GIRIJANANDA CHOWDHURY UNIVERSITY
Hathkhowapara, Azara, Guwahati 781017, Assam

School of Engineering & Technology

DEPARTMENT OF CIVIL ENGINEERING

B.Tech - Civil Engineering

Semester VI

Sl.No	Course Code	Course Name	Hours per week			Credits
			L	T	P	
1.	BCE23601T	Structural Design -II	3	1	0	4
2.	BCE23601P	Structural Design -II (STAAD LAB)	0	0	2	1
3.	BCE23602T	Intelligent Transportation Systems	3	0	0	3
4.	BCE23603T	Sustainable and Green construction	3	0	0	3
5.	BCE236PE**T	Program Elective Course -2	3	0	0	3
6.	BCE236PE**T	Program Elective Course -3	3	0	0	3
7.	MOPEC- 02	Multidisciplinary Open Electives Courses -2 *Principle of Management*	3	0	0	3
8.	MNC-AU-06	Instrumentation & Sensor Technologies for Civil Engineering Applications	3	0	0	0
		Total	**21**	**1**	**0**	**20**
9.		Minor/Honours/Value Added Courses (Optional)	3	0	0	3

Multidisciplinary Open Electives Courses

MOPEC – 01,02,03,04 – 4 courses x 3 credit each starts from Semester V

Multidisciplinary and holistic education across the sciences, social sciences, arts, humanities, and sports for a multidisciplinary world

https://www.ugc.gov.in/pdfnews/7193743_FYUGP.pdf

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Program Elective	VI Semester		
	Track	**Course Code**	**Course Name**
2	I	BCE236PE21T	Advanced Structural Analysis.
2	III	BCE236PE23T	Transport of Water and Wastewater
2	IV	BCE236PE24T	Open Channel flow
3	I	BCE236PE31T	Reliability Analysis of Structures
3	II	BCE236PE32T	Soil Mechanics II
3	III	BCE236PE33T	Environmental Impact Assessment and Life Cycle Analyses

TRACK I: Structural Engineering
TRACK II: Geotechnical Engineering
TRACK III: Environmental Engineering
TRACK IV: Water Resources Engineering

BCE23601T	Structural Design -II	L	T	P	C
		3	1	0	4

Pre-requisite: Nil

Course Objectives:

1. Design of roof truss system.
2. Design of columns and columns bases.
3. Design of structural steel flooring system.
4. Design of bolted and welded connections.

Expected Course Outcome:

Upon completion of this course, the student will be able to

1. Identify and compute the design loads on various structural steel systems.
2. Apply the limit state design philosophy for analysis and design of various structural steel components as well as steel connections.
3. Analyze various loads and load cases for design of various structural systems like roofs and floors.
4. Design of columns subjected to axial loads, combination of axial and bending loads using single or built-up members.

Module:1 ***Bolted and welded connections***	**15 hours**

Introduction to riveted connection, design of bolted and welded connections, axially and eccentrically loaded joints, simple connection of bracket plates to columns, beam to beam and beam to column connections, design of framed, unstiffened and stiffened seat connections.

Module:2 ***Roofing system***	**20 hours**

Imposed loads on flat and sloping roofs and floors, wind loads on sloping roofs and vertical cladding including effect of degree permeability and wind drag, analysis of pin-jointed trusses under various loading cases, computation of design forces in members, design and detailing of connections and supports

Module:3 ***Flooring system***	**5 hours**

Concept of floor system with secondary beams, main beams and columns, design of simply supported beams using rolled steel sections

Module:4 ***Columns and bases***	**8 hours**

Design of columns under axial loads using single or multiple rolled steel sections, design of lacing, battens, columns subjected to axial load and bending, design of slab and Gusseted base.

Total Lecture hours	**48 hours**

Text Book(s)

1.	S.K. Duggal, Limit State Design of Steel Structures, Tata McGraw Hill Education Private Limited, 2017. (ISBN: 9789351343493/9351343499)
2	N. Subramanian, Design of Steel Structures, Oxford University Press, 2011. (ISBN: 9780198068815/0198068816)
3	V.L. Shah and V. Gore, Limit State Design of Steel Structures IS:800-2007, Structures Publication, 2012. (ISBN: 8190371754)

Reference Books

1.	S.S. Bhavikatti, Design of Steel Structures, I.K. International Publishing House Limited, 2017.(ISBN: 9789385909559/938590955X)
2.	IS 800 (2007), General Construction in Steel- Code of Practice, Ced 7: Structural Engineering and Structural Section, Published by Bureau of Indian Standard ManakBhavan, New Delhi.
3.	IS 875- Part 1 (1987): Dead Loads, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Published by Bureau of Indian Standard Manak Bhavan, New Delhi.
4	IS 875- Part 2 (1987): Imposed Loads, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Published by Bureau of Indian Standard Manak Bhavan, New Delhi
5	IS 875- Part 3 (2017): Wind Loads, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Published by Bureau of Indian Standard Manak Bhavan, New Delhi

6	IS 875- Part 4 (1987): Snow Loads, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Published by Bureau of Indian Standard Manak Bhavan, New Delhi
7	IS 875- Part 5 (1987): Special Loads and Combinations, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Published by Bureau of Indian Standard Manak Bhavan, New Delhi

Mode of Assessment: Continuous Assessment Test, Quizzes, Assignments, Final Assessment Test			
Recommended by Board of Studies			
Approved by Academic Council		Date	

BCE23601P	STAAD Pro LAB	L	T	P	C
		0	0	2	1

Pre-requisite: Structural Analysis, Structural Design-I and Structural Design-II

Course Objectives:

1. To introduce students to STAAD Pro as a structural analysis and design tool.
2. To provide hands-on experience in modeling, analyzing, and designing civil engineering structures.
3. To develop skills for interpreting results and validating designs through code compliance.

Expected Course Outcome:

Upon completion of this course, the student will be able to:

1. Develop 2D and 3D structural models and assign appropriate loads and boundary conditions using STAAD.Pro.
2. Analyze structural systems and interpret results for various civil engineering applications.
3. Design basic RCC and steel members in compliance with IS codes using STAAD.Pro.

List of Experiments / Lab Sessions:		**11 hours**
1	Introduction to STAAD.Pro Interface and File Handling	
2	Modeling of Basic 2D Frames and Trusses	
3	Load Assignments: Dead Load, Live Load, Wind Load, Seismic Load (Manual & Auto methods)	
4	Support Assignments and Load Combinations	
5	Structural Analysis of Simply Supported and Cantilever Beams	
6	Analysis of 2D RCC Frame under various loading	
7	Design of RCC Beam and Column as per IS 456	
8	Design of Steel Beam and Column as per IS 800	
9	Analysis and Design of a G+2 RCC Building (Plan given)	
10	Introduction to Seismic Analysis using STAAD.Pro	
11	Foundation Design Module: Isolated & Combined Footing	

Mini Project	**4 hours**
Students will model, analyze, and design a G+3 residential or commercial building using STAAD.Pro, applying relevant codes and generating reports.	
Total Lecture hours	**15 hours**

Reference Materials

1.	STAAD.Pro User Manual (Bentley Systems)
2	Krishnamurthy, K., Structural Analysis and Design using STAAD.Pro, Cengage
3	IS Codes: IS 456:2000, IS 800:2007, IS 875 (Part I to V), IS 1893:2016
4	NPTEL video lectures on Structural Analysis and Design

Mode of Assessment: Continuous Assessment Test, Quizzes, Assignments, Final Assessment Test

Recommended by Board of Studies			
Approved by Academic Council		Date	

BCE23602T	INTELLIGENT TRANSPORTATION SYSTEMS	L	T	P	C
		3	0	0	3

Pre-requisite: Nil

Course Objectives:

1. To understand the basic concepts of ITS, including its role, responsibilities, benefits, and advantages in transportation systems.
2. To provide detailed discussions on data collection strategies and technologies used.
3. To provide an overview of ITS implementation in both developed and developing countries

Expected Course Outcome:

Upon completion of this course, the student will be able to

1. CO1: Explain ITS and its data collection techniques.
2. CO2: Identify the necessity of telecommunication and functional areas in ITS.
3. CO3: Explain the user needs and services of ITS
4. CO4: Elaborate AHS and different ITS programs in the world.

Module:1 ***Introduction to Intelligent Transportation Systems (ITS)***	**8 hours**
Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS, ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.	
Module:2 ***Telecommunications in ITS***	**10 hours**
Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC), Vehicle – Road side communication – Vehicle Positioning System.	
Module:3 ***ITS functional areas***	**10 hours**
Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).	
Module:4 ***ITS User Needs and Services***	**6 hours**
Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.	
Module:5 ***Automated Highway Systems*** **and** ***ITS Programs in the World***	**8 hours**
Vehicles in Platoons, Integration of Automated Highway Systems. Overview of ITS implementations in developed countries and developing countries.	
Total Lecture hours	**42 hours**

Text Book(s)

1.	Gordon, R. (2016), Intelligent Transportation Systems: Functional Design for Economical and Efficient Traffic Management, Springer.

Reference Books

1.	Sarkar, P.K and Jain, A. K. (2017), Intelligent Transport Systems, PHI Learning Pvt. Ltd., New Delhi
2.	Perallos, A. Jayo, U. H., Onieva, E. and Zuazola, I. G., (2015) Intelligent Transport Systems: Technologies and Applications, John Wiley and Sons, London.
3.	Chowdhury, M.A. and Sadek, A. (2003), Fundamentals of Intelligent Transportation Systems Planning, Artech House, USA.
4.	Ghosh, S., Lee, T.S. (2000), Intelligent Transportation Systems: New Principles and Architectures, CRC Press, New Delhi.

Mode of Assessment: Continuous Assessment Test, Quizzes, Assignments, Final Assessment Test

Recommended by Board of Studies			
Approved by Academic Council		Date	

BCE23603T	SUSTAINABLE AND GREEN CONSTRUCTION	L	T	P	C
		3	0	0	3

Pre-requisite: Nil

Course Objectives:

1. To explain the principles and importance of sustainable development in the construction industry.
2. To identify environmentally friendly construction materials and techniques.
3. To evaluate green building concepts, including energy efficiency, water conservation, and waste minimization.
4. To apply knowledge of green building rating systems such as LEED and analyze the lifecycle costs and benefits of sustainable construction practices.
5. To design construction projects incorporating sustainability strategies for site planning, energy, water, and materials.
6. To discuss ethical considerations in sustainable construction practices.

Expected Course Outcome:

Upon completion of this course, the student will be able to

1. To understand the principles of sustainability and identify sustainable building materials and technologies.
2. To use the concepts of energy efficient, water management system and sustainable site planning, building design.
3. To apply green building standards and certification and promote waste management in construction.
4. To analyze economic, social, and environmental implications of green construction decisions and examines ethical responsibilities in sustainable construction.

Module:1 *Introduction to sustainable development, Environment science and ecology:*	**4 hours**
Definition and principles of sustainable development, Historical context and evolution of sustainability, Global and local challenges related to sustainability, Fundamentals of ecology, Biodiversity and conservation, Climate change and its impacts, Environmental pollution and waste management.	
Module:2 *Sustainable construction Material and Technology*	**6 hours**
Green building materials and technologies, Life cycle assessment of materials, Resource efficiency and waste reduction in construction, Low-impact construction methods	
Module:3 *Energy Efficiency in Buildings and Water Management in Construction*	**6 hours**
Principles of energy-efficient design, Renewable energy integration in building design, Energy-efficient HVAC systems, Building energy modeling and simulation, Sustainable water use in construction processes, Rainwater harvesting and greywater recycling, Water-efficient construction practices, Strategies for mitigating water pollution on construction sites	
Module:4 *Sustainable Site Planning and Building Design:*	**6 hours**
Site selection and evaluation for sustainable construction, green space planning and landscaping, Sustainable stormwater management, Principles of green building design, Passive design strategies for energy efficiency, Daylighting and natural ventilation, Integration of sustainable technologies in design.	
Module:5 *Construction and Demolition Waste Management*	**6 hours**
Waste reduction and recycling in construction, Responsible demolition practices, Circular economy concepts in construction.	
Module: 6 *Building Certifications, Standards, Environmental regulations and policy*	**6 hours**
LEED (Leadership in Energy and Environmental Design) certification, BREEAM (Building Research Establishment Environmental Assessment Method), Other regional and international green building certifications, Building codes and regulations for sustainable construction - Environmental impact assessments - Government policies promoting green construction	
Module:7 Economics, Project management for Sustainable Construction, Ethics and social responsibility in construction	**6 hours**

Cost-benefit analysis for green building projects - Financial incentives for sustainable construction - Business models for green technologies in construction, Sustainable project planning and execution - Stakeholder engagement and communication - Monitoring and evaluating sustainability performance, Ethical considerations in sustainable construction - Social impacts of green construction projects- Community engagement and stakeholder involvement.			
Total Lecture hours			**40 hours**
Text Book(s)			
1.	Sustainable Construction: Green Building Design and Delivery (5th Edition) by Charles J. Kibert.		
Reference Books			
1.	*Handbook of Green Building Design and Construction* (2nd Edition) by Sam Kubba.		
2.	*Green Building with Concrete: Sustainable Design and Construction* (2nd Edition) edited by Gajanan M. Sabnis		
3.	*Sustainable Design for the Built Environment* by Rob Fleming and Saglinda H. Roberts		
Mode of Assessment: Continuous Assessment Test, Quizzes, Assignments, Final Assessment Test			
Recommended by Board of Studies			
Approved by Academic Council		Date	

BCE236PE21T	Advanced Structural Analysis	L	T	P	C
		3	0	0	3

Pre-requisite: Structural Analysis

Course Objectives:

To develop a deep understanding of structural behavior under various loading conditions using advanced analytical techniques such as elasticity theory, direct stiffness method, and finite element analysis, enabling students to solve boundary value problems and perform modal analysis of structural systems.

Expected Course Outcome:

Upon completion of this course, the student will be able to

1. Apply the fundamental concepts of elasticity to analyze stress and strain in structural components.
2. Formulate and solve structural problems using the Direct Stiffness Method for various types of structural systems.
3. Analyze and interpret boundary value problems relevant to structural engineering applications.
4. Perform modal analysis and understand the principles of the Finite Element Method for structural modeling and simulation.

Module:1 ***Concepts of Elasticity*** **8 hours**

Elasticity: Introduction, Components of strain and strain, Hooke's law, Plane stress and plane strain, Equations of equilibrium and compatibility,

Module:2 ***Direct Stiffness Method*** **14 hours**

Introduction to Local and Global/ Structure coordinate systems; displacement and force transformation matrices; Element and Structure stiffness matrices; equivalent joint loads; stiffness and flexibility approaches.

Formation of Member stiffness matrices in Local coordinate; Assembly of Structure stiffness matrix in Global coordinate; Understanding application of Boundary conditions; Formulation of Load vectors; Matrix solution for Global displacements. Structural Analysis of Plane truss, Beams, Plane Frames, Grids.

Module:3 ***Boundary value problems*** **8 hours**

Boundary conditions, Two dimensional problems in rectangular and polar coordinates, Bending of simple and cantilever beams.

Module:4 ***Model Analysis*** **8 hours**

Model Analysis: Structural similitude, Direct and indirect model analysis, Model material and model making, Measurement for forces and deformations

Module:5 ***Introduction to Finite element method*** **10 hours**

Introduction to Finite element method for structural analysis; Review of principle of virtual work, Ritz method, Discretization of domain, Basic element shape, Discretization process; Application of finite element method to one and two-dimensional plane stress-strain elements.

Total Lecture hours **48 hours**

Text Book(s)

1. Matrix Method of Structural Analysis-S S Bhavikatti, VIKASH PUBLISHING HOUSE PVT LTD
2. Advanced Structural Analysis-Devdas Menon, Narosa Publishing House, 2009.
3. Matrix Methods of Structural Analysis-P. N. Godbole R.S. Sonparote, S.U. Dhote, Publisher: PHI

Reference Books

1. Matrix Analysis Framed Structures -Weaver, William,Gere, James M. Publisher: CBS
2. Structural Analysis: T S Thandavamoorthy, Oxford University Press.
3. Basic Structural Analysis-C S Reddy, McGraw Hill Education (India) Pivate Ltd., New Delhi.
4. Structural Analysis-II- S SBhavikatti, Vikash Publishing House Pvt Ltd

Mode of Assessment: Continuous Assessment Test, Quizzes, Assignments, Final Assessment Test

Recommended by Board of Studies			
Approved by Academic Council		Date	

BCE236PE23T	TRANSPORT OF WATER AND WASTEWATER	L	T	P	C
		3	0	0	3

Pre-requisite: Nil

Course Objectives:

The objective of the course is to make students gain insight:

- into how the water and wastewater gets transported through conduits and open channels
- use the same for the design, operation and maintenance of these systems.

Expected Course Outcome:

CO1: Students will be able to interpret water supply system and understands its storage requirements, intake structures, design, distribution and balancing of reservoirs, understand uses of pipe materials and its operation and maintenance.

CO2: Students will be able to understand estimation of flow, sewer materials, flow hydraulics, layout of systems.

CO3: Students will be able to understand different Pumping systems and its types and its operation and maintenance.

CO4: Students will be able to understand and design storm water discharge and transition systems including flow hydraulics and material qualities and its operation and maintenance.

Module:1 Water Supply Systems: Storage requirements, impounding reservoirs, intake structures, pipe hydraulics, design of distribution systems, distribution and balancing reservoirs, pipe materials, appurtenances, maintenance and operation.	**10 hours**
Module:2 Sanitary Sewerage Systems: Flow estimation, sewer materials, hydraulics of flow in sewers, sewer lay out, sewer transitions, materials for sewers, appurtenances, manholes, sewer design, sewage pumps and pumping stations, corrosion prevention, operation and maintenance, safety.	**12 hours**
Module:3 Storm water Drainage Systems: Drainage layouts, storm runoff estimation, hydraulics of flow in storm water drains, materials, cross sections, design of storm water drainage systems, inlets, storm water pumping, operation and maintenance	**8 hours**
Total Lecture hours	**30 hours**

Text Book(s)

1. Waste Water Engineering, Laxmi Publication: Dr. B.C Punmia, Ashok Jain
2. Water Supply and Waste water: D.Lal & A.K Upadhyay
3. Waste Water Engineering, Treatment and Reuse: Metcalf and Eddy.

Reference Books

1. Water Supply and Sanitary Engineering: Rangawala

Mode of Assessment: Unit Test/Assignment/Class Test/Quiz

Recommended by Board of Studies			
Approved by Academic Council		Date	

BCE236PE24T	OPEN CHANNEL FLOW	L	T	P	C
		3	0	0	3

Pre-requisite: Nil

Course Objectives:

1. To know the types of open channel flow.
2. To obtain knowledge on the uniform flow, specific energy, Gradually and Rapidly varied flows.
3. To learn the basics of finite element method for flow problems.
4. To learn the flood estimation and flood routing methods.

Expected Course Outcome:

Upon completion of this course, the student will be able to

1. To understand the basic concept of open channel flow.
2. To apply physical mechanisms and apply mathematical relationships for hydraulic jumps, surges, and critical, uniform, and gradually varying flows.
3. To analyze the flow characteristics through finite element methods.
4. To design the flood routing by solving flood estimation problems using various methods.

Module:1 *Introduction to Open Channel Flow* — **3 hours**

Introduction, Differences in Open Channel and Pipe Flow, Types of Channel, Classification of Open Channel Flow. Computation of Hydraulic depth and Hydraulic Radius of different shapes of Channels.

Module:2 *Uniform Flow and Specific Energy* — **10 hours**

Introduction, Chezy's Equation for average velocity, Manning's Formula, Kutter's Formula, Bazin's Formula. Computation of uniform flow, Computation of normal depth –Trial & Error Method, Graphical method, Das& Bar Formula, Section factor curves. Related Numerical Problems. Hydraulically Efficient Channel sections, Numerical Problems. Specific Energy, Specific Energy Diagram and its characteristics, Minimum Specific Energy at a Given Discharge, Maximum Discharge at a Given Specific Energy, Critical Depth, Computations –Direct expression, Trial & Error Method, Section factor curves, Numerical Problems.

Module:3 *Steady Gradually Varied Flow* — **8 hours**

Dynamic equation of GVF (Steady) –dynamic equation for wide rectangular channel using Chezy's equation and Manning's formula. Classification & characteristics of water surface profile. Computation of GVF profile: Graphical Integration method, Direct step method, Introduction to Numerical methods.

Module:4 *Rapidly Varied Flow: Hydraulic Jump* — **8 hours**

Introduction, Practical uses of Jump, Types of Jump, Length of Jump, Velocity Profile and Pressure Distribution in Jump. Momentum Equation in Hydraulic Jump and finding of the relationship betweenthe sequent depths in case of horizontal rectangular frictionless channel. Numerical problems.

Module:5 *Basics of Numerical Methods* — **8 hours**

Basics of numerical methods: Finite- Difference and Finite Element Methods, Latest shock capturing Finite Volume methods for solving 1-D and 2-D shallow water flow equations.

Module:6 *Estimation of Flood* — **5 hours**

Introduction, Methods of Estimation –Rational method, envelop curves, Empirical formulae, PMP chart, UH method, Flood Frequency Analysis –Gumbel's method, Log-Pearson Type –III Distribution, (Allrelated numerical problems).

Module:7 *Flood Routing* — **6 hours**

Introduction–Reservoir routing and Channel routing, Hydrologic Routing–Basic Equations, Reservoir Routing by Modified Pul's Method, Channel Routing –Muskingum Equation and Muskingum method, Hydraulic Routing –Introduction by S.V. Equation.

Total Lecture hours — **48 hours**

Text Book(s)

1. Flow in Open Channels ---K. Subramanya, Tata McGraw Hill Education Private limited,2008.

Reference Books

1. Open Channel Flow ---M. M. Das PHI, 2009.

2.	Open Channel Hydraulics ---V. T. Chow, V. T. Chow, The Blackburn press, 2009.		
3.	Engineering Hydrology –K. Subramanya, Tata McGraw- Hill Education.		
Mode of Assessment: Continuous Assessment Test, Quizzes, Assignments, Final Assessment Test			
Recommended by Board of Studies			
Approved by Academic Council		Date	

BCE236PE31T	**RELIABILITY ANALYSIS OF STRUCTURES**	L	T	P	C
		3	0	0	3

Pre-requisite: Nil

Course Objectives:

1. To understand the fundamental principles of reliability in structural engineering.
2. To apply concepts of probability and statistics to model uncertainties in structural systems.
3. To use appropriate probabilistic models to evaluate structural performance.
4. To apply first-order reliability methods (FORM) to solve real-world structural reliability problems.
5. To model stochastic variations in material properties and loading conditions.
6. To perform reliability assessment of structural components and simple systems.

Expected Course Outcome:

Upon completion of this course, the student will be able to:

1. To understand the principles of reliability engineering and its application in structural systems.
2. To apply the concepts of tools for modeling uncertainty in engineering analysis and design.
3. To develop an understanding of probabilistic methods for evaluating structural safety and performance.
4. To analyze methods for reliability-based structural design.

Module:1 ***Introduction to Reliability in Civil Engineering:***	**4 hours**
Role of reliability in civil engineering; Historical background, Deterministic vs. probabilistic approaches in engineering.	
Module:2 ***Probability Theory and Random Variables***	**6 hours**
Random events, random variables, model uncertainty; Common probabilistic models; Important statistical parameters and their estimations, normal, lognormal, extreme value distribution.	
Module:3 ***Basic Concepts in Structural Reliability***	**6 hours**
Fundamental concept of structural reliability; Derivation of stress-strength interface equation, graphical representation of reliability concepts.	
Module:4 ***Reliability Index and Simple Reliability Computation:***	**6 hours**
Cornel reliability index, reliability and failure probability; computations for simple linear functions.	
Module:5 ***Second Moment and First-Order Reliability Methods***	**6 hours**
Second moment concepts; First order second moment theory, Hasofer-Lind transformation, Linear and non-linear limit state functions, Solution schemes, geometric interpretation of solution scheme, Rackwitz-Fiessler iterative method, First order reliability method.	
Module: 6 ***Stochastic Modeling in Structural Engineering and Reliability Assessment of Structural Systems*****.**	**6 hours**
Stochastic models for material strength, Stochastic modeling of loads, Reliability assessment of structural component and simple civil engineering structures.	
Total Lecture hours	**34 hours**

Text Book(s)

1. Structural Reliability Analysis & Design by Prof. R. Ranganathan (Author)

Reference Books

1. *Structural Reliability Analysis and Prediction - Robert E. Melchers, Andre T. Beck.*
2. *Probability and Statistics for Engineering and the Sciences by Jay L. Devore (Author)*
3. *Sustainable Design for the Built Environment* by Rob Fleming and Saglinda H. Roberts

Mode of Assessment: Continuous Assessment Test, Quizzes, Assignments, Final Assessment Test

Recommended by Board of Studies			
Approved by Academic Council		Date	

BCE236PE32T	**SOIL MECHANICS II**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Pre-requisite: Nil

Course Objectives:

1. To understand the theory of earth pressure on retaining walls and other retaining structures.
2. To assess stability of natural and man-made slopes and check its stability.
3. To plan and interpret subsurface investigations.
4. To determine bearing capacity and settlement of shallow foundations.
5. To analyze and design deep foundations such as piles and caissons.

Expected Course Outcome:

Upon completion of this course, the student will be able to

1. understand the theory of earth pressure on retaining walls, and other retaining structures.
2. identify the type of slope and compute its stability.
3. list the different methods of soil exploration.
4. calculate the bearing capacity of soil and design various types of foundations, including shallow foundations and deep foundations.

Module:1 *Earth Pressure Theories* — **8 hours**

Type of earth retaining structures. Lateral earth pressure. Active and passive earth pressure, earth pressure at rest. Theory application to all types of soils with different surcharge and saturation (Rankine's theory). Coulomb's wedge theory. Culmamm's graphical method for active earth pressure. Numerical problems.

Module:2 *Stability of Slopes* — **8 hours**

Infinite and finite slopes. Stability analysis of infinite and finite slopes. The Swedish slip circle method. Friction circle method. Use of Taylor's stability chart. Numerical solutions.

Module:3 *Ground Investigation and Geotechnical Characterization* — **8 hours**

Depth of exploration. Number and disposition of pits and boring. Ground water levels. Methods of sub surface exploration. Soil samples and samplers. Standard penetration test and different corrections over it. Seismic refraction method and electrical resistivity method.

Module:4 *Bearing Capacity* — **10 hours**

Bearing capacity criteria. Modes of Shear failure. Terzaghi's bearing capacity theory. Skempton's, Meyerhof's and Brinch Hansen's bearing capacity theory. B.I.S. Codal provision. Settlement analysis in sands and clays. Permissible settlements for different structures. Allowable bearing pressure. Bearing capacity from field tests-based on Standard Penetration Test, based on Cone Penetration Test, Based on Plate Load Test. Numerical Problem

Module:5 *Deep Foundation* — **8 hours**

Types of piles. Method of installation. Point resistance and skin friction. Load carrying capacity of piles -dynamic formulae, static formulae, pile load test. Group action in piles –efficiency, Under-reamed pile. Negative skin friction. Pull out resistance of piles. Numerical problems

Module:6 *Well Foundation* — **6 hours**

Types of wells and Caissons. Necessity, different components. Depth and bearing capacity calculations. Forces acting. Well sinking. Control of shifts and tilts.

Total Lecture hours — **48 hours**

Text Book(s)

1. Punmiya, B.C., Jain, A. K., Jain, A. K., (2017), Soil Mechanics and Foundation: Laxmi Publications; Sixteenth edition., New Delhi

Reference Books

1. Raj, P. P. (2018), Soil Mechanics and Foundation Engineering, Pearson Education in South Asia, Second Edition.
2. Moitra, D., (2016) Geotechnical Engineering Universities Press; First Edition edition
3. Gulati, S. K. & Dutta, M. (2005) Geotechnical Engineering, McGraw Hill Educaton
Bowles, J. E. (1977), Foundation Analysis and Design, McGraw Hill.

Mode of Assessment: Continuous Assessment Test, Quizzes, Assignments, Final Assessment Test

Recommended by Board of Studies			
Approved by Academic Council		Date	

BCE236PE33T	ENVIRONMENTAL IMPACT ASSESSMENT AND LIFE CYCLE ANALYSES	L	T	P	C
		3	0	0	3

Pre-requisite: Nil

Course Objectives:

To equip students with a comprehensive understanding of Environmental Impact Assessment (EIA) and Life Cycle Analysis (LCA) methodologies, alongside knowledge of environmental legislation, management systems, and auditing practices.

Expected Course Outcome:

Upon completion of this course, the student will be able to

1. Analyze the reciprocal impacts between human activities and the environment; apply the principles and methodologies of EIA, to assess potential environmental changes.
2. Conduct a Life Cycle Analysis (LCA) to evaluate the environmental impacts of a product, process, or service throughout its entire lifecycle.
3. Develop comprehensive strategies for pollution control, reduction, and monitoring, and select appropriate treatment techniques for water, wastewater, solid waste, and contaminated air.
4. Demonstrate knowledge of national and international environmental legislation, policies, and standards to apply in environmental decision-making and auditing contexts.

Module:1 *Introduction for EIA* — **10 hours**

Introduction for EIA Framework, screening, scoping and baseline studies; techniques for assessment of impacts on physical resources, ecological resources, human use values and quality of life values. Impact assessment methodologies - various methods, their applicability. Strategic environmental assessment. Cumulative impact assessment. Risk and uncertainty in EIA.

Module:2 *EIA Methodology* — **12 hours**

Environment Attributes Prediction and Methods of Assessment of Impacts on Various Aspects of Environment, Impact Assessment Methodologies, Techniques for Assessment of Impacts, Application of Models for Impact Prediction, Advanced EIA Concepts; Strategic Environmental Assessment , Cumulative Impact Assessment ,Risk and Uncertainty in EIA, Mitigation and Enhancement Measures, Hierarchy of mitigation, Public Participation

Module:3 *Introduction for LCA* — **8 hours**

Fundamentals of Life Cycle Analysis, Applications of LCA in product design, process improvement, policy formulation, and consumer information, International Organization for Standardization (ISO) 14040 and 14044 series standards for LCA methodology, Phases of LCA, Goal and Scope, Life Cycle Inventory (LCI) Analysis; Data collection methods for inputs (raw materials, energy) and outputs (emissions to air, water, soil; waste) for all unit processes, Developing process flow diagrams, Mass and energy balance calculations, Comparison of LCA with other environmental assessment tools (e.g., carbon footprinting, water footprinting).

Module:4 *Life Cycle Impact Assessment (LCIA)* — **8 hours**

Life Cycle Impact Assessment (LCIA) & Interpretation, Phases of LCA, Classification, Characterization, Midpoint vs. Endpoint approaches in LCIA, Detailed study of categories, Life Cycle Interpretation; Completeness, sensitivity, and consistency checks, identifying limitations, and formulating recommendations, Applications of LCA, Product design and development (Eco-design), supply chain management, environmental product declarations (EPDs), Case Studies in LCA

Module:5 *Environmental Legislation, Management Systems, and Auditing* — **10 hours**

Environmental Legislation, Management & Auditing, National Environmental Legislation, International Environmental Policies and Treaties, Carbon Management Concepts, Environmental Standards, Environmental Auditing; Objectives, types, and key features, Planning an auditing program, onsite audit procedures, Environmental Management Systems; Introduction to ISO 14001 series, Integration of EMS with EIA and LCA, Environmental Management Strategies; Preventive environmental policy: Pollution prevention, waste minimization, industrial ecology, Conservation of water and energy, promotion of renewable energy sources, Pollution control strategy; Disposal of treated effluents, solid waste disposal concepts, Concept of green cities and green belt development, Integrated case studies applying EIA, LCA, and regulatory compliance to real-world projects

Total Lecture hours — **48 hours**

Reference Books	
1.	Environment Impact Assessment, Impact Assessment Division, MoEF, GoI, January 2001 (Manual)
2.	Water (Prevention and Control of Pollution) Act 1974. Air (Prevention and Control of Pollution) Act 1981
3.	Environmental Impact Assessment (2nd Ed.) -LW Canter, McGraw Hill Inc. Singapore, 1996
4.	Environmental Impact Assessment Methodologies by Y. Anjaneyulu and Valli Manickam , B.S. Publications, 2023)
5.	Life Cycle Assessment by Surjya Narayana Pati, ,Scientific Publishers (India), 2020
6.	Environmental Management SystemG Gyani and A Lunia, Raj Publishiong House, Jaipur, 2000.
7.	"The ISO: 14000 Handbook" – J Caseio (Ed), Published - CEEM Information Services. 2000
8.	An Introduction to Environmental Audit - RD Tripathi, Alpha Publications, 2009.
Mode of Assessment: Continuous Assessment Test, Quizzes, Assignments, Final Assessment Test	

BCE236OE02T	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-requisite: Nil

Course Objectives:

This course introduces students to the core concepts, tools, and techniques of management with a focus on applications in the civil engineering and construction industry. It covers essential aspects of planning, organizing, leadership, motivation, communication, controlling, and ethics. It prepares students to assume managerial and leadership roles in project teams and professional practice.

Expected Course Outcome:

1. Understand the evolution, functions, and scope of management in the context of civil engineering.
2. Apply managerial concepts to the planning and execution of construction and infrastructure projects.
3. Develop basic project management skills including time, resource, and team management.
4. Identify ethical responsibilities and professional practices relevant to engineers.

Module:1 *Introduction to Management*	**6 hours**
Functions and importance of management; Evolution of management thought; Role of management in engineering and construction.	
Module:2 *Planning and Decision Making*	**6 hours**
Types of planning; Strategic management; Decision-making process and basic tools (SWOT, PERT/CPM intro)	
Module:3 *Organizational Structure and HRM*	**6 hours**
Organization types in construction; Delegation, authority, span of control; Basics of human resource management	
Module:4 *Leadership and Motivation*	**6 hours**
Leadership styles in project teams; Motivation theories: Maslow, Herzberg; Conflict and team management	
Module:5 *Communication and Control*	**6 hours**
Communication in project environments; Control process and performance measurement; Budgeting and cost control (intro)	
Module:6 *Ethics and Professional Practice*	**6 hours**
Engineering ethics and safety; Labour laws, contracts, dispute resolution; Sustainability and environmental responsibility	
Total Lecture hours	**36 hours**

Text Book(s)

1. Harold Kooritz & Heinz Weihrich “Essentials of Management”, Tata McGraw-Hill.
2. L.M. Prasad, Principles of Management, Sultan Chand & sons, New Delhi.
3. Sherlekar & sherlekar, Principles of Management, Himalaya Publishing House, New Delhi.
4. Harold Kooritz & Heinz Weihrich “Essentials of Management”, Tata McGraw-Hill.

Mode of Assessment: Continuous Assessment Test, Quizzes, Assignments, Final Assessment Test

MNC-AU-06	**INSTRUMENTATION & SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING APPLICATIONS**	**L**	**T**	**P**	**C**
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Pre-requisite: Nil

Course Objectives:

1. The objective of this Course is to understand instrumentation, sensor theory and technology, data acquisition, digital signal processing, damage detection algorithm, life time analysis and decision making.
2. This course introduces theoretical and practical principles of design of sensor systems. Topics include: transducer characteristics for acoustic, current, temperature, pressure, electric, magnetic, gravity, salinity, concentration of contaminants, velocity, heat flow, and optical devices; limitations on these devices imposed by building/structure/pavement environments; signal conditioning and recording; noise, sensitivity, and sampling limitations; and standards.

Expected Course Outcome:

1. To specify the requirements in the calibration of sensors and instruments and suggest proper sensor technologies for specific applications.
2. To describe the noise added during measurements and transmission of electrical variables and their requirements during the transmission of measured signals.
3. To construct Instrumentation/Computer Networks.
4. To analyze the errors during measurements.

Module:1 Fundamentals of Measurement, Sensing and Instrumentation covering	**6 hours**
definition of measurement and instrumentation, physical variables, common types of sensors; function of these sensors; sensor applications; sensor type, Sensor Specifics, Permanent installations, Temporary installations of sensors.	
Module:2 Sensor Installation and Operation	**8 hours**
Predict the response of sensors to various inputs; Construct a conceptual instrumentation and monitoring program; Describe the order and methodology for sensor installation; Differentiate between types of sensors and their modes of operation and measurement and Approach to Planning Monitoring Programs. Define target, Sensor selection, Sensor siting, Sensor Installation & Configuration, Advanced topic, Sensor design, Measurement uncertainty.	
Module:3 Data Analysis and Interpretation	**6 hours**
Fundamental statistical concepts, Data reduction and interpretation, Piezometer, Inclinometer, Strain gauge, etc. Time domain signal processing, Discrete signals, Signals and noise and a few examples of statistical information to calculate are: mean, standard deviation, median, mode.	
Module:4 Frequency Domain Signal Processing and Analysis	**5 hours**
frequency domain analysis and its principles; Basic concepts in frequency domain signal processing and analysis, Fourier Transform, FFT (Fast Fourier Transform), Example problems: Noise reduction with filters, Leakage, Frequency resolution	
Total Lecture hours	**25 hours**

Text Book(s)

1.	Alan S Morris (2001), Measurement and Instrumentation Principles, 3rd/e,
2.	Butterworth Hienemann David A. Bell (2007), Electronic Instrumentation and Measurements 2nd/e, Oxford Press
3.	J.G. Joshi (2021), Electronic Measurement and Instumentation, Khanna Publishing House.

Reference Books

1.	
2.	

Mode of Assessment: Continuous Assessment Test, Quizzes, Assignments, Final Assessment Test

Recommended by Board of Studies			
Approved by Academic Council		Date	