS technologies in Civil engineering

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

1.	Understand working principles of remote sensing, history of satellite development Procurement of India and global satellite data (K1,K2)
2.	Interpret satellite images, verify and derive conclusions(K3,K4)
3.	Apply processing tools to classify land use and land cover(K4,K5)
4	Integrate the applications of Air borne platforms (K4)
5	Understand the extent and apply remote sensing techniques in civil engineering(K5)

Syllabus

Module I: Principles of Remote Sensing
Definition and Historical overview, Image Procurement, Electromagnetic spectrum, Atmospheric Windows, Physics of Remote Sensing, Spectral Signatures, Spectral Response pattern of soil, Vegetation & water.

Module II: Satellite, Sensors and Image Interpretation
Imaging & non-imaging sensors, Active & passive sensors, High- and Low-resolution sensors, Sensor Resolutions, Indian and Global Satellites, Fundamentals of Image Interpretation Techniques. Applications of different sensors.

Module III: Image Processing
Contrast Enhancement, Filtering, Band Ratio and Indices. Supervised Classification and Unsupervised Clustering. Applications of processing tools.

Module IV: Platforms and Aerial Vehicles
Aerial Photography, platforms, UAVs and their applications in environmental management and Biodiversity conservation.

Module V: Applications in Civil Engineering
Applications of Remote Sensing in transportation, urban planning, water resource, and soil studies.

Text books:

1. Jensen, J.R., (2006) "Remote Sensing of the Environment – An Earth Resources Perspective", Pearson Education, Inc. (Singapore) Pvt. Ltd., Indian edition, Delhi.
2. Jensen, J.R., (1996) Introductory Digital Image Processing A remote sensing perspective. Prentice Hall Series in GIS , USA
3. Lillesand, Thomas M. and Kiefer, Ralph, W., (2007) "Remote Sensing and Image Interpretation", 4th Edition, John Wiley and Sons, New York

Reference books:

1. Sabins, F.F. Jr., (2007). 'Remote Sensing – Principles and Interpretation", W.H. Freeman & Co.
2. Reeves, Robert G. (1991), "Manual of Remote Sensing, Vol. I, American Society of Photogrammetry and Remote Sensing, Falls Church, Virginia, USA

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	√
Tutorials/Assignments	√
Seminars	√
Mini projects/Projects	√
Laboratory experiments/teaching aids	√
Industrial/guest lectures	√
Industrial visits/in-plant training	√
Self- learning such as use of NPTEL materials and internets	√
Simulation	√

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	60
Assignment / Quiz (s)	15

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√			
End Sem Examination Marks	√	√	√	√	√
Assignment		√	√	√	√

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	1	1	1	3	3	3	2	1	1	1	1	0
2	2	3	1	1	2	2	3	2	3	3	2	1	1	2	0
3	2	2	2	2	2	2	2	2	2	3	1	1	2	2	0
4	2	3	2	2	1	1	2	3	1	1	1	1	2	2	0
5	3	3	3	2	2	2	2	2	1	2	1	1	3	2	0

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1,CD2,CD8,
CD2	Tutorials/Assignments		CO2	CD1,CD2,CD8
CD3	Seminars		CO3	CD1,CD2, CD3,CD8
CD4	Mini projects/Projects		CO4	CD1,CD2, CD3,CD8
CD5	Laboratory experiments/teaching aids			
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 426

Course title **Application of Civil Engineering in Mining**

Pre-requisite(s):

Co- requisite(s):

Credits: L:3 T: 0 P: 0

Class schedule per week:3

Class: B,Tech.

Semester / Level: 7th Semester/ Level 4

Branch: Civil Engineering

Name of Teacher:

Course Objectives

This course enables the students to:

A.	Obtain knowledge about basics of Rock Mechanics (K1, K2)
B.	Learn Engineering behaviour of Rock. (K2, K4)
C.	Know about Mine planning . (K3)
D.	Learn about Rock and Waste dump stability (K2, K4)
E.	Learn about Mining Environment (K2, K4)

Course Outcomes

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

1.	Explain about Mechanical nature of rocks. (K1, K2)
2.	Explain influence of structural discontinuity in rock mass behaviour. (K2, K4)
3.	Explain opencast mining and underground mining (K3)
4.	How to analyse stability of Rock slope and Waste dump stability (K2,K4)
5.	Prepare EIA and EMP reports for MOEF and Climatology (K2, K4)

Syllabus

Module 1. Introduction and Basic Concepts – :

Rock as material-geological considerations; Rock forming minerals; Fabric of rocks; Mechanical nature of rock; Joints and Faults.

Methods of rock exploration; Direct penetration; Core boring; Core recovery; Rock Quality Designation; Laboratory testing of rock specimens: Uni-axial compression, Tri-axial shear tests at high confining pressures.

Module 2. Rock Engineering Behaviour: -

Mechanical behaviour: Strength of rocks; Influence of discontinuities upon engineering behaviour of rock masses; Rock quality indices; Joints; Folds and Faults; Methods of improving properties of rock masses: Pressure grouting; Consolidation grouting, Rock reinforcement.

Module 3. Introduction to Mining

Advantages and disadvantages of surface mining vis-à-vis underground mining; Open-pit layout and design; Selection of surface boundary of quarry; Difference between peat coal, lignite, bituminous and anthracite; Heavy earth moving machinery; Bench and dump formation; Dragline, shovel, bucket-wheel excavator; Surface miner; Dumper; Bench configuration of highwall; Formation of external and internal dump.

Module 4. : Rock and Waste Dump Slope stability in Surface Mining in Surface Mining
Slope failure in rock quarry batter, Failure in weathered rock: Toppling failure, plane failure and wedge failure in rock slope; Slope failure in soil slope or soft rock.
Different failure modes in waste dump; Geo-engineering parameters in waste dump stability; Stability of shovel-dumper dump; Stability of dragline dump; Stability of external dump; Different methods of stability analysis.

Module 5 : Mining Environment
Air, water and noise pollution due to surface-mining; Rehabilitation and resettlement policy of surface-mining; slope-stabilisation by geo-textiles; Reclamation of surface mining; Surface mine closure.

Text books:

1. Coal Mining : S.P.Mathur.
2. Surface Mining Technology : S.K.Das
3. Rock Slope Engineering: Hoek and Bray

Reference books:

1. Pit Slope Manual by CAN MET Canada.
2. Fundamental of Rock Mechanics. Jaeger and Cook

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	√
Tutorials/Assignments	√
Seminars	√
Mini projects/Projects	√
Laboratory experiments/teaching aids	√
Industrial/guest lectures	√
Industrial visits/in-plant training	√
Self- learning such as use of NPTEL materials and internets	√
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10 + 10
Assignment	5

AssessmentComponents	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√			
End Sem Examination Marks	√	√	√	√	√
Quiz 1	√	√			
Quiz 2			√	√	√
Assignment	√	√	√	√	√

Indirect Assessment –

1.Student feedback on teaching quality and teaching methods adopted

2. Student feedback on course syllabus and course outcome

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Course Outcome	Program Outcomes												Program Specific Outcomes		
#	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2		1	3			2	2	3	2	3	3		1
2	3	3		1	3				2	2	3	3	3		
3	3	3		1	3				2	2	2	3	3	2	
4	2	2		1	2				2	2	2	3	2	2	2
5	3	3		1	3				2	2	2	3	3		

Mapping Between COs and Course Delivery (CD) methods

CD	Course Delivery methods		Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2, CD3, CD4, CD6, CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2, CD3, CD4, CD6, CD8
CD3	Seminars		CO3	CD1, CD2, CD3, CD4, CD6, CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, CD3, CD4, CD6, CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD3, CD4, CD6, CD7, CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 427
Course title: BUILDING CONSTRUCTION
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: 7TH SEMESTER/ LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students:

A.	To understand the various steps involved in construction of a building foundation (K1, K2)
B.	To know the components of masonry works and their construction process (K1).
C.	To know about the different temporary structures erected in building construction and understand their uses (K1, K2)
D.	To know about the different roof and floor types and their construction methodology (K1)
E.	To get exposed to different types of wall finishing (K1)

Course Outcomes

After the completion of this course, students will be:

1.	Able to explain the various steps involved in construction of a building foundation (K1, K2).
2.	Able to plan and execute masonry work (K1).
3.	To identify the different types of temporary structures required in construction and explain their uses (K1, K2).
4.	Able to select the suitability of a floor/roof type and execute its construction (K1).
5.	Able to plan and execute wall-finishing works (K1).

Syllabus

Module I: Foundation construction
Site investigation, Foundation system, earthwork & excavation, keeping excavation dry.

Module II: Masonry materials and construction
Materials for stone and brick masonry, Types of stone masonry, principle to be observed in construction of stone masonry, joints in stone masonry, bonds in brick masonry, principle to be observed in construction of brick masonry, defects in brick masonry, concrete block masonry.

Module III: Temporary Structures
Classification of temporary structures, scaffolding, centering and shuttering, underpinning, shoring.

Module IV: Roofs and floors

Features of good roof, Classification of roofs, Roof covering for pitched roofs, flat roofs, surface drainage of flat roofs, repair of leaky roofs.
Sub-floor, finishing, Types of floors, construction of floors

Module V: Wall finishing

Plastering, Method of plastering, common defects of plaster-causes and remedies, pointing, white washing, colour washing, distemper, cement paint

Text books:

1. A Text Book of Building Construction and Construction Materials, G.S Birdie, T.D. Ahuja. Dhanpat Rai Publishing Company (P) Ltd.
2. Building Construction, S S Bhavikatti. Vikas Publishing House.

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10 + 10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination	✓	✓			
End Sem Examination	✓	✓	✓	✓	✓
Quiz 1	✓	✓			
Quiz 2			✓	✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓	✓

Indirect Assessment –

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Course Outcome	Program Outcomes												Program Specific Outcome		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	1		1	1				2	2		3	3	3
2	2	1	1		2	1				2	2		3	3	3
3	2		1	2	1					1	2		3	3	3
4	2	1	1			1				2	2		3	3	3
5	2				2		1			2	2		3	3	3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2 and CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2 and CD8
CD3	Seminars		CO3	CD1, CD2, CD5 and CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, CD6, CD7 and CD8
CD5	Laboratory experiments/teaching aids			
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 428
Course title: Construction Management
Pre-requisite(s):
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B,Tech.
Semester / Level: 6th/ 7th Semester, Level 4
Branch: Civil Engineering
Name of Teacher:

Course Objectives

This course enables the students to:

A.	Learn about basics of construction projects and its management. (K1, K2)
B.	Learn about construction economics. (K2, K4)
C.	Know about construction materials management. (K3)
D.	Learn about construction quality management. (K3)
E.	Learn construction safety management. (K3)

Course Outcomes

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

1.	Explain about construction project management and its relevance as well as ethical conduct of engineers. (K1, K2)
2.	Work out economics of the construction project. (K2, K4)
3.	Manage procurement of construction materials and inventory. (K3)
4.	Implement quality control/ management technique during constructions. (K3)
5.	Implement safety management and form safety policies in construction projects. (K3)

Syllabus

Module 1. Introduction:

Indian construction industry, Construction project management and its relevance, Stakeholders of a construction project, Project organization.

Module 2. Construction Economics:

Introduction. Economic decision making. Cash-flow diagrams. Present worth comparison, Future worth comparison, Annual cost and worth comparison, Rate of return method. Project cost estimation-preliminary and revised estimates.

Module 3. Construction Material Management:

Material procurement process, Materials management functions – planning, procurement, custody, materials accounting, transportation, inventory monitoring and control, materials codification, source

development, disposal. Inventory management – inventory related cost, functions of inventory, inventory policies, selective inventory control, inventory models.

Module 4. Construction Quality Management:

Description of quality, Evolution of quality, Inspection and quality control. Total quality management, ISO standards, Audit, Construction productivity, Typical causes of low labour productivity.

Module 5. Construction Safety Management:

Evolution of safety, Health and safety act and regulations, Roles of safety personnel, Causes of accidents, Principles of safety, Safety and health management system – Safety policy and organization, Budget, Education and Training, Safety manual, Safety committee, Accident reporting, investigation and report keeping, Worker's health facilities.

Text books:

6. Construction Project Management – Theory and Practice – Kumar Neeraj Jha, Pearson

7. Construction Project Management – Planning, Scheduling and Controlling – K.K. Chitkara, McGraw Hill Education (India) Private Limited

Reference books:

4. Construction Management and Machinery – B.L. Gupta & Amit Gupta, Standard Publishers Distributors.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	√
Tutorials/Assignments	√
Seminars	√
Mini projects/Projects	√
Laboratory experiments/teaching aids	
Industrial/guest lectures	√
Industrial visits/in-plant training	√
Self- learning such as use of NPTEL materials and internets	√
Simulation	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End SemExamination Marks	50
Quiz	10 + 10
Assignment	5

AssessmentCompoents	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√			
End Sem Examination Marks	√	√	√	√	√
Quiz 1	√	√			
Quiz 2			√	√	√
Assignment	√	√	√	√	√

Indirect Assessment –

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Course Outcome #	Program Outcomes											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	2		1	3				2	2	2	3
2	3	3		1	3				2	2	3	3
3	3	1	2	2	3				2	2	2	3
4	3	1	2	2	3				2	2	2	3
5	3	1	2	2	3				2	2	2	3

Mapping Between COs and Course Delivery (CD) methods

CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2, CD3, CD4, CD6, CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2, CD3, CD4, CD6, CD8
CD3	Seminars		CO3	CD1, CD2, CD3, CD4, CD6, CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, CD3, CD4, CD6, CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD3, CD4, CD6, CD7, CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE 429
Course title: DISASTER MANANGEMENT
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: B.Tech.
Semester / Level: LEVEL 4
Branch: CIVIL ENGINEERING
Name of Teacher:

Course Objectives

This course enables the students to:

A.	Understand the disaster phenomenon and their implications in real life. (K1, K2)
B.	Acquire knowledge of various risk reduction measures to reduce the impact of disasters. (K1, K2)
C.	Know various structural and non-structural measures to prevent or mitigate impact of disasters. (K2, K3)
D.	Aware of the various institutions, organizations or bodies which manage disaster occurrences. (K1, K2, K3)

Course Outcomes

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

1.	Understand natural hazards and the disaster phenomenon along with their practical implications. (K1, K2)
2.	Know various disaster risk reduction techniques and disaster management process. (K2, K3)
3.	Understand the various meteorological disaster phenomena and know their preventive and remedial measures to reduce their impact in human lives. (K2, K3, K4)
4.	Become aware of various topographical disaster phenomena, their affects and possible preventive or mitigative measures. (K2, K3, K4)
5.	Create awareness among people and society regarding various biological and environmental disasters. (K3, K4, K6)

Syllabus

Module I: Introduction
Hazards and disasters, Distinction between hazard and disaster, History of disasters, Major trend, Characteristics and damage potential, Hazard assessment, Vulnerabily, Vulnerability assessment, Classification of disasters, Types of disasters, Natural and man-made disasters, Causes, effects and practical examples of the disasters, Response time, Frequency.

Module II: Disaster Risk Reduction and Management
Risk Management: Risk, Risk assessment, Risk management, Risk reduction, Crisis Management,

Disaster management: Principle, Planning, Awareness, Prediction and forewarning, Disaster Management cycle, Pre- and post-management stage, Preparedness, Mitigation, Response, Recovery, Rehabilitation, Capacity building, Community capacity building, Disaster management in India,
Institutional Organizations: Disaster management act, National policy, Institutional framework, National and international organizations, NDMA, Responsibilities of NDMA, Nodal agencies, Disaster management strategies.

Module III: Meteorological Disasters
Floods: Flood hazard and disaster, Flood hazards in India, Types of floods, Causes and effects, Flood management, Flood control and mitigation, Forecast and early warning.
Drought: Concept of drought, Impacts of drought, Consequences of drought, Types of drought, Drought profile, Drought hazards in India, Drought management, Drought risk reduction, Drought prediction and monitoring, Mitigation and prevention.
Tsunami: Tsunami wave characteristics, Tsunami Formation and evolution, Causes and effects, Identification and mapping, Protection, Warning system, Indian Ocean tsunami, Pre- and post-management of tsunami.
Cyclone: Characteristics, Occurrences, Distribution, Effects, Classification, Tropical cyclones, Cyclone reduction and management, Preparedness, mitigation and prevention.

Module IV: Topographical Disasters
Earthquake: Earthquake hazards/disasters, Earthquake characteristics, Plate tectonics, Causes of earthquakes, Distribution of earthquakes, Hazardous effects of earthquakes, Earthquake hazards in India, Epicenter, Hypocenter, Magnitude and intensity, Earthquake waves, Seismic zoning of India, Earthquake disaster reduction, Preparedness and mitigation, Rehabilitation, reconstruction and recovery.
Volcanoes: Volcanic hazard, Distribution, Causes and effects, Environmental impact, Risk and vulnerability, Management of volcanic disaster, Warning and prediction, Preparedness and mitigation, Rescue and relief.
Landslides: Meanings and concepts, Causes and effects, Types, Vulnerability and risk, Signs and early warning systems, Preparedness, prevention and mitigation.

Module V: Biological and Environmental Disasters
Biological Disasters: Biological hazards, Pathogen, Human, animal and plant epidemics, Mitigation and management, Safety and precautionary measures, Protection and control.
Global Warming: Evidence of global warming, Ozone depletion, Greenhouse effects, Effects of global warming, Global warming and climate change, Mitigation and remedial measures, Environmental laws.
Fire: Terminologies, Fire triangle, Fire resistance, Fire endurance, Fire detection and alarms, Fire safety, Prevention and mitigation measures.

Text books:

5. Disaster Science and Management, T. Bhattacharya, Tata McGraw Hill.
6. Disaster Management, M. Pandey, Wiley India Pvt. Ltd.

7. Natural Hazard and Disaster Management, S. C. Chakraborty.
8. Fire Safety in Building, V. K. Jain.

Reference books:

5. Manual on Disaster Management, National Disaster Management, Agency Govt. of India.

Gaps in the syllabus (to meet Industry/Profession requirements)
POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10 + 10
Assignment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Mid Sem Examination	✓	✓			
End Sem Examination	✓	✓	✓	✓	✓
Quiz 1	✓	✓			
Quiz 2			✓	✓	✓
Assessment/Assignment by Teacher	✓	✓	✓	✓	✓

Indirect Assessment

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Course Outcome #	Program Outcomes												Program Specific Outcome	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	1	1	2	2	1	2	3	2	1	2	1	3	2	2
2	1	1	2	2	1	2	3	2	1	2	1	3	2	2
3	1	2	2	2	1	2	3	2	1	2	1	3	2	2
4	1	2	2	2	1	2	3	2	1	2	1	3	2	2
5	1	2	2	2	1	2	3	2	1	2	1	3	2	2

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD5, CD8
CD2	Tutorials/Assignments		CO2	CD1, CD5, CD8
CD3	Seminars		CO3	CD1, CD2, CD4, CD5, CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, CD4, CD5, CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD4, CD5, CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

COURSE INFORMATION SHEET

Course code: CE430
Course title: ENVIRONMENT MANAGEMENT (OPEN ELECTIVE)
Pre-requisite(s): NA
Co- requisite(s): NA
Credits: L:2 T:0 P:0
Class schedule per week: 02
Class: B.Tech
Semester / Level: 03/01
Branch: All
Name of Teacher:

Course Objectives
This course enables the students:

1	To develop basic knowledge and understanding of principles of environment and its application. (K_1,K_2)
2	To identify and understand the structure and composition of the environment and its management. (K_1,K_2)
3	To analyse, how the environment is getting contaminated and probable control mechanisms for them. (K_1,K_2 K_3)
4	To generate awareness about management laws and regulation in india so that they become a sensitive citizen towards the changing environment. (K_1,K_2)

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

1	Able to explain the structure and function of ecosystems and their importance in the holistic environment. (K_1,K_2)
2	Able to identify the sources, causes, impacts and control of air pollution. (K_1,K_2)
3	Able to distinguish and analyse the various types of water pollution happening in the environment and understand about their effects and potential control mechanisms. (K_1,K_2 K_3)
4	Able to judge the importance of soil, causes of contamination and need of energy and waste management. (K_1,K_2)
5	Able to predict the sources of radiation hazards and pros and cons of noise pollution. (K_1,K_2)

Syllabus

Module-1: Environment and its components

Definition and components of Environment, Structure and Function of Environment, Levels of Organization in environment, Energy flow in environment, Food chain and Trophic level, Biogeochemical Cycles, Atmosphere: Composition and structure, terrestrial radiation, heat balance..

Module-2: Water and soil management

Water in biosphere, Surface and groundwater, Water management, Rain water harvesting, Water shed management. Lithosphere: landforms and types, Soil as basic natural resource- Definition and Composition, Formation of Soil, Properties of soil, Soil erosion- Causes, Effects and Control measures. Aquaculture- Inland water resources and their economic potential with respect to fisheries.

Module-3: Environmental pollution and its impact

Air Pollution: Definition, Sources of air pollution. Air pollutants (CO, CO_2, SO_2, NO_x, Hydrocarbons & aerosols). Green House Effect, acid rain, Ozone layer depletion and Smog. Water Pollution: Definition and sources of water pollution. Specific phenomena related with water pollution- Algal bloom, Eutrophication, Biomagnifications/ Bioaccumulation. Land/ Soil Pollution: Definition, Sources of land/ soil pollution, Specific phenomena related with land/ soil pollution, Noise Pollution: Definition, Measurement of noise and its intensity. Types and classification of waste: Air, Liquid and Solid.

Module-4: EIA and Environmental Laws

Environmental Acts, Rules and Notifications. a) Water (Prevention & Control of Pollution) Act and the corresponding Rule, b) Water (Prevention & Control of Pollution) Act and the corresponding Rule, c) Air (Prevention & Control of Pollution) Act and the corresponding Rule d) Environment (Protection) Act and Rule. Concept of Sustainable Development, EIA: Steps in EIA, ISO 9000 and ISO 14000, Environmental Audit. Forest: Forest types, role of forest, Forest Management and Wildlife conservation

Module-5: Energy Management

Conventional sources of energy: Coal, Oil and Natural gas, Thermal power, Firewood, Hydropower, Nuclear power. Non- Conventional Sources of Energy: Solar energy, Wind energy, Ocean/ Tidal energy, geothermal energy, Biomass based energy, Dendrothermal energy, Energy from urban waste, Bagasse based energy. Energy from refuse, recycling of waste materials. Forest: Forest types, role of forest, Forest Management and Wildlife conservation

Text books:

1. A, K. De. (3rd Ed). 2008. Environmental Chemistry. New Age Publications India Ltd.
2. R. Rajagopalan. 2016. Environmental Studies: From Crisis to Future by, 3rd edition, Oxford University Press.
3. Eugene P. Odum. 1971. Fundamentals of Ecology (3rd ed.) -. WB Sunders Company, Philadelphia.
4. C. N. Sawyer, P. L. McCarty and G. F. Parkin. 2002. Chemistry for Environmental Engineering and Science. John Henry Press.
5. S.C. Santra. 2011. Environmental Science. New Central Book Agency.

Reference books:

1. D.W. Conell. Basic Concepts of Environmental Chemistry, CRC Press.
2. Peavy, H.S, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw - Hill International
3. G.M. Masters & Wendell Ela. 1991. Introduction to Environmental Engineering and Science, PHI Publishers.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	✓
Tutorials/Assignments	✓
Seminars	✓
Mini projects/Projects	✓
Laboratory experiments/teaching aids	✓
Industrial/guest lectures	✓
Industrial visits/in-plant training	✓
Self- learning such as use of NPTEL materials and internets	✓
Simulation	✓

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz (s) (1 & 2)	10+10
Teacher's assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Mid sem exam	✓	✓	✓		
End Sem Examination Marks	✓	✓	✓	✓	✓
Quiz 1	✓	✓			
Quiz 2			✓	✓	✓
Assignment	✓	✓	✓	✓	✓

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Graduate Attributes

Course Outcome #	Program outcomes												Program specific outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1		**1**	**3**			**1**	**3**						**1**		
2		**1**	**3**			**1**	**3**						**1**		
3		**1**	**3**			**1**	**3**						**1**		
4		**1**	**3**			**1**	**3**						**1**		
5		**1**	**3**			**1**	**3**						**1**		

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD1, CD2, CD8
CD2	Tutorials/Assignments		CO2	CD1, CD2, CD8
CD3	Seminars		CO3	CD1, CD2, CD8
CD4	Mini projects/Projects		CO4	CD1, CD2, CD8
CD5	Laboratory experiments/teaching aids		CO5	CD1, CD2, CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			