VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF CIVIL ENGINEERING

B. Tech. Civil Engineering

(B. Tech. BCL)

ACE Curriculum

(*2025-2026*)

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VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

World class Education: Excellence in education, grounded in ethics and critical thinking, for improvement of life.
Cutting edge Research: An innovation ecosystem to extend knowledge and solve critical problems.
Impactful People: Happy, accountable, caring and effective workforce and students.
Rewarding Co-creations: Active collaboration with national & international industries & universities for productivity and economic development.
Service to Society: Service to the region and world through knowledge and compassion

VISION STATEMENT OF THE SCHOOL OF CIVIL ENGINEERING

To excel in Civil Engineering education and research with a global perspective and commitment to sustainability.

MISSION STATEMENT OF THE SCHOOL OF CIVIL ENGINEERING

M1. Academic Excellence: Impart high-quality Civil Engineering education through innovative teaching methodologies and modern laboratory facilities.

M2. Research: Promote research, consultancy, and innovation addressing real-world Civil Engineering challenges with emphasis on sustainable infrastructure and societal needs.

M3. Global Perspective & Industry Engagement: Prepare globally competent Civil Engineers through industry interaction and collaboration with national and international institutions.

M4. Ethics, Sustainability & Lifelong Learning: Produce socially responsible Civil Engineers with strong ethical values and leadership skills, dedicated to sustainable development and lifelong learning.

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B. Tech. Civil Engineering

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates will be successful civil engineering professionals / entrepreneurs.

PEO2: Graduates will pursue higher studies and research for professional development.

PEO3: Graduates will demonstrate civic responsibility in addressing societal and environmental challenges.

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PROGRAMME OUTCOMES (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, environment and as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8)

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5 and WK7)

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change (WK8).

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B. Tech. Civil Engineering

PROGRAMME SPECIFIC OUTCOMES (PSOs)

After successful completion of the program, students will be able to

PSO 1: Apply core civil engineering principles in structural, geotechnical, transportation, environmental, and water resources engineering to create resilient infrastructure.

PSO 2: Apply emerging technologies to plan, model, design and manage civil engineering projects to meet global infrastructure needs.

PSO 3: Analyse societal challenges and develop innovative solutions for the sustainable built environment.

WASHINGTON ACCORD KNOWLEDGE PROFILE (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

B. Tech. Civil Engineering

Curriculum

SI.NO	Programme Credit Structure	Credits
1	University Core Courses	60
2	Programme Core	40
3	Concentration	20
4	Open Elective Courses	40
Total Graded Credit Requirement		**160**

University Core Courses

S. No	Course Code	Course Title	L	T	P	C
1	BAPHY103	Physics and Mechanics for Engineers	3	0	2	4
2	BACHY103	Chemistry for Civil Engineers	3	0	2	4
3	BAMAT101	Multivariable Calculus and Differential Equations	3	0	2	4
4	BAMAT201	Complex Variables and Linear Algebra	3	1	0	4
5	BAEEE101	Basic Engineering	3	0	2	4
6	BACSE101	Problem Solving Using Python	0	0	4	2
7	BACSE102	Problem Solving Using Java	0	0	4	2
8	BAENG101	Technical English Communication	3	0	2	4
9	BASTS101	Qualitative and Quantitative Skills Practice I	3	0	0	1
10	BASTS102	Qualitative and Quantitative Skills Practice II	3	0	0	1
11	BACLE191	Basic Multidisciplinary Project	0	0	4	2

Human Science Management (HSM)

S. No	Course Code	Course Title	L	T	P	C
1	BACLE104	Waste Management	3	0	0	3
2	BACLE105	Disaster Mitigation and Management	3	0	0	3
3	BACLE106	Urban Planning and Development	3	0	0	3
4	BACLE107	Sustainable Infrastructure Management	3	0	0	3

Programme Core Courses

S. No	Course Code	Course Title	L	T	P	C
1	BACLE101	Digital Surveying	3	0	2	4
2	BACLE102	Environmental Engineering	3	0	2	4
3	BACLE103	Mechanics of Solids	3	0	2	4
4	BACLE201	Fluid Mechanics and Hydraulic Machines	3	0	2	4
5	BACLE202	Soil Mechanics and Foundation Engineering	3	0	2	4
6	BACLE203	Structural Analysis	3	1	0	4
7	BACLE204	Transportation Engineering	3	0	2	4
8	BACLE205	Design of Steel and Reinforced Concrete Structures	3	0	2	4
9	BACLE206	Estimation, Costing and Drawing	3	0	2	4
10	BACLE207	Artificial Intelligence and Machine Learning in Civil Engineering	3	0	2	4

Concentrations in Built System

S. No	Course Code	Course Title	L	T	P	C
1	BACLE301	Construction Materials and Techniques	3	1	0	4
2	BACLE302	Concrete Technology	3	0	2	4
3	BACLE303	Digital Management and Practices in Construction	3	0	2	4
4	BACLE401	Hydrology and Water Resources Engineering	3	1	0	4
5	BACLE402	Engineering Geology	3	1	0	4

Concentrations: Integrated Building System Design for L & T Powered

S. No	Course Code	Course Title	L	T	P	C
1	BACLE416	Building Information Modelling in Construction	3	0	2	4
2	BACLE417	Sustainability Practices in Design of Buildings	3	1	0	4
3	BACLE418	Concrete Building System Design	3	0	2	4
4	BACLE419	Structural Steel Buildings – Design and Practices	3	0	2	4
5	BACLE420	Precast Concrete – Members and Systems	3	1	0	4

Open Elective Courses for L & T Powered

S. No	Course Code	Course Title	L	T	P	C
1	BACLE319	Essentials of Data Science and AI for Civil Engineers	2	0	0	2
2	BACLE422	Critical Thinking, Design Thinking, Leadership & Teamwork	2	0	0	2
3	BACLE423	Career Readiness in Digital Era	2	0	0	2
4	BACLE421	Foundation Engineering Practices	2	0	0	2
5	BACLE424	Project Management for Professionals	2	0	0	2

Open Elective Courses

S. No	Course Code	Course Title	L	T	P	C
1	BACLE308	Prefabricated Structures	3	1	0	4
2	BACLE309	Pre-Stressed Concrete and Industrial Structures	3	1	0	4
3	BACLE310	Additive Manufacturing for Construction	3	1	0	4
4	BACLE311	Construction Quality and Safety	3	1	0	4
5	BACLE312	Groundwater Engineering	4	0	0	4
6	BACLE313	Environmental Impact Assessment	4	0	0	4
7	BACLE314	Industrial Waste Management	4	0	0	4
8	BACLE315	Air and Noise Pollution Control	4	0	0	4
9	BACLE316	Solid Waste Management	4	0	0	4
10	BACLE406	Resource Management and Circular Economy	4	0	0	4
11	BACLE407	Traffic Engineering	4	0	0	4
12	BACLE408	Ground Improvement Techniques	3	1	0	4
13	BACLE409	Geotechnical Earthquake Engineering	3	1	0	4

Ancillary Courses

S. No	Course Code	Course Title	L	T	P	C
1	BACLE410	AI in Climate-Resilient Infrastructure	3	0	0	3
2	BACLE411	Unmanned Aerial Systems in Transportation Systems	3	0	0	3
3	BACLE412	Digital Project Management	3	0	0	3
4	BACLE413	Smart Buildings and Energy Performance	3	1	0	4
5	BACLE414	Structural Health Monitoring	3	0	2	4
6	BACLE415	Digital Twins in Built Environment	3	1	0	4

Minor in Environment and Sustainable Infrastructure

S. No	Course Code	Course Title	L	T	P	C
1	BACLE304	Introduction to Civil Engineering and Built Environment	3	0	0	3
2	BACLE305	Water and Environmental System	3	0	0	3
3	BACLE306	Transportation Systems and Urban Mobility	3	0	0	3
4	BACLE307	Environmental Sustainability and Smart Cities	3	0	0	3
5	BACLE403	Infrastructure Management and Disaster Resilience	3	0	0	3
6	BACLE404	Climate Change and Urban Resilience	3	0	0	3
7	BACLE405	Geo-Informatics and Remote Sensing Applications	3	0	0	3

University Core Courses

BAPHY103	Physics and Mechanics for Engineers	L	T	P	C
		3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

1. To introduce the fundamental concepts of classical mechanics, focusing on kinematics, and dynamics
2. To explore advanced concepts of energy, momentum, and relative motion
3. To familiarize with the concepts of dynamics of rigid bodies and rotational motion

Course Outcomes

1. Employ Newton's equations of motion in polar coordinates to describe the motion of a particle.
2. Identify different types of friction involved in the static and dynamic behaviour of particles
3. Calculate the dynamical variables of particles and rigid bodies using equations of motions
4. Solve the problems of rigid body motion using work–energy and angular impulse-momentum principles.
5. Apply experimental methods to analyze various mechanical systems.

Module:1	Vector mechanics of particles	8 hours

Different coordinate systems – Transformation of scalars and vectors under rotation transformation; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's second law; Solving Newton's equations of motion in polar coordinates.

Module:2	Statics of Particles	9 hours

Particle and rigid body idealization – point mass and rigid body; Resultant of system of forces in plane and space; Static equilibrium problems – Application of static equilibrium to Beams, Trusses and Frames; Equilibrium of rigid bodies in two and three dimensions – Types of beams, supports and reactions; Principle of virtual work – System of connected rigid bodies.

Module:3	Friction	6 hours

The laws of dry Friction – Coefficients of Friction – Angles of Friction – Types of Friction Problems – Wedges and Ladder Friction – Belt Friction.

Module:4	Dynamics of Particles	10 hours

Kinematics of particles: displacement, velocity and acceleration – rotating vectors, motion in polar coordinates, Motion curves – Rectilinear motion, curvilinear motion, (projectile motion) and relative motion problems. Kinetics of particles: Dynamics of a system of particles – conservation of momentum, impulse, momentum and flow of mass – Application of Newton's second law – Work and energy theorem in multiple dimensions – Particle collision – direct and oblique impact problems.

Module:5	**Dynamics of Rigid Bodies**	**10 hours**
Kinematics of rigid bodies: Classification of rigid body motion – Translational and rotational motion – Rotational Dynamics and Angular Momentum, velocity calculation in connected rigid bodies – relative velocity method and Instantaneous center of rotation methods. Kinetics of rigid bodies: Equation of motion – Inertial and non – inertial frame of reference – Mass moment of inertia, Work and energy method – Angular impulse and momentum method for rigid bodies in motion.		
Module:6	**Contemporary Issues**	**2 hours**
Lectures by Industry or Research experts.		
	Total Lecture Hours:	**45 hours**

Text Book(s)

1. Herbert Goldstein, Charles P. Poole Jr., and John L. Safko,, "**Classical Mechanics**", Pearson India, 3rd Edition, **2011**

Reference Books

1. J.L. Meriam and L.G. Kraige, "**Engineering Mechanics: Dynamics**", John Wiley and Sons Inc India, 9th Edition, **2020**

Indicative Experiments

1. Hanging mass method and trolley experiments with photogates to explore the changes in variables in Newtons second law.	2 hours
2. Investigating elastic and inelastic collisions through the measurement of impulse.	2 hours
3. Unlocking rotational secrets: Probing the moment of inertia of a spinning flywheel.	2 hours
4. Determine the moment of inertia of irregular-shaped rigid bodies using torsional pendulum experiments.	2 hours
5. Demonstrating the conservation of momentum during elastic collisions	2 hours
6. Demonstrating the conservation of angular momentum in rotational collision.	2 hours
7. Exploring surface interactions: Measurement of static friction coefficients across materials	2 hours
8. Unveiling motion resistance: Evaluating kinetic friction coefficients for varied surfaces	2 hours
9. Determination of the Center of Gravity of Complex Bodies	2 hours
10. Evaluating spring stiffness using static and oscillatory techniques	2 hours
11. Determine gyroscopic precession and nutation analysis under various torques	2 hours
12. Measuring acceleration due to gravity using simple pendulum.	2 hours

13. High-precision measurement of gravity using kater's pendulum.	2 hours
14. Investigating resonance phenomena in forced harmonic motion	2 hours
15. Observing and analysing the motion of objects exhibiting SHM and free vibrations of a cantilever beam and measuring its oscillations.	2 hours
Total Laboratory Hours:	**30 hours**

Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment		
Recommended by Board of Studies :	26-05-2025	
Approved by Academic Council : No. 78	**Date**	12-06-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-

BACHY103	Chemistry for Civil Engineers	L	T	P	C
		3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

1. Enabling students to know the chemistry behind cement, glass, refractories and real-world applications
2. Aiding the students to grasp the basics of nanomaterials, characterization techniques, polymers, composite materials, and their properties
3. Helping students to learn the fundamentals of the phase rule, water treatment techniques, corrosion, and surface protection techniques

Course Outcomes

1. Apply the phase diagrams for selected systems.
2. Illustrate the water treatment techniques, corrosion types, corrosion mechanisms and protection methods.
3. Classify the properties and preparation of nanomaterials and apply XRD and TEM for their characterization.
4. Explain composition, properties, manufacturing and applications of cement, glass and refractories.
5. Apply instrumental, wet-chemical, and computational methods to analyze materials, molecules, and ions.

Module:1	Tha Phase Rule	7 hours

Gibbs phase rule, definition of terms: phase, homogeneous and heterogeneous systems, components, degree of freedom, phase rule equation, eutectic phase transition. Phase diagrams: Single component system – water; two component system – silver-lead. Applications and limitations of phase diagrams.

Module:2	Water Technology and Corrosion	10 hours

Water Technology: Water quality parameters – dissolved oxygen, COD, BOD, pH, total dissolved solids, and hardness. Advanced water treatment techniques – ion-exchange, reverse and forward osmosis, desalination using graphene membrane, nanofiltration.
Corrosion: Types of corrosion - mechanism of corrosion – oxidation and oxygen absorption, liquid metal corrosion, wet corrosion, hydrogen evolution. Corrosion in civil structures and protection methods - protective coatings, cathodic protection, corrosion inhibitors.

Module:3	Polymers and Composites	10 hours

Polymers: Classification of polymers. Preparation, properties, and industrial applications of polyvinyl chloride, polystyrene, Teflon, polyester, and Kevlar. Polymers for 3D printing. Molecular weight determination of polymers - number average and weight average methods (numerical problems).
Composite materials: Definition and types of composite materials - examples for matrix and reinforcement phases (fibres) - properties and applications of composite materials.

Nanocomposite materials – polymer-clay nanocomposites – preparation, properties and applications.

Module:4	**Nanomaterials and Structural Analysis of Materials**	**6 hours**

Nanomaterials: Definition – classification of nanomaterials based on dimensionality–- properties of bulk Vs nanomaterial (example: Gold). Preparation of nanomaterials – top-down and bottom- up methods (Ball milling & Sol-gel methods). Carbon nanomaterials – fullerene, carbon nanotube and graphene - structural aspects - Preparation of carbon nanotubes by CVD method.
Structural analysis of materials: Principles and applications of X-ray diffraction, SEM and TEM.

Module:5	**Cement Glass and Refractories**	**10 hours**

Cement: Classification, composition and properties - manufacturing of Portland cement – reactions involved in setting and hardening of cement.
Glass: Definition of glass, raw materials for glass manufacturing and their functions, glass manufacturing process - different types of glasses. Advanced glasses – smart glass, self-cleaning glass, glasses for solar photovoltaic cells.
Refractories: Definition of refractory, classification, properties and applications, manufacturing process.

Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours:	**45 hours**

Text Book(s)

1. O.V Roussak, H. D. Gesser, "Applied Chemistry - A Textbook for Engineers and Technologists", Springer Nature, 2nd Edition, 2013
2. Shikha Agarwal, "Engineering Chemistry Fundamentals and Applications", Cambridge University Press, 2nd Edition, 2019

Reference Books

1. M. Balasubramanian, "Composite materials and processing", CRC Press Taylor and Francis Group, 1st Edition, 2013
2. P.C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, 16th Edition, 2018
3. Bradley D. Fahlman, "Materials Chemistry", Springer Nature , 4th Edition, 2023

Indicative Experiments

1. Thermodynamic functions from EMF measurements: Zn – Cu system. Evaluation of properties - enthalpy, entropy, and free energy	2 hours
2. Determination of reaction rate, order and molecularity of ester hydrolysis	2 hours
3. Determination of hardness of water before and after treatment with ion-exchange resin	2 hours
4. Assessment of the Fe^{2+} content using potentiometry	2 hours
5. Preparation of ZnO nanoparticles and their characterization	2 hours

6. Determination of viscosity average molecular weight of polymer	2 hours
7. Building atoms and molecules, visualization of atomic orbitals and hybridized orbitals and calculating the orbital contributions	2 hours
8. Conformational analysis of cyclohexane and ethane molecules and plotting the potential energy profile.	2 hours
9. Application of AI to screen semiconductors, materials and drugs - case study.	2 hours
10. Size-dependent colour variation of Cu_2O nanoparticles by spectrophotometer	2 hours
11. Synthesis of hydroxyl apatite from biowaste and its use for the removal of heavy metals	2 hours
12. Fabrication of DSSC as a renewable energy resource using a natural dye	2 hours
13. Colorimetric estimation of Fe^{2+} using conventional and smartphone digital-imaging method	2 hours
14. Determination of reaction rate, order, and molecularity following sucrose hydrolysis by the amylase enzyme	2 hours
Total Laboratory Hours:	**30 hours**
Mode of Evaluation : Continuous Assessment Test, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment	

Recommended by Board of Studies :	23-05-2025	
Approved by Academic Council : No. 78	**Date**	12-06-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-

BAMAT201	Complex Variables and Linear Algebra	L	T	P	C
		3	1	0	4
Pre-requisite	Multivariable Calculus and Differential Equations	Syllabus Version 1.1			

Course Objectives

1. To develop mathematical models for analysing fluid dynamics and electromagnetic fields using complex function construction techniques.
2. To apply transformation methods to enhance image boundary identification, improving precision in engineering visualization and contour integration in computational analysis.
3. To explore vector spaces, subspaces, linear transformations, and orthonormal basis generation, enabling efficient representation and manipulation of engineering data.

Course Outcomes

At the end of the course the student is able to:

1. Construct analytic functions and determine complex potentials for fluid-flow and electric-field problems.
2. Apply elementary conformal and bilinear transformations to map regions in the complex plane.
3. Evaluate real integrals using contour integration.
4. Determine bases, dimension of a vector space and matrix representation of linear transformations.
5. Apply vector normalization and Gram–Schmidt orthogonalization techniques to generate orthonormal bases.

Module 1	Analytic Functions	7 hours

Complex variable- Analytic functions and Cauchy–Riemann equations - Laplace equation and Harmonic functions - Construction of Harmonic conjugate and analytic functions - Applications of analytic functions to fluid-flow and Field problems.
Applications: Complex Impedance and AC Circuit Analysis, 2D Potential Flow Around Reactor Vessels and Groundwater Seepage.

Module 2	Conformal and Bilinear Transformations	9 hours

Conformal mapping - Elementary transformations - Translation, magnification, rotation, inversion. Exponential and Square transformations ($w = e^z$, z^2) - Bilinear transformation - Cross-ratio- Images of the regions bounded by straight lines under the above transformations.
Applications: Smith Chart as a Bilinear Transformation, Fluid Flow in Pipe Bends using Exponential Transformation, Seepage Under Gravity Dams via Conformal Mapping.

Module 3	Power Series and Complex Integration	9 hours

Functions given by Power Series - Taylor and Laurent series -singularities - poles – Residues.
Integration of a complex function along a contour - Cauchy-Goursat theorem- Cauchy's integral formula -Cauchy's residue theorem - Evaluation of real integrals
Applications: Nyquist Stability Criterion via Contour Integration, Structural Vibration and Dynamic Response using Poles and Residues.

Module 4	Vector Spaces and Linear Transformations	10 hours

The Euclidean space - Vector space and subspace, linear combination, span, linear dependence and independence, basis and dimension. Row space, column space, null space, and Rank-Nullity Theorem. Linear transformations – definition, properties, matrix representation, invertibility, and change of basis.
Applications: State-Space Representation of Linear Circuits, Material Balance in Multi-Component Distillation using Rank-Nullity Theorem.

Module 5	**Inner Product Spaces**	**8 hours**
Dot and inner products, length of a vector, angle between vectors, and matrix representation of inner products. Gram-Schmidt orthogonalization, orthonormal basis. Quadratic forms and their nature – positive definite, negative definite, and indefinite forms. Applications: Signal Energy Power and Orthogonality in Communications, Stoichiometric Analysis of Chemical Reaction Networks using Inner Products.		
Module:6	**Contemporary Topics**	**2 hours**
	Total Lecture hours: **Total Tutorial hours:**	**45 hours** **15 hours**

Text Book(s)	
1	G. Dennis Zill, Patrick D. Shanahan, Complex Analysis, 3rd Edition, Jones and Bartlett Publishers, 2019
2	Bernard Kolman and David R. Hill, Elementary Linear Algebra with Applications, 9th Edition, Pearson Education, 2023.
Reference Books	
1	B.S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers, 2020
2	Gilbert Strang, Introduction to Linear Algebra, 6th Edition, Wellesley-Cambridge Press, 2023.

Mode of Evaluation: Quizzes, Assignments, CATs and FAT			
Recommended by Board of Studies	14-May-2025		
Approved by Academic Council	No. 82	**Date**	10.06.2026

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-

BAEEE101	Basic Engineering	L	T	P	C
		3	0	2	4
Pre-requisite	NIL	Syllabus version			
		1			

Course Objectives

1. To introduce fundamental principles of major engineering disciplines.
2. To create awareness of interdisciplinary engineering systems and their applications

Course Outcomes

At the end of the course students will be able to

3. Analyse the electrical circuits, electrical motors and the role of power electronics in industrial applications.
4. Acquire foundational knowledge of electronic devices and communication systems.
5. Apply BIS standards to create basic 2D and 3D representations of engineering components.
6. Explain the fundamental principles and applications of manufacturing processes, energy conversion systems, and mechanical automation technologies.
7. Analyze real-world examples where bio-inspired solutions have led to breakthroughs in engineering.

Module:1	Principles of Electrical Engineering: Circuits and Power conversion equipment	12 hours

Electric circuit components, Mesh current analysis, Node voltage analysis, Thevenin's and Superposition theorems, Single phase AC circuits- RL, RC, RLC, Power and Energy Calculations, Power Factor, Basics of Electrical Safety and Earthing. Introduction to electro mechanical energy conversion, principle of operation of Electrical Machines - DC Motor, Induction motors, BLDC Motor and single phase Transformer, Concepts of Power Electronics and Industrial Applications of Electrical Drives (Qualitative Analysis)

Module:2	Foundations of Electronics and Communication systems: Devices, Circuits, and Systems	8 hours

Characteristics of PN Junction Diode, Zener Diode, BJT and MOSFET. Rectifiers and Voltage Regulators. Introduction to Operational Amplifiers. Electromagnetic Specturm. Elements of Communication Systems. Overview of cellular communication. Fundamentals of Satellite Communication and Radar.

Module:3	Engineering Graphics and CAD	9 hours

Introduction to Engineering Drawing – Importance and scope of engineering graphics, BIS standards for lines, lettering and dimensioning. Orthographic Projections – Principles of projection, first angle and third angle projections. Introduction to Projection of Solids- Isometric Projections and perspective projections. Freehand Sketching – Sketching of simple machine components and objects. Drawing of a simple residential floor plan as per IS SP7, Introduction to CAD.

Module:4	Manufacturing Processs, Energy conversions and Mechanical Automation.	9 hours

Basic Metal Casting, Forming, Joining and Cutting Processes - Introduction to CNC Machining. Additive Manufacturing (3D Printing): Principles and Applications.

Fundamentals of Thermal engineering systems, Internal Combustion Engine. Introduction to Power Plants. Introduction to Refrigeration and Air Conditioning. Basics of Fuel Cells and Sustainable Energy Technologies.

Introduction to Mechanisms - Four-bar mechanism and its inversions- Hexapod mechanisms. Mechanical Components and Motion Control in mechanical systems. Introduction to Robotics and Automation – Pneumatic and hydraulic actuators.

Module:5	Bio-Inspired Design in Engineering	5 hours

Introduction to Biomimicry- Core principles. Case Studies Across Disciplines: Velcro inspired by burrs, self-healing materials based on skin regeneration -Termite mound-inspired ventilation systems in green buildings-Insect-inspired drones and soft robotics-Neural networks based on the human brain -Identify a problem and brainstorm a bio-inspired solution.		
Module: 6	**Contemporary Issues**	**2 hours**
Lectures by Industry or Research experts		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Allan R. Hambley, "Electrical Engineering -Principles & Applications", 2019, 6th Edition, Pearson Education
2	R.L. Boylestad and L. Nashelsky, "Electronic Devices and circuit theory", 11th Edition, person Publications
3	Louis E Frenzel Jr, "Principles of Electronics Communication Systems", 2016, McGraw Hill Eduation.
4	Bhatt N. D., Engineering Drawing, Charotar Publishing House Pvt. Ltd, 2019.
Reference Books	
1.	John bird, "Electrical Circuit Theory and Technology", 4th edition, Newnes Publications, Elsevier, 2010
2.	George Kennedy,Brendan Davis, Srm Prasanna "Electronic Communication Systems", McGraw Hills, 2011
3.	Serope Kalpakjian, and Steven Schmid, Manufacturing Engineering and Technology, 2020, 8th edition, Pearson education.
4.	Nag P. K., Basic & Applied Thermodynamics, 2009, 2nd Edition, McGraw Hill Education.
5.	Rattan S. S, Theory of Machines, Tata McGraw Hill, 2019
6.	Craig, John. J. (2008), Introduction to Robotics: Mechanics and Control, Second Edition, Pearson Education, New Delhi.

List of indicative experiments: -

1. Two loop (node)/Three loop(node) electric circuit simulation for voltage and current analysis (PSpice).
2. Wireless power transfer through inductive coupling by lighting an LED wirelessly over a short distance (Hardware).
3. Analysis of a single phase series RL Circuit by varying inductance value (PSpice).
4. Measurement of Power and Power Factor in a single phase RL Circuit using 3- volt meter method (Hardware).
5. DC-DC Buck Converter based speed control of PMDC Wiper Motor for Cars (Hardware).
6. Gesture Controlled LED Dimmer (Hardware).
7. Light-Activated Alarm System (Hardware).
8. Smart control of lighting system (Hardware).
9. Temperature controlled fan system (Hardware).
10. Measurement of Earth Resistance for Electrical safety (Hardware).
11. Light intensity control of head lamp of Vehicles (Hardware).
12. Design and development of 5V Charger circuit for mobile phone (Hardware/Simulation).
13. Performance analysis of single phase full wave diode rectifier with and without capacitor filter (PSpice).
14. Create a 2D profile using basic sketch tools and apply appropriate geometric and dimensional constraints (Solid works).
15. Develop a simple 3D solid model using features such as extrude, revolve, cut, fillet, chamfer, and shell (Solid works).

16. Generate detailed 2D engineering drawings of simple parts from 3D solid models, including multiple views, dimensions, and annotations (Solid works). 17. Students can choose any one of the challenging experiments based on their choice.		
Mode of Evaluation: CAT, Assignment, Quiz, Seminar, Project, FAT		
Recommended by Board of Studies	23-05-2025	
Approved by Academic Council No.78	**Date**	12-06-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-

BACSE101	Problem Solving Using Python	L	T	P	C
		0	0	4	2
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

1. To impart algorithmic skills through python programming language fundamentals and constructs.
2. To explore python collections for efficient data handling techniques and to learn modular, recursive programming approaches for developing software applications.
3. To understand python libraries for data analysis and manipulations

Course Outcomes

4. Identify appropriate algorithmic approach, data representation, control constructs in developing software solutions for solving real-world problems.
5. Inculcate data handling techniques using python collections and modular programming strategies for developing multi-disciplinary software applications
6. Idealize the importance of python libraries for handling, manipulating and analyzing multi-faceted real world problem domains.

Indicative Experiments

1. **Subsidy Computation** Agricultural subsidies are offered by the Indian government to farmers for improving crop yields and benefiting them. To facilitate the farmers in finding the subsidy amount, develop a Python code to calculate the subsidy based on the crop the farmer grows. The farmers can grow one of these three types of crops: Rice, Wheat, or Maize. The program calculates and displays the type of crop, total subsidy based on the type of crop selected, along with the yield and market rate. Use menu driven approach to implement the same. Each crop has a different formula for calculating the subsidy: Rice: Subsidy= (Yield × Market Rate) +100 Wheat: Subsidy= (Yield × Market Rate) +200 Maize: Subsidy= (Yield × Market Rate) +300 Input Format Press 1/2/3 to compute the Subsidy of Rice/Wheat/Maize Next Line to enter the Market Rate Next Line to enter the Yield Enter either Yes/No . Press 1/2/3 to compute the Subsidy of Rice/Wheat/Maize Next Line to enter the Market Rate Next Line to enter the Yield Enter either Yes/No Output Format Display “Press 1/2/3 to compute the Subsidy of Rice/Wheat/Maize”	4 hours

Display the Type of Crop, Subsidy, Yield and Market Rate Do you want to continue (Yes/No). If Yes . Press 1/2/3 to compute the Subsidy of Rice/Wheat/Maize Display the Type of Crop, Subsidy, Yield and MarketRate Do you want to continue (Yes/No). If No, display 'Thank you' **Climate Change Data Analyzer** Scientists track daily temperatures as a string of values separated by spaces (e.g., "30.5 32.1 29.8"). Write a python program that extracts the temperatures, converts them into float values, and finds the highest, lowest, and average temperature. Rules & Constraints: 1. Input is a string of space-separated float values (e.g., "30.5 31.2"). 2. All values must be valid floating-point numbers. 3. The list must have at least two values. 4. Temperatures must be within a realistic range: -100.0°C to 60.0°C. 5. The program should round the average to two decimal places. 6. If the input is invalid (non-numeric, empty, out-of-range), return an error message. Input Format: A single string with space-separated temperature readings (e.g., "25.4 27.8 26.5") Output Format: Highest: Lowest: Average:	
2. **Gaming Leaderboard Username Validator** In an online game, players choose usernames for the leaderboard. To make sure all usernames are clean and fair, they must follow these rules: 1. The username must start with a letter (A–Z or a–z). 2. It can contain letters, numbers, and underscores (_) only. 3. It cannot start with a number. 4. No other symbols or spaces are allowed. 5. The length must be between 5 and 15 characters. Write a python program using regular expressions to check if a username is valid or invalid. If invalid, display a message "Invalid Name" Input Format: A single string – the username to validate. Output Format: Print "valid username" if it follows all rules. Otherwise, print "Invalid Name". **Number Game** In Numeria, Alchemists must build an arithmetic expression using given numbers and operations to match a target. Use each number once, with +, -, *, or /. If no exact match, return the expression closest to the target. If multiple expressions give the same best result, return "No single solution"	4 hours

Rules: 1. Use all numbers once. 2. Only +, -, *, / allowed. 3. Division must result in integers only. 4. Left-to-right evaluation only (no brackets) 5. All numbers must be positive integers. 6. Return one valid expression, or "No single solution" if ties exist. Input Format: ((num1, num2, ..., numN), target) Output Format: 1. A string like "2+3*5", or 2. "No single solution" 3. Error message for invalid input	
3. **Drone Delivery** A delivery drone needs to find the shortest path from a warehouse (starting point) to a delivery location (destination) in a grid-based city map. The drone can move up, down, left, or right, but it cannot pass through restricted zones (obstacles). Implement an algorithm (only) using a top-down approach to find the shortest path from the warehouse to the delivery location. Input Format: A 2D grid (N × N) where 0 represents open paths and 1 represents obstacles. The starting position (warehouse) and destination position (delivery location). Top- down Design Approach: If the destination is reached, return the path length. If the current cell is an obstacle or out of bounds, return an invalid path value. Try moving in all four directions (up, down, left, right). Use memoization to store results of already visited paths. Output Format: The minimum number of steps required to reach the destination. The shortest path length or an indication that the delivery is not possible. **Task Completion Time** A group of students is participating in a coding competition, where they need to solve a set of problems as quickly as possible. Each student has a recorded completion time (in minutes) for each problem. The goal is to identify the student who solved their problems in the shortest total time. Implement an algorithm using Divide and Conquer problem solving approach to determine the student with the lowest total completion time. **Input:** A list of students with their total completion times. **Base Case:** If there is only one student, return them as the fastest. **Divide**: Split the student list into two halves. **Conquer**: Recursively find the fastest student in both halves. **Combine**: Compare the two selected students and return the one with the lower total time.	6 hours
4. **Rental Computation**	4 hours

Maya is developing a pricing system for a photography studio that rents out different types of cameras and needs to calculate the rental cost based on the equipment type and duration. The system should apply discounts based on the rental cost thresholds: Video Camera: The rental rate is ₹250 per hour. If the total rental cost exceeds ₹1500, a 12% discount is applied. Drone Camera: The rental rate is ₹300 per hour. If the total rental cost exceeds ₹2000, a 15% discount is applied. Write a Python code to compute the rentalCost for VideoCamera, and DroneCamera and apply the respective discount based on the rental duration and the type of camera. Input Format First line contains the duration of usage of Video Camera Second line contains the rental rate of Video camera per hour Third line contains the duration of usage of Drone Camera Fourth line contains the rental rate of Drone camera per hour. Output Format First line prints the total rental cost of Video Camera Second line prints the discount for Video Camera usage. Third line prints the total rental cost with discount for Video Camera. Fourth line prints the total rental cost of Drone Camera Fifth line prints the discount for Drone Camera usage. Sixth line Prints the total rental cost with discount for Drone Camera. **Leader Selection** In the city of Solaria, a group of n scholars sit in a circle. Each scholar has a number from 1 to n. The selection for the next Guardian of Harmony works like this: 1. Scholar 1 tells Scholar 2 to leave the circle. 2. Then the next scholar (still in the circle) tells the person next to them to leave. 3. This continues in a circle — each person removes the one next to them — until only one scholar is left. Determine which scholar will be the last one standing Input Format: A single number n — the number of scholars. Output Format: A number — the scholar who is left at the end.	
5. **Analyze health risk** Analyze health risks based on multiple individuals' BMI (Body Mass Index), blood pressure, and heart rate. Using a loop to collect data for multiple individuals. Calculate BMI using BMI = weight / (height ** 2), use conditional statements to classify BMI as low, medium or high. Low BMI (underweight): Less than 18.5 kg/m² Medium BMI (normal weight): 18.5 - 24.9 kg/m² High BMI (overweight): 25 kg/m² and above	6 hours

A "low" blood pressure is generally considered to be below 90/60 mmHg, while a "medium" or normal blood pressure is between 90/60 mmHg and 120/80 mmHg, otherwise high. For heart rate, a "low" resting rate is under 60 beats per minute (bpm), and a "medium" or normal resting rate is between 60-100 bpm, otherwise high. Additionally, check if blood pressure (systolic/diastolic) and heart rate fall within healthy ranges, categorizing individuals into Low, Moderate, or High health risk levels. Write a python code to display the BMI, blood pressure and heart rate. If two or more health risks are high, then the risk level is high. If any one of the health risk is high, then the risk level is medium. Otherwise, it is under low risk. Finally, display a summary report showing the number of individuals in each risk category.

Input Format:
First line contains the number of People ‘n’
Next line contains the Blood pressure(Systolic/Diastolic) of Person1 in mm/hg
Next line contain heartrate of Person1 in beats per minute(bpm)
.
Next line contains the weight of the Person ‘n’ in Kg
Next line contains the height of the Person ‘n’ in meter
Next line contains the Blood pressure(Systolic/Diastolic) of Person ‘n’ in mm/hg
Next line contain heartrate of Person ‘n’ in beats per minute(bpm)

Output Format
First line Prints the BMI of Person 1(kg/m2)
Second line prints underweight/normalweight/overweight of Person 1
Third line Prints the Blood Pressure of Person 1(mm/hg)
Fourth Line prints Low/Medium/HighBloodPressure of Person 1
Fifth line prints the Heart rate of Person 1(bpm)
Sixth line prints low/normal/high heartrate of Person 1
Seventh line prints low/medium/high risk level of Person 1
.
Next line Prints the BMI of Person ‘n’(kg/m2)
Next line prints underweight/normalweight/overweight of Person ‘n’
Next line Prints the Blood Pressure of Person ‘n’(mm/hg)
Next Line prints Low/Medium/HighBloodPressure of Person ‘n’
Next line prints the Heart rate of Person ‘n’(bpm)
Next line prints low/normal/high heartrate of Person ‘n’
Next line prints low/medium/high risk level of Person ‘n’
Next prints the

Summary:

High risk level : number of People
Medium risk level: number of People
Low risk level: number of People

Process DNA sequence
DNA sequences are primarily analyzed by scientists, researchers, and medical professionals in fields like genetics, molecular biology, and medicine, to

understand genetic variations, diagnose diseases. Write a Python program to process and analyze the DNA sequences by performing various operations based on nucleotide sequence rules. The program should perform the following on valid DNA Sequences:

1. Accept 'n' DNA sequences from the user.
2. Verify whether each sequence contains only the valid DNA bases (A, C, G, T). If so, display as Valid otherwise invalid.
3. Search for the specific "TATAAA" sequence within the given DNA sequences. If so Display as match/nomatch
4. Count and display the occurrences of base 'A' in each DNA sequence.
5. Store the unique bases and their frequency in a dictionary for all sequences combined and display them.
6. Replace a specific substring in the DNA sequences with 'X' (e.g. replacing "AT" in "TATA" results in "TXA").
7. Convert DNA to RNA by replacing 'T' with 'U', and store the RNA sequences in a list.
8. Search for a specific pattern in the DNA sequences and display its position if found.
9. Compute and display the complementary strand for each DNA sequence, where A pairs with T, and C pairs with G (e.g., "ATCGA" → "TAGCT").

Input Format
First line contains number of DNA sequences
Next line contains the DNA sequence 1
Next line contains the DNA sequence 2
.
Next line contains the DNA sequence n
Next line contains the specific sequence
Next line contains the base to find its occurrence:
Next line contains the substring to replace:
Next line contains the string to replace with:
Next line contains the string to replace to convert DNA to RNA
Next line contains the string to replace with to convert DNA to RNA
Next line contains the pattern to display its position

Output Format
First Line displays DNA sequence 1 valid/invalid
Next Line displays DNA sequence 2 valid/invalid
.
Next Line displays DNA sequence n valid/invalid

Next Line displays DNA sequence 1 Match/No Match
Next Line displays DNA sequence 2 Match/No Match
.
Next Line displays DNA sequence n : Match/No Match

Next Line displays DNA sequence 1 count
Next Line displays DNA sequence 2 count
.

Next Line displays DNA sequence n count Frequency of Unique bases: {'A': count, 'T': count, 'G': count, 'C': count} Next Line displays DNA sequence 1: New DNA sequence 1 after replacing Next Line displays DNA sequence 2: New DNA sequence 2 after replacing . Next Line displays DNA sequence n: New DNA sequence n after replacing DNA to RNA:['New Sequenc1', 'New Sequenc2',… 'New Sequencn'] Next Line displays the position of the given Pattern in DNA sequence 1: Next Line displays the position of the given Pattern in DNA sequence 2: . Next Line displays the position of the given Pattern in DNA sequence n: Display the position of the given Pattern in DNA sequence 1: Display the position of the given Pattern in DNA sequence 2: Display the position of the given Pattern in DNA sequence n: Display the complementary strand of DNA sequence 1: Display the complementary strand of DNA sequence 2: Display the complementary strand of DNA sequence n:	
6. **Renewable Energy Grid** In the year 2050, the world is powered by solar energy storage units, distributed across three major smart power stations. These stations are: (a) Station 1: Primary source, (b) Station 2: Intermediate (buffer) , (c) Station 3: Final destination. To ensure sustainable and stable energy flow, scientists have developed a precise transfer protocol that moves energy units from Station 1 to Station 3. Transfer Rules (Constraints): 1. Only one energy unit can be transferred at a time to prevent system overload. 2. A larger unit can never be placed on top of a smaller unit. 3. The number of energy units n must be an integer between 1 and 20. 4. The transfer output must be a sequence of moves: each move is a pair (a, b) meaning "move a unit from Station a to Station b", where a and b are in {1, 2, 3}. 5. Two consecutive moves must not involve the same pair of stations in opposite directions. For example, (1, 3), (3, 1) back-to-back is not allowed, as it causes unnecessary energy loss and instability. Input Format: An integer n represents the number of energy storage units to be transferred from the primary station to the final station. Output Format: A list of ordered pairs (a,b), where each pair represents a transfer of an energy unit from station a to station b. **Rainfall prediction using Sorting**	4 hours

Write a Python program to assist meteorologists in forecasting rainfall by analyzing relative humidity based on air temperature (23°C to 28°C) and dew point temperature (7°C to 16°C). Use the given formulas to compute specific humidity, saturation point, and relative humidity: specific humidity = 6.11 x 10^{7.5 x dew point} / {237.3 + dew point} saturation point = 6.11 x 10^{7.5 x air temp} / {237.3 + air temp} relative humidity = (specific humidity) / (saturation point) x 100 The chance of rainfall is high when the relative humidity is high and the temperature is dropping. The program should sort the relative humidity values in increasing order and display the highest relative humidity along with its corresponding air temperature and dew point temperature, providing valuable insights for rainfall prediction. Input Format: An integer 'N' representing the number of temperature readings. 'N' lines, each containing: Air Temperature (integer, between 23°C and 28°C) Dew Point Temperature (integer, between 7°C and 16°C) Output Format: Sorted list of relative humidity values in increasing order along with their corresponding air temperature and dew point temperature. Highest relative humidity value with its associated air temperature and dew point temperature. Prediction statement indicating whether the chance of rainfall is High/Low (if humidity is high and temperature is dropping).	
7. **Browser Tracking** Write a Python program to simulate a web browser's back and forward navigation system using stacks, where visiting a new webpage pushes the URL onto the back stack and clears the forward stack. Implement functions to navigate back by popping the top page from the back stack and pushing it onto the forward stack, and to navigate forward by popping the top page from the forward stack and pushing it onto the back stack. The program should allow users to enter URLs, navigate back and forward, and display the current page along with available navigation options dynamically. Input Format: •An integer N representing the number of webpage visits. •N lines, each containing a URL (string) representing a webpage visit. •User can enter the following commands dynamically after initial webpage visits: BACK: Navigate to the previous page.	6 hours

FORWARD: Navigate to the next page.
VISIT : Visit a new webpage, clearing the forward history.
EXIT: Terminate the program.

Output Format:

•Display the current page after each operation.

•Show available navigation options (Back and Forward stacks).

•Display messages when back or forward navigation is unavailable.

•Display Browser session ended when Exit.

Customer Orders Queue Processing

In a smart manufacturing unit, automated machines process customer orders in a First-In-First-Out (FIFO) manner to ensure efficiency. Write a Python program using a queue to simulate an order processing system, where customers place orders for different industrial products (e.g., raw materials, electronic components, machinery parts), and each order is stored along with its order placed time. The system should process the orders in the same sequence they were received, record the order completion time, and remove them from the queue upon completion. Finally, display the status of the order queue before and after processing, along with the time taken to complete each order.

Input Format:

An integer 'N' representing the number of orders

N lines, each containing:

Order ID (string)

Product Name (string)

Order Placed Time (HH:MM 24hr -format)

Order Completion Time ((HH:MM format)

Output Format:

Order queue before processing

Processing details, including:

Order ID - Product Name - Order Placed Time - Order Completion Time - Time Taken to Process (in minutes)

Order queue after processing

8. **Smart Building** Elena Vasquez, a futuristic architect, is designing modular smart buildings on a blueprint. Each building is represented as a rectangle with: •(x, y) — coordinates of the bottom-left corner •Width and height — horizontal and vertical sizes of the building To avoid overlap during construction, Elena needs a tool that calculates the exact overlapping area between any two buildings. Write a python function (collections framework) that takes two building rectangles as input and returns the area of overlap. If they do not overlap, return 0. Input Format: Each rectangle is given as a list of 4 integers: [x, y, width, height] Output Format: A single integer — the overlapping area between the two buildings. If no overlap, return 0. Constraints: •All coordinates and dimensions are integers. •Width and height must be positive (greater than 0). •Input lists must contain exactly 4 integers. •Coordinates may be negative (to allow buildings in all quadrants). **Analyze Water Quality** Environmental agencies, researchers assess the overall water quality, monitor potential pollution sources, and ensure the water is safe for intended uses like drinking, agriculture, and aquatic life using water pH and dissolved oxygen levels and turbidity. Assist them by developing a Python program using functions and conditional statements to analyse the water quality based on pH, turbidity, and dissolved oxygen levels. The program should take input values for these parameters, check if they are within safe limits, and classify the water as safe or unsafe for consumption.	6 hours

If pH value is 6.5 and 8.5, Turbidity lesser than 3 NTU(Nephelometric Turbidity Unit) and Dissolved Oxygen between 6.5 and 8 mg/L then the water quality is safe Use conditional statements to give recommendations if the water is safe or unsafe. Allow users to input data for any location and display a summary of safe and unsafe water sources. Locations may include Clean River area, lake near agriculture area, urban storm drain area, Deep Ground water Source etc Use menu driven approach and functions to compute and display for multiple locations Input Format First Line contains the name of the Location 1 Second Line contains the pH value Third Line contains the Turbidity Fourth Line contains Dissolved Oxygen Enter either Yes/No . Next Line contains the name of the Location 'n' Next Line contains the pH value Next Line contains the Turbidity Next Line contains Dissolved Oxygen Enter either Yes/No Output Format Safe/unsafe Do you want to continue (Yes/No). If Yes . Safe/unsafe Do you want to continue (Yes/No). If No, display 'Thank you'	
9. **Reforestation** In a reforestation project, each tree grows a fixed number of saplings every year. These saplings become mature trees starting from the next year and also begin	6 hours

producing saplings. Implement a python program using functions that calculates the total number of mature trees after a given number of years.

Input Format:

A tuple of three integers:

initial_trees – Number of trees at year 0

saplings_per_tree – Number of saplings each tree produces per year

years – Number of years to simulate

Output Format:

A single integer: total number of mature trees after the given number of years.

Recurring Character

For a given string which is made of uppercase letters (A–Z). Implement a recursive function that finds the first character that appears more than once.

The function should return a dictionary with:

1. The character (key)
2. A list of two indices:
3. The index where it first appeared
4. The index where it reappeared first
5. If no recurring character is found, or if the input is None or an empty string, return an empty dictionary {}.
6. Rules & Constraints:
7. Input must be a string containing only uppercase A–Z.
8. Return the first recurring character based on position.
9. Ignore later repetitions after the first recurrence.
10. Use recursion (no loops allowed).
11. Return an empty dictionary if:
12. Input is None
13. Input is an empty string
14. No character repeats

Input Format:

A single string: "ABCDAB"

Output Format:

A dictionary like: {"A": [0, 4]}

Or: {} (if no recurring character or invalid input)

Tower of Hanoi In robotic warehouse automation, autonomous robotic arms move stacked containers or pallets between storage locations while following strict stacking rules. Similar to the Tower of Hanoi problem, the system must transfer stacked items from a source rack to a destination rack using an intermediate rack, ensuring that larger items are never placed on smaller ones. Write a Python program using a recursive function to simulate this process, where a set number of stacked containers (disks) must be moved while following the First-In-Last-Out (FILO) principle. The program should determine the optimal sequence of moves, ensuring safe and efficient stacking, and display each step of the movement process to track how robotic arms relocate items. Input Format: An integer 'N' representing the number of stacked containers. Output Format: A sequence of steps showing how the containers are moved from the Source Rack to the Destination Rack using the Intermediate Rack.	
10. **Student Attendance Data Analysis using Numpy** Involve as a team to collect attendance dataset from professors. Design a Python program using NumPy to analyse a student attendance dataset. Compute the total attendance per student, identify the student with the highest attendance, calculate the class average attendance per day, and determine the day with the lowest attendance rate. Finally, compute each student's attendance percentage and display students who have less than 75% attendance. Input Format: •An integer N representing the number of students. •An integer D representing the number of days. •A N x D matrix, where each row corresponds to a student, and each column represents a day. o1 indicates present o0 indicates absent Output Format: •Display the original attendance matrix. •Compute and display the total attendance per student.	10 hours

•Identify and display the student with the highest attendance. •Calculate and display the class average attendance per day. •Determine and display the day with the lowest attendance rate. •Compute and display each student's attendance percentage. •Identify and display students who have less than 75% attendance.	
11. **Student Marks Data Analysis using Pandas** Involve as a team to collect sample archived student marks dataset from professors. Write a Python program using Pandas to analyse students' internal marks, where each student is evaluated based on six internal components and a final component. Create a DataFrame with student names, six internal scores, and final score. Calculate the class average internal score, compute the total marks for each student by summing all components, and determine the student with the highest total marks. Additionally, filter and display students who have scored below 40% indicating the need for improvement. Input Format: An integer 'N' representing the number of students. N lines, each containing: Student Name (String) Six Internal Component Scores (Integers from 0 to 100) Final Component Score (Integer from 0 to 100) Output Format: •Display the original DataFrame with student names, internal scores, and final scores. •Compute and display the class average internal score. •Calculate and display the total marks for each student. •Identify and display the student with the highest total marks. •Filter and display students scoring below 40% of the total (i.e., below 40 out of 100).	4 hours
12. **Restaurant Food Waste Cost**	6 hours

Restaurants throw away a lot of food every day, which affects both costs and the environment. Consider the dataset which contains details of food waste over a month. Write a python program using Pandas to analyze and reduce this waste.

Input Format:

A CSV file with the following columns:

•Date (YYYY-MM-DD) – The day waste was recorded

•Food Item – Name of the food item wasted

•Category – Type of food (e.g., Vegetables, Dairy, Meat)

•Quantity Wasted – Amount wasted (in kg or units)

•Cost per Item – Cost of one unit of the food item

Perform the following:

1. Clean the Data

o Handle missing values in Date, Food Item, Category, Quantity Wasted, or Cost per Item (e.g., fill or remove).

2. Calculate Waste Cost

o Per Day: Total waste cost for each day

o Per Category: Waste cost for each food category

3. Top 5 Most Wasted Items

o Find the 5 food items with the highest total quantity wasted

o Suggest simple strategies to reduce waste for each (e.g., store better, reuse, order less)

4. Trend & Strategy Analysis

o Spot patterns (e.g., which days waste the most)

o Recommend ways to reduce waste (e.g., smaller portions, better planning, donation)

Output Format:

•A cleaned DataFrame (after handling missing data)

•Two summary tables:

o Total waste cost per day

o Total waste cost per category •A ranked list of top 5 wasted food items, with suggestions •Trend insights and recommendations for reducing waste. **Smart Energy Grid** A smart energy grid tracks hourly electricity usage (in kWh) for a residential building over 30 days. The data is stored in a NumPy array. Write a Python program that analyzes the energy usage using NumPy. Input Format: A NumPy array with shape (30, 24): 30 rows = 30 days 24 columns = 24 hours per day Each value shows the electricity used during that hour. Perform the following: 1. Calculate Energy Usage • Daily Consumption: Total energy used per day (output: array of 30 values) • Monthly Consumption: Total energy used in 30 days (output: one float) 2. Find Peak Hours For each day, find hours where usage is above that day's average Output: A dictionary {day_index: [list_of_peak_hours]} 3. Predict Next Day's Usage Use the last 7 days to predict the next day's total energy usage using simple average of daily totals from the last 7 days Output Format: Daily Consumption: NumPy array (30 values) Monthly Consumption: Float Peak Hours: Dictionary of peak hour indices per day Predicted Next-Day Usage: Float (average of last 7 days)	
Total Laboratory Hours:	**60 hours**
Text Book(s)	

1. John V. Guttag, "Introduction to computation and programming using Python ", The MIT Press, 3rd Edition, 2021 2. Eric Matthes , "Python Crash Course. ", No Starch Press, 3rd Edition, 2022
Reference Books
1. Luciano Ramalho, "Fluent Python ", OReilly Media Inc , 2nd Edition, 2022 2. Charles R. Severance , "Python for Everybody ", Shroff Publishers, 1st Edition, 2024
Mode of Evaluation : Lab Continuous Assessment, Lab Final Assessment

Recommended by Board of Studies :		21-05-2025
Approved by Academic Council : No. 78	**Date**	12-06-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BACSE102	Problem Solving using Java	L	T	P	C
		0	0	4	2
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

1. To introduce the fundamental concepts of object-oriented programming using the Java language, including data types, control structures, and basic programming constructs
2. To enable students to design and implement Java programs utilizing classes, objects, inheritance, polymorphism, and interfaces to build modular and reusable code
3. To equip students with a comprehensive understanding of Java's exception handling and multithreading capabilities. Java's File Object, input/output (I/O) streams and to equip students with the skills to leverage generic programming and the Java Collection Framework with Databases

Course Outcomes

4. Develop basic Java programs utilizing fundamental programming constructs, object-oriented principles such as classes, objects, inheritance, and polymorphism
5. Implement robust and efficient Java applications by applying exception handling techniques, managing concurrent execution using threads, and performing file input/output operations.
6. Utilize the Java Collection Framework, including Lists and Maps, along with generic programming concepts to effectively manage and manipulate data within Java applications.

Indicative Experiments

1. a. Calculating Interest for Financing Options, Bobby is a financial analyst working for a construction company. He is tasked with evaluating two financing options for funding a new construction project. Each option involves different principal amounts and annual interest rates. Write a program for him that takes the principal amounts and interest rates for both financing options as input and calculates the respective interests for the financial options. Note: Multiply the principal amount by the annual interest rate and then divide by 100 to find the total interest paid b. Three-Digit Number Analysis: Sum of Digits and Parity Check. Alex is teaching a class on number properties and wants to create an exercise for his students. He needs a program that takes a three-digit number as input,	2 hours

calculates the sum of its digits, and determines whether the sum is even or odd. Write a program to assist Alex in this task. c. Generating Prime Numbers Within a Specified Range. Arun is tasked with creating a program that prints prime numbers within a given range. The program should take two integers, start and end, as input, and output the prime numbers between these two values (inclusive). Help Arun to complete the task using a 'for' loop.	
2. a.Calculating Total Distance from Merged Daily Step Counts You are given the number of steps a person takes on two consecutive days. Your task is to merge the step counts from both days and calculate the total distance the person covers, assuming that each step covers a fixed distance of 1 unit. Write a program that takes the step counts for the two days as input, merges them, calculates the total distance covered and outputs the result. b. Identifying and Locating Prime Numbers in a 2D Grid Yashna is creating a program to analyse a 2D grid, identifying prime numbers and printing their coordinates. The input consists of the grid's dimensions and elements. The program's output displays the coordinates of each prime number found in the grid, aiding in the exploration of numerical patterns. Can you assist Yashna in creating the program?	2 hours
3. a. Designing a Rectangle Class to Calculate Area and Perimeter. Arun wants to design a program using a class that calculates and prints both the area and perimeter of a rectangle. Define a class named Rectangle to encapsulate the properties and behaviour related to a rectangle. Include two integer variables length and breadth to represent the dimensions of the rectangle. Calculate and print the area and perimeter of the rectangle. Help Arun to design the program b.Developing an ArrayConcatenator Class for Merging Arrays.Help Roshni to complete the program. Input Format The first line of input consists of an integer N, representing the number of elements of the first Roshni is tasked with developing a program for concatenating two arrays provided by the user. To accomplish this, she wants to create a class named ArrayConcatenator. The class includes a constructor to concatenate the elements of the input arrays. She wants to print the elements of the resulting array. The second line consists of N space-separated integers representing the first array elements. The third line consists of an integer M, representing the number of elements of the second array. The fourth line	2 hours

consists of M space-separated integers, representing the second array elements. Output Format: The output prints the concatenated array of elements separated by space. Refer to the sample output for the formatting specifications. Constraints: In this scenario, the test cases fall under the following constraints $1 \leq N, M \leq 10$ $1 \leq$ array elements ≤ 100	
4. a. Calculating Employee Bonuses Using Hierarchical Inheritance Shasha, an HR manager in a multinational corporation, requires a program to compute bonuses for developers and designers using hierarchical inheritance. Three classes: Employee with a base salary attribute; Developer and Designer extending Employee, each with a bonus percentage, work hours, and methods to calculate and display the final income. Shasha inputs the base salary and work hours for a developer and a designer, and the program outputs their respective final incomes. Note: For developers, the bonus percentage is 10%, for designers, it is 5% Formula: Final income = Base salary + (base salary * bonus percentage * work hours / 100) b.Designing a Fantasy Game Character System.Jessica is tasked with designing a fantasy game character system. The system includes an abstract class named GameCharacter with two abstract methods: attack() and defend().Two subclasses, Warrior and Wizard, extend the GameCharacter class.The program prompts the player to choose a character class (1. Warrior, 2. Wizard) and input their character's strength or magic power. The dynamic calculations involve tripling the strength (strength * 3) for the Warrior's attack and doubling the magic power(power * 2) for the Wizard's attack. Jessica needs your help in completing the program. Help her finish it.	2 hours
5. a. Designing a Washing Machine Control System. Alex and Bob are designing a control system for household appliances, and one of the appliances is a washing machine. You want to create a program to help them that models the washing machine as a motor and calculates its electricity consumption based on its capacity. Define an interface named Motor with the following methods:	2 hours

void run() double consume(double capacity) Create a class called WashingMachine that implements the Motor interface. In the WashingMachine class: Implement the run() method to print "Washing machine is running." Implement a consume() method to print "Washing machine is consuming electricity." Implement the consume(double capacity) method to calculate the electricity consumption (in kWh) of the washing machine based on its capacity. The formula for electricity consumption is (capacity * 0.05). b. Unique Character Extraction.Ashok needs to implement a program using the java.lang package to process a given string. The goal is to create a program that extracts and displays a new string containing only the unique characters from the provided input string. Ashok should efficiently use the java.lang.StringBuilder class and display the output. Help him to complete the program.	
6. a. Validating Student Grade Input with Multi-Catch Exception Handling. Sampad wants to implement a program that takes input for a student's name and grade, validates the input, and then displays the grade for the given student. The grade should be an integer value. The program should validate the grade using the validateGrade() method. The method should throw an IllegalArgumentException if the grade is less than 0 or greater than 100. If the input is invalid due to a non-integer grade, catch the NumberFormatException and print the built-in exception message. If the input is invalid due to an out-of-range grade, catch the IllegalArgumentException and print the built-in exception message. Catch the exceptions using the multi-catch block. Assist Sampad to implement this program. b. Implementing Custom Exceptions for Time Input Validation.Alice is tasked with creating a program that validates user input for time values (hours, minutes, and seconds). The program should check whether the input values are within the valid range. If any value falls outside the valid range, a custom	2 hours

exception, InvalidHourException, InvalidMinuteException, or InvalidSecondException, should be thrown, indicating which part of the time (hours, minutes, or seconds) is invalid. If no exceptions occur, print "Correct Time - " followed by the time in the format "hours:minutes:seconds."	
7. Synchronizing Producer and Consumer Threads with a Shared Message Buffer.A shared resource, a message buffer, needs to be managed by two threads: a Producer and a Consumer. The Producer thread will generate messages and place them into the buffer. The Consumer thread will retrieve and process messages from the buffer. To ensure proper synchronization and avoid issues like the Consumer trying to read from an empty buffer or the Producer overwriting a message before it's consumed, you need to implement inter-thread communication using wait(), notify(), and synchronized blocks. Create a MessageBuffer class that holds a single message. The Producer thread will put a message into this buffer, and the Consumer thread will take a message from it. Implement the necessary synchronization mechanisms so that: The Consumer waits if the buffer is empty.The Producer waits if the buffer is full (i.e., already contains a message that hasn't been consumed).The Producer notifies the Consumer when a new message is available.The Consumer notifies the Producer after consuming a message, indicating the buffer is now empty.Write a Producer class that generates a sequence of messages (e.g., "Message 1", "Message 2", etc.) and puts them into the MessageBuffer.Write a Consumer class that retrieves and prints the messages from the MessageBuffer.Create a Main class to instantiate the MessageBuffer, a Producer thread, and a Consumer thread, and then start both threads.	2 hours
8. Calculating Final Prices with Tax: File Input and Output.Ella is managing her expenses and wants to calculate the final prices after applying a 10% tax to her purchases. She has a list of item prices that she wants to process. Create a file named prices.txt and write the entered item prices to this file. Then, the program should read from prices.txt, apply a 10% tax to each item, write the taxed amounts to a file named tax.txt, and display the taxed amounts. Input Format: The first line of input consists of an integer N, representing the number of items Ella wants to process.The second line consists of N space-separated double values, representing the price of an item.Output Format:The output displays a double value, representing the taxed amounts, each with two decimal places, separated by a space.Refer to the sample output for formatting specifications.Constraints: this scenario, the test cases fall under the following constraints:$1 \leq N \leq 10$.	2 hours
9. Basic Sentiment Analysis: Classifying Sentences from File Input. Mr. Styles is working on a sentiment analysis program to understand the sentiments conveyed in various sentences. he needs your assistance in	2 hours

developing a program that analyzes the sentiment of a given sentence and classifies it as positive, negative, or neutral. positive keywords = happy, good, excellent, positive. negative keywords = sad, bad, terrible, negative. Anything else is Neutral. Create a file named input.txt, the input is written into the file input.txt. The program then reads the sentence from input.txt and sentiment analysis is performed based on predefined positive and negative keywords. The classified sentiment (positive, negative, or neutral) is written to a new file named output.txt and displayed.	
10. Converting Speed Units (km/h to m/s) with File Input and Output: Nick is developing a program to convert speed units from kilometers per hour (km/h) to meters per second (m/s). However, he needs assistance in creating a structured and user-friendly program. Create a file named data.txt to enter the speed in km/h as given in the input. The program reads the speed from data.txt and then converts the speed from km/h to m/s using the formula. The converted speed is written to a new file named converted.txt and then displayed.	2 hours
11. Implementing Persistent Bank Account Transactions using Serialization. Sam is managing his bank account and wants to perform various transactions using a program. He wants to deposit and withdraw funds and then save the account details using serialization. Upon restarting the program, he wants to be able to load the serialized data and continue with his banking transactions. Write a program to assist Sam in managing his bank account, create a BankAccount class, and Serialize the BankAccount object to a file named bankAccount.ser after the transactions. Deserialize the BankAccount object from the file when the program restarts. Display the final balance after the transactions in a formatted manner with two decimal places.	2 hours
12. Serializing and Deserializing Savings Data to Determine Savings Category. Alice is managing her expenses and wants to create a simple program to track her savings she wants to categorise her savings as "Poor savings," "Good savings," or "High savings" using a serialization mechanism. Design a program to create an object of the SavingsData class with the provided salary and savings data. Serialize the created object to a file named savings.ser. Deserialize the SavingsData object from the savings.ser file. Display the category determined by the program after deserialization. Note:	2 hours

"Poor savings", if the savings percentage is between 1% (inclusive) and 10%. "Good savings", if the savings percentage is between 10% (inclusive) and 20%. "High savings", if the savings percentage is greater than or equal to 20%. "Invalid input", if none of the above conditions are met.	
13. Implementing a Generic Record Holder for Academic Data. A university needs a system to manage different types of academic records, such as student grades and course enrollments. To create a flexible and type-safe system, they want to use generic classes.Design a generic class named RecordHolder that can hold any type of academic record. This class should have the following functionalities: A private instance variable to store the record. A constructor that takes an object of the specific record type and initializes the instance variable. A method named getRecord() that returns the stored record. A method named displayRecordInfo() that prints some relevant information about the record. The implementation of this method will depend on the specific type of record being held. Create two concrete classes to represent different types of academic records: GradeRecord: This class should have private instance variables for studentName (String) and grade (Double). It should have a constructor to initialize these variables and a displayRecordInfo() method that prints: "Grade for [studentName]: [grade]". EnrollmentRecord: This class should have private instance variables for courseName (String) and studentId (Integer). It should have a constructor to initialize these variables and a displayRecordInfo() method that prints: "Student [studentId] is enrolled in [courseName]". In your Main class, demonstrate the use of the RecordHolder generic class with both GradeRecord and EnrollmentRecord objects. Create instances of RecordHolder to hold a GradeRecord and an EnrollmentRecord, and then call the getRecord() and displayRecordInfo() methods on these RecordHolder instances.	2 hours
14. Student Registration System using ArrayList in Java. Raman is a computer science teacher who is responsible for registering students for his programming class. He wants to streamline the registration	2 hours

process using a simple program. The program should allow him to input the names of students and later retrieve a student's name based on the index entered. Raman has decided to use an ArrayList to store the names.	
15. Calculating Median Temperature from City Data using HashMap. As a data analyst for a weather forecasting agency, you have a HashMap storing temperature data for various cities. Each city's entry consists of temperature readings. Your task is to find and report the median temperature, providing a more representative measure of the overall temperature patterns over a specific period. Note: To calculate the median, sort the numbers in ascending order. If the count is odd, the median is the middle number. If the count is even, the median is the average of the two middle numbers.	2 hours
16. You are tasked with developing a simple Employee Management System using Java and JDBC. The system should allow users to perform the following operations on employee records stored in a MySQL database Develop a menu-driven program (EmployeeApp.java) that allows users to: 1. Add Employee 2. View Employees 3. Update Employee Salary 4. Delete Employee 5. Exit	2 hours
Total Laboratory Hours:	**60 hours**

Text Book(s)

1. Marc Loy, Patrick Niemeyer and Daniel Leuck, , "Learning Java, ", O Reilly Media, 5th Edition, 2020
2. Herbert Schildt and Dr. Danny Coward, " Java: The Complete Reference", McGraw Hill, 13th Edition, 2024

Reference Books

1. Kathy Sierra, Bert Bates and Trisha Gee,, " Head First Java", O Reilly Media, 3rd Edition, 2022
2. Dhruti Shah, "100+ Solutions in Java: A Hands-On Introduction to Programming in Java, ", BPB Publications, 1st Edition, 2020

Mode of Evaluation : Lab Continuous Assessment, Lab Final Assessment

Recommended by Board of Studies :	21-05-2025	
Approved by Academic Council : No. 78	**Date**	12-06-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-

BAENG101	Technical English Communication	L	T	P	C
		3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1.0			

Course Objectives

1. To enable learners to decipher the tenets of general and interpersonal communication
2. To facilitate application of grammar skills in academic and general situations
3. To help foster learning of productive skills for communicative competence

Course Outcomes

4. Apply the principles of academic and research writing to produce well-organized written texts.
5. Comprehend the basic concepts of communication and its various aspects.
6. Apply grammatical rules in academic and real-life contexts.
7. Interpret research articles using analytical reading skills.
8. Demonstrate effective writing skills by drafting emails and academic documents.
9. Communicate effectively in scenarios involving interpersonal communication.

Module:1	Introduction to Technical Communication	6 hours

The Nature of Technical Communication

Taxonomy of Technical Writing-Scientific Writing, Technical Reporting

Business Communication

5Cs of Technical Writing

Activity: Applying these concepts to answer conceptual questions

Module:2	Grammar	9 hours

Concord

Tense

Conditionals

Voice

Transitions and Linking words

Activity: Error Detection

Module:3	**Reading**	**10 hours**
Analysing definitions – Types of definitions, Methods for Expanding Definitions Reading Comprehension – Drawing Inferences from Scientific Texts Structure of a Research Article Analysing a Research Article **Activity:** Reading a research article		
Module:4	**Writing**	**12 hours**
Research Writing: Structure of a Review Paper Types of Reviews Literature Review Referencing Style - IEEE, APA **Activity:** Writing a literature review		
Module:5	**Interpersonal Communication**	**6 hours**
Cross-cultural Communication Interpersonal Communication Leadership Styles Belbin's Team Roles Negotiation Skills Thomas-Kilmann Modes of Conflict Management Statement of Purpose **Activity:** Case study Analysis		
Module:6	**Contemporary Issues**	**2 hours**
Activity: Guest lectures from Industry and, Research and Development Organizations		
	Total Lecture Hours:	**45 hours**
Text Book(s)		
1. Lannon, J.M. & Gurak, L.J., "Technical communication", Pearson, 7th Edition, 2025		

2. Shoba, K.N. & Sam, P., "Technical English: A workbook", Cambridge University Press, 2018

Reference Books

1. Alred, G.J., Brusaw, C.T., & Oliu, W.E., "Handbook of technical writing", Bedford St Martins, 11th Edition, 2015
2. Gross, A., Hamlin, A., Merck, B., Rubio, C., Naas, J., Savage, M., & Desilva, M. , "Technical writing. ", Open Oregon Educational Resources, 2017
3. Laplante, T.A. , "Technical writing: A practical guide for engineers, scientists, and nontechnical professionals.", CRC Press, 2nd Edition, 2019
4. Markel, M. & Selber, S.A. , "Technical communication.", Bedford St Martins , 12th Edition, 2018

Indicative Experiments

1. **Vocabulary and Proof Reading** Verbal Traps in Technical Communication: Cliches- Malapropisms- Erroneous Heterographs- The Laziness of "very" Proofreading Symbols Proofreading a Short Passage **Activity**: Interactive Worksheets, Proof Reading	4 hours
2. **Intensive Listening** Listening to Podcasts Viewing Documentaries **Activity**: Listening and Note-taking/ Summarising	8 hours
3. **Speaking** Role Play Storytelling Group Discussion Video Resume Presentations **Activity**: Individual and group presentations	8 hours
4. **Reading** Elements of Fiction-Plot-Character-Setting-Theme-Point of View	6 hours

Appreciation of a text-The Ant and the Grasshopper by Somerset Maugham **Activity**: Story/ Book Review	
5. **Writing** Blog Writing Transcoding Statement of Purpose Creating a Portfolio **Activity**: Blog/ Portfolio Design	4 hours
Total Laboratory Hours:	**30 hours**

Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment		
Recommended by Board of Studies :		16-05-2025
Approved by Academic Council : No. 78	**Date**	12-06-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	-	-	-	-	-

BASTS101	Qualitative and Quantitative Skills Practice I	L	T	P	C
		3	0	0	1
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

1. To enhance students' quantitative, reasoning, verbal, and life skills through problem-solving and critical thinking.

Course Outcomes

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

2. Apply quantitative and logical reasoning techniques such as speed math, data arrangement, and analytical problem-solving to solve aptitude and reasoning-based problems efficiently.
3. Demonstrate effective life skills, including profile building, decision making, critical thinking, and communication skills for personal and professional growth in placement and career contexts.

Module:1	Speed Math	8 hours

Addition and Subtraction of Bigger Numbers - Square and square roots-Cubes and cube roots-Vedic Math - Multiplication Shortcuts -Multiplication of 3 and higher digit numbers-Simplifications - Comparing fractions – Calculation Shortcuts - Divisibility rules

Module:2	Percentages, Simple and Compound Interest	6 hours

Percentage -Increase and Decrease – Dealing with Fractions and Decimals - Simple Interest - Compound Interest - Relation between Simple and Compound Interest

Module:3	Profit and Loss, Partnership, Time, Speed and Distance	10 hours

Profit and Loss – Partnership- Averages and Weighted Averages- Mixtures and Allegations-Basics- Relative Speed- Average Speed- Problems on Trains -Problems on Boats and Streams- Problem on Races

Module:4	Data Arrangements, Blood relations, Cryptarithmetic and Attention to detail	10 hours

Linear Arrangement -Circular Arrangement-Multi-dimensional Arrangement- Blood relations - Crypt Arithmetic Type: Addition, Multiplication - Attention to detail

Module:5	**Reading Comprehension and Vocabulary**	**6 hours**
Types of questions - Comprehension Strategies - Synonyms – Antonyms – Analogy - Confusing words		
Module:6	**Profile Building, Professional Networking and Resume writing**	**5 hours**
Profile building-Learn how to create a strong personal and professional profile - Identify elements of a resume, portfolio, and LinkedIn profile, Importance of professional networking		
	Total Lecture Hours:	**45 hours**

Text Book(s)

1. Dr R. S. Aggarwal," Quantitative Aptitude for Competitive Examinations", Chand & Company Ltd, ISBN 978-9358705010, Revised Edition, 2024-25

2. M. Tyra, "Magical Book on Quicker Maths", BSC Publishing Co. Private. Ltd, ISBN 978-8190458924,5th Edition, 2024

Reference Books

1. Stephen R. Covey," The 7 Habits of Highly Effective People", Simon & Schuster, ISBN 978-1982137274, 30th Anniversary Edition, 2020

2. Stella Cottrell, "Critical Thinking Skills: Effective Analysis, Argument and Reflection," Bloomsbury Academic (Palgrave Macmillan), ISBN 978-1350322585, 4th Edition, 2023

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test

Recommended by the Board of Studies:		10-02-2026
Approved by Academic Council: No: 81	**Date**	10-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-

BASTS102	Qualitative and Quantitative Skills Practice II	L	T	P	C
		3	0	0	1
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

1. Equip learners with key life skills and problem-solving, while preparing them for career opportunities through training in quantitative aptitude, logical reasoning, verbal ability and resume building.

Course Outcomes

2. Apply time management techniques, write professional emails, and prepare well-structured reports to enhance productivity and communication.
3. Solve quantitative problems involving time and work, probability, and logical reasoning with accuracy and confidence.

Module:1	Permutation and Combinations, Probability	6 hours

Fundamentals of Counting Principle, Computation of Permutations – Computation of Combinations – Circular Permutation and Probability

Module:2	Time and Work, Logarithms, Progression	8 hours

Work with different efficiencies - Pipes and Cisterns - Work equivalence - Division of wages - Advanced application problems with complexity in calculation - Logarithms, Arithmetic Progression - Geometric Progression and Harmonic Progression

Module:3	Logical Reasoning	9 hours

Coding and decoding - Visual Reasoning – Clocks – Calendars - Direction Sense -Cubes

Module:4	Number System and Algorithmic Thinking	10 hours

Power Cycle - Reminder Cycle - Applications of number system- Introduction to Algorithmic Thinking and Problem-solving, thinking with numbers, thinking with visuals and finding the shortest path, Branching and repetitive problems

Module:5	Verbal Ability	7 hours

Sentence Correction - Subject Verb agreement – Modifiers – Parallelism - Pronoun

Antecedent Agreement - Verb Time sequence – Comparisons – Prepositions - Determiners		
Module:6	**Grooming, Impression Management and Personal Interview**	**5 hours**
Grooming- Dressing Etiquette-Impression Management - Building a Positive Personal Brand - Body Language & Non-Verbal Cues -Types of Interviews – HR Interview, Telephonic Interview, Panel Interview		
	Total Lecture Hours:	**45 hours**

Text Book(s)

1. R.S. Aggarwal, " Quantitative Aptitude for Competitive Examinations", S. Chand Publishing, ISBN 978-8121924624, Revised Edition, 2024-25

2. John Sonmez, " Soft Skills: The Software Developer's Life Manual ", Manning Publications, ISBN 978-1617292392, 1st Edition, 2014

Reference Books

1. R.S. Aggarwal., " A Modern Approach to Logical Reasoning ", S. Chand Publishing, ISBN 978-9352833227, 1st Edition, 2018

2. Richard Paul & Linda Elder, " Critical Thinking: Tools for Taking Charge of Your Professional and Personal Life ", Pearson ISBN 978-0132180915, 2nd Edition, 2014

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test

Recommended by the Board of Studies:		10-02-2026
Approved by Academic Council: No:81	**Date**	10-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-

BACLE191	Basic Multidisciplinary Project	L	T	P	C
		0	0	4	2
Pre-requisite	NIL	Syllabus Version			
		1.0			

Course Objectives

1. Enable students to collaborate effectively in diverse groups by integrating multidisciplinary engineering knowledge to develop practical solutions.
2. Enhance students' skills in project planning, execution, documentation, and technical communication through hands-on engineering activities.
3. Encourage ethical and innovative practices to design sustainable solutions for society and environmental challenges.

Course Outcomes

1. Apply multidisciplinary engineering concepts and techniques to design a sustainable working model.
2. Utilize appropriate technological tools, effective time management to design and document the prototype as an individual or team member.
3. Demonstrate the societal impact, and cost-effectiveness of the developed product with ethics.

Module:1	Project Duration First and Second Semesters	20 hours

Projects can be an experimental setup/model to realize the conceptual prototype, and validate its performance.

Each project team should have 3 to 5 students from at least three different disciplines.

The team must submit both the prototype and a technical report that explains each member's individual contribution.

	Total Lecture Hours:	20 hours

Reference Books

YouTube , "https://www.youtube.com/watch?v=y4drM0vz3us ", University of Sydney, 1st Edition, 2020 YouTube, "https://uwaterloo.ca/engineering-ideas-clinic/about/engineering-design-days/first-year-design-days ", Waterloo Engineering, 1st Edition, 2017 YouTube, "https://www.youtube.com/watch?v=et6E7hWyS0g", University of UTAH, 1st Edition, 2015 YouTube, " https://www.youtube.com/watch?v=hbNTI1NGQ40", Johns Hopkins University, 1st Edition, 2017 YouTube, "https://www.youtube.com/watch?v=Inxl84LBRd0 ", University of Colorado Boulder, 1st Edition, 2017 YouTube, "https://www.youtube.com/watch?v=uIjTK226rsU ", Olin College of Engineering, 2nd Edition, 2021 YouTube, " https://www.youtube.com/watch?v=rHAzpXiO1bg", Olin College of Engineering , 1st Edition, 2019
Mode of Evaluation : Review

Recommended by Board of Studies :	23-05-2025
Approved by Academic Council : No. 78	12-06-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	-	-	2	-	-	-	3	-	-
CO2	3	2	-	2	3	-	3	2	3	3	2	3	3	-
CO3	3	-	-	-	-	3	-	2	-	3	3	3	-	3

Human Science Management (HSM)

BACLE104	Waste Management	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

The objectives of this course are:

1. To make the students understand waste management
2. To enable the students to analyse the socio-economic and environmental factors for waste management towards sustainable development
3. To enable the students to manage emerging types of waste.

Course Outcomes

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

1. Identify the sources, impacts and challenges involved in waste management
2. Suggest suitable methods of collection, transportation and disposal of municipal solid waste for its effective management
3. Apply suitable strategies for management of hazardous, biomedical and radioactive waste
4. Choose appropriate processes and technologies for effective wastewater treatment
5. Outline the sources and characteristics of emerging waste

Module:1	Introduction to Waste Management	7 hours

Waste generation: Sources, impacts, characteristics, segregation and disposal of waste; Linear economy, Circular economy: Urbanization and challenges in waste management; Relevant regulations; Sustainable Development Goals (SDGs); Responsible consumption and production.

Module:2	Municipal Solid Waste Management	8 hours

Sources, Composition, Generation; Collection of waste: Segregation, Transfer and transport of waste; Treatment and disposal options: Landfill, Bio-mining, Incineration

Module:3	Hazardous and Radioactive Waste Management	12 hours

Hazardous waste sources, Characterization and impacts; Storage, Transport, Fate and transport of chemicals; Treatment techniques, Disposal; Biomedical waste: Source, Generation and classification, Waste management; Nuclear waste management: Generation, Characteristics, Impacts and legal requirements; Low level and high-level waste management

Module:4	**Wastewater Management**	**7 hours**
Sources and characteristics of wastewater; Primary wastewater treatment; Secondary wastewater treatment; Sludge treatment alternatives; Industrial wastewater treatment; Zero Liquid Discharge; Reuse, Recycle of wastewater		
Module:5	**Emerging Waste**	**9 hours**
Sources and characteristics: Plastic waste, Microplastic waste, E-waste, Agriculture waste, Glass waste, Metal waste, Waste from oil and gas exploration and production, Construction and demolition waste, Tyre waste, End of life textiles; Waste to wealth		
Module:6	**Contemporary issues**	**2 hours**
	Total Lecture Hours:	**45 hours**

Text Book(s)

1. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, "Environmental Engineering", Mc Graw Hill, 4th Edition, 2017

2. John Pichtel , "Waste Management Practices: Municipal, Hazardous, and Industrial", Taylor and Francis Books India Pvt. Ltd., 2nd Edition, 2024

3. Metcalf & Eddy, "Wastewater Engineering: Treatment and Reuse", Mc Graw Hill, 4th Edition, 2017

Reference Books

1. Letcher, T. M., Vallero, D.A. , "Waste- A Handbook for Management", Elsevier Academic Press USA, 2nd Edition, 2019

2. Stefanakis, A., Nikolaou, I. , "Circular Economy and Sustainability Volume 2: Environmental Engineering", Elsevier Academic Press, USA, 1st Edition, 2021

3. Taherzadeh, M., Bolton, K., Wong J. Pandey, A, "Sustainable Resource Recovery and Zero Waste Approaches", Elsevier Academic Press, USA, 1st Edition, 2019

Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Seminar, Group Discussion, Presentation.

Recommended by Board of Studies	28-5-2025		
Approved by Academic Council	No. 78	**Date**	12-6-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	-	2	3	-	2
CO3	3	2	-	-	-	-	-	-	-	-	2	3	-	2
CO4	3	2	-	-	-	-	-	-	-	-	2	3	-	2
CO5	3	-	-	-	-	-	-	-	-	-	2	3	-	2

BACLE105	Disaster Mitigation and Management	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

The objectives of this course are:

1. To provide adequate knowledge to know about disasters and its impacts, preparedness, response, and recovery to face disaster among government bodies, institutions, NGO's, etc.

2. To obtain the knowledge different disaster and proactive mitigation and preparedness strategies to reduce the impact of disasters.

3. To provide adequate knowledge about applications of different technological tools in disaster monitoring and information dissemination.

Course Outcomes

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

1. Apply disaster risk concepts, disaster management frameworks, and institutional mechanisms to address disaster – related challenges in India.
2. Suggest appropriate mitigation, preparedness, and safety measures by analyze natural Hazard
3. Assess human-induced disasters and develop appropriate prevention and emergency response measures.
4. Apply technological tools for disaster risk analysis, monitoring, early warning, and information dissemination.
5. Prepare community-based disaster Readiness and response strategies by integrating capacity building and indigenous knowledge.

Module:1	Disaster Management	9 hours

Definition of disaster; Types of disaster; Overview on Disaster Management (DM); Global scenario; Hyogo Framework for Action (HFA), Sendai framework for disaster risk reduction; Disaster management system; Important community needs; Hazard, vulnerability and risk– History of disaster Management in India; Disaster Management Act; Disaster management structure in India: Nodal agencies for disaster management in India.

Module:2	Natural Disasters	9 hours

Natural disasters: Earthquakes and tsunamis, landslides, cyclones, floods, droughts, thunders and lightnings, heat waves; Causes, types, assessment, mitigation and preparedness and safety measures.		
Module:3	**Human-induced Disasters**	**8 hours**
Man-made disasters: Chemical and industrial disasters, nuclear disasters, biological disasters and epidemics, fire accidents; Causes and prevention; Offsite and onsite emergency management plans; Road accidents (Causes and Do's and Don'ts).		
Module:4	**Applications of Technological Tools for DM**	**9 hours**
Modelling, risk analysis and loss estimation; Natural disaster risk reduction strategies; Prevention and mitigation; Applications of space technology: Satellite communications, GPS, GIS and Remote sensing and Information / Communication Technologies (ICT) in Early warning systems; Disaster Monitoring and Support Centre: Information dissemination; Application of AI in Disaster Management; Mobile communications: social media etc.; Case studies.		
Module:5	**Community Based Disaster Management**	**8 hours**
Emergency health care: First Aid; Psychological effects after disasters: Socio psycho care, Managing stress, Education and training; Search and Rescue; Disaster mock drill; Establishment of capacity building among various stake holders: Government, Educational institutions, Civil Society; Traditional and indigenous knowledge in Disaster Management.		
Module:6	**Contemporary Issues**	**2 hours**
Lectures by industrial experts.		
	Total Lecture Hours:	**45 hours**
Text Book(s)		
1. McEntire, D. A., "Disaster Response and Recovery: Strategies and Tactics for Resilience", John Wiley & Sons Inc, 3rd Edition, 2021 2. Srivastava A. K., "Text book of Disaster Management", Scientific Publishers (India), 1st Edition, 2021		
Reference Books		
1. Ranke, U., "Natural Disaster Risk Management-Geosciences and Social Responsibility", Springer International Publishing, 1st Edition, 2016		

2. Janki A., "Disaster Studies: Exploring Intersectionalities in Disaster Discourse", Springer Nature , 1st Edition, 2020
Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Seminar, Group Discussion, Presentation.

Recommended by Board of Studies	28-6-2025		
Approved by Academic Council	No. 78	**Date**	12-6-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	2	-	-	-	-	2	3	-	-
CO5	3	-	-	-	-	2	-	-	-	-	2	3	-	-

BACLE106	Urban Planning and Development	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

The objectives of this course are:

1. To make the students to understand the fundamentals of urban and regional planning and their process.

2. To familiarize the students about infrastructure planning.

3. To impart knowledge about resource planning and make students understand planning of new Indian cities

Course Outcomes

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

1.Identify the fundamental concepts, principles and processes of urban and regional planning in the context of the evolution and development of human settlements.

2.Analyse the factors influencing the location, growth, transformation and development of urban settlements in different contexts.

3.Apply principles of planning for the effective provision and management of urban infrastructure and services.

4.Apply geospatial technologies for sustainable resource management and development.

5.Analyse urban and regional planning approaches and their implications for sustainable and resilient city growth.

Module:1	Fundamentals of Urban and Regional Planning	7 hours

Various definitions of town and country planning - Purpose of planning - History of planning in India - Components of planning; Benefits of planning - Arguments for and against planning - Reasoning and its various forms in planning: Space, place and location.

Module:2	Urban Processes	8 hours

Criteria of location and development of towns in history, Political, economic, technological, social and cultural factors which have shaped settlements through history, Indian city typologies and study of urban growth, decline, renewal in different cities based on function, location etc.

Module:3	Infrastructure Planning	8 hours
Planning and management of Storm Water System, Water Supply System, Sanitation & Sewer System and Solid Waste Management - Other Services such as Telecommunication Services - Locational criteria for mobile phone towers - Gas and oil pipelines - Electric substations requirements - capacity, location and space requirement.		
Module:4	**Resource Planning**	**8 hours**
Types of resources, exhaustive and renewable resources development - utilization and conservation of national, technological and human resources - resource management - recycling of resources and resource equilibrium - water resource management - waste land management - rural industrialization and use of non-conventional energy in rural development - major resource development programmes in India. - Introduction to Geographic Information Systems (GIS) - Introduction to GPS and Remote sensing in planning.		
Module:5	**Planning Of Indian Cities**	**12 hours**
Town planning schemes, comprehensive development plans, new towns to regional planning - Technological advances and their effect on the town; utopian thinking and movements about urban improvement and planning - the concept of neighbourhood planning - planning concept and city structure, plan and concept of new towns in India, The concept of ring towns and satellite towns; Delhi Master Plan and the concept of NCR - disorientation of contemporary towns from its cultural context; the concept of conservation; the role of planner as a central figure to understand the present day problems through the medium of the study of history - Planning in post liberalization area, Nature of planning reforms, JnNURM, SEZ, URIF, CCF, DMIC, changes in legal and institutional framework for planning, privatization of planning, corridor planning and its implications.		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours:	**45 hours**

Text Book(s)

1. Gary Hack, et al., "Local Planning: Contemporary Principles and Practice", ICMA, 1st Edition, 2015

2. Pattanaik, B. , "Introduction to Urban Development and Planning Paperback, 2020.", SAGE, 1st Edition, 2020

Reference Books

1. Ministry of Housing and Urban Affairs, "Urban And Regional Development Plans Formulation and Implementation (URDPFI) Guidelines.", Ministry of Housing and Urban Affairs, 1st Edition, 2015

Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Seminar, Group Discussion, Presentation			
Recommended by Board of Studies	28-5-2025		
Approved by Academic Council	No. 78	**Date**	12-6-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	-	3	-	-	-	3	-	-	-	-	2	3	-	-
CO3	3	2	-	-	-	3	-	-	-	-	2	3	-	-
CO4	3	2	-	-	2	3	-	-	2	-	2	-	3	
CO5	3	2	-	-	2	3	-	-	2	-	2	-	-	3

BACLE107	Sustainable Infrastructure Management	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

The objectives of this course are:

1. To familiarize the students with the fundamentals of sustainability and sustainable development goals

2. To impart knowledge on the Construction Materials and Techniques used for sustainable construction and to learn the basic concepts of sustainable planning and design

3. To provide adequate knowledge about assessment, rating systems and policies for sustainable infrastructure

Course Outcomes

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

1. Apply sustainability principles and relevant SDGs to infrastructure development, considering environmental, social, and economic aspects.

2. Identify suitable materials and techniques for sustainable construction.

3. Prepare suitable sustainable building plan for urban infrastructure.

4. Apply the assessment methods and analyse the sustainable building rating systems

5. Illustrate the role of national and international sustainability policies, green financing, carbon credits, net-zero concepts, and AI in sustainable infrastructure development.

Module:1	Fundamentals of Sustainable Infrastructure	8 hours

Introduction to sustainability in infrastructure; Principles of sustainable development; Environmental, social, and economic aspects of sustainability; Sustainable Development Goals (SDGs) and their relevance to infrastructure; Life cycle thinking and sustainability in construction

Module:2	Sustainable Construction Materials and Techniques	9 hours

Eco-friendly and recycled construction materials; Low-carbon and energy-efficient building materials; Green building technologies; Waste minimization and management in construction; Case studies on sustainable construction projects

Module:3	**Sustainable Infrastructure Planning and Management**	**9 hours**
Sustainable design and planning for infrastructure: Smart cities and sustainable urban planning, Building shape and orientation, Heat insulation and building density, Solar protection, Glare protection, Daylight utilization, Noise protection; Façade construction management		
Module:4	**Assessment and Rating of Sustainable Infrastructure**	**9 hours**
Impace Water and Environmental System (EIA) and Social Impact Assessment (SIA); Infrastructure sustainability rating systems: LEED, BREEAM, IGBC, GRIHA, Envision- Carbon Footprint and Energy Performance Assessment; Life Cycle Cost Analysis (LCCA) for sustainable infrastructure; Case studies on sustainable infrastructure rating and assessment		
Module:5	**Policy, Governance, and Future Trends in Sustainable Infrastructure**	**8 hours**
National and international policies for sustainable infrastructure; Role of government, private sector and NGOs in sustainability; Financial aspects: Green financing, Carbon credits, and PPP Models, Net-Zero Infrastructure; AI in sustainability; Future directions in sustainable infrastructure		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours:	**45 hours**

Text Book(s)

1. Fenner, Richard A., Sykes, Judith, Ainger, Charles, "Sustainable Infrastructure: Principles into Practice", Thomas Telford Ltd, 2nd Edition, 2022

2. Fenner, Richard A., Sykes, Judith, Ainger, Charles. T London, , "Sustainable Infrastructure: Principles into Practice", homas Telford Ltd, 5th Edition, 2022

Reference Books

1. Bry Sarte, S, "Sustainable Infrastructure - The Guide to Green Engineering and Design", John Wiley and Sons Inc, 1st Edition, 2015

2. Pollalis, S. N., Georgoulias, A., Ramos, S., Schodek, D. , "Infrastructure Sustainability and Design", Routledge, 1st Edition, 2015

3. Kubba, S, "Handbook of Green Building Design and Construction: LEED, BREEAM, and Green Globes", Butterworth Heinemann, 2nd Edition, 2015

Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Group Discussion, Presentation			
Recommended by Board of Studies	28-5-2025		
Approved by Academic Council	No.78	**Date**	12-6-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	-	-	-	-	-	3	-	3
CO2	3	-	-	-	-	2	-	-	-	-	-	3	-	3
CO3	3	-	-	-	-	2	-	-	-	-	-	3	-	3
CO4	3	-	-	-	-	2	-	-	-	-	-	3	-	3
CO5	3	-	-	-	-	2	-	-	-	-	-	3	-	3

Programme Core Courses

BACLE101	Digital Surveying	L	T	P	C
		3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

The objectives of this course are:

1. To make the students understand the basic principles behind the advanced surveying techniques like Total station survey, DGPS survey and LIDAR Survey.
2. To familiarise the students with advanced surveying techniques and their practical applications.
3. To enable the students to prepare the required survey output in the form of maps and 3D models.

Course Outcomes

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

1. Apply the traditional surveying concepts for various engineering measurements.
2. Use Total Station surveying techniques for topographic and contour mapping.
3. Apply principles of remote sensing and photogrammetry for land surveying.
4. Identify appropriate DGPS and LiDAR techniques for engineering surveys.
5. Conduct land survey using Auto Level, Total station, DGPS and LiDAR to prepare topographic, contour and 3D maps.

Module: 1	Traditional Surveying	8 hours

Definition, principles, and objectives of surveying - Classification of surveying - Introduction to chain surveying,- Types of compasses - Bearings - Local attraction and its correction – Theodolite - Components and working principles- Measurement of horizontal and vertical angles - Methods of plane tabling - Principle of leveling - Types of leveling - Contouring

Module: 2	Total Stations	8 hours

Total Station (TS) and its advantages; Types of Total Stations; Electronic Distance Measurement (EDM) Principle, Angle Measurement in Total Station, Coordinate System in Total Station, Traversing with Total Station, Property boundary marking, land parcel mapping: Setting out roads, buildings; Data recording and storage, Transferring survey data.

Module: 3	Aerial Surveying and Remote Sensing	9 hours

Basic concepts; Perspective geometry of aerial photograph, Relief and tilt displacements, Terrestrial photogrammetry; Flight planning; Stereoscopy; Ground control extension for photographic mapping-mosaics; Drone technology: Unmanned Aerial Vehicles (UAVs), Drone survey and its applications; Applications of aerial survey in civil engineering. Electromagnetic spectrum; Interaction of electromagnetic radiation with the atmosphere and earth surface, Platforms and sensors, Remote sensing data acquisition, Visual image interpretation; Digital image processing, Study of typical Google Street map and Google Earth map; Applications in surveying.		
Module: 4	**GPS, DGPS , GNSS, and IRNSS Technology**	**9 hours**
Surveying with Global Positioning Systems (GPS) – Introduction to Differential GPS (DGPS) Survey – Types of DGPS Survey – Static survey – Real time kinematic (RTK) Survey –GNSS – IRNSS- Applications.		
Module: 5	**LiDAR Technology and Digital Mapping**	**9 hours**
Light Detection and Ranging (LIDAR) Survey; Types of LIDAR system and how it works: Airborne LIDAR, Ground based LIDAR, Advantages and disadvantages of LIDAR, Applications of LIDAR survey, Preparation of topographic map, Preparation of contour map, Preparation of TIN model and Generation of 3D surface; Applications.		
Module: 6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)

1.	S.K. Duggal, "Surveying - Vol. 1 & 2", McGraw Hill , 5th Edition, 2019.
2.	R. Subramaniyan, "Surveying and Levelling", Oxford University, 2nd Edition, 2015.
3.	Satheesh Gopi, R., "Advanced Surveying: Total Station, GIS and Remote Sensing ", Pearson education, 3rd Edition, 2017.

Reference Books

1. Jayanta Kumar Ghosh, "GPS Surveying ", Create Space Independent, 1st Edition, 2015.

2. Paul F. McManamon, "LIDAR Technologies and Systems ", SPIE Press, 1st Edition, 2018.

Indicative Experiments

1.	Measurement of Horizontal, Vertical and Slope distance using Total station.	2 hours

2.	Measurement of Height of Inaccessible / Remote Points using REM Method in Total station.	2 hours
3.	Performing Area Calculation for a Given Parcel of Land using Total station.	2 hours
4.	Three dimensional (3-D) Coordinate measurement (X, Y, Z) using Total station.	2 hours
5.	Perform setting out using Total station.	2 hours
6.	Preparation of Topographic Map using Autoplotter software.	2 hours
7.	Preparation of Contour Map, TIN model and Generation of 3D Surface using Autoplotter software.	2 hours
8.	Static survey using DGPS.	2 hours
9.	LIDAR survey and post processing.	2 hours
10.	RTK survey using DGPS	2 hours
Total Laboratory Hours		**30 hours**

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Oral Examination, Seminar, Group Discussion, Presentation.

Recommended by Board of Studies	28-5-2025		
Approved by Academic Council	No. 78	**Date**	12-6-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	2	2	-	-	3	-	-
CO2	3	2	-	-	3	-	-	3	2	-	2	3	-	-
CO3	3	-	-	-	-	-	-	2	2	-	-	3	-	-
CO4	3	-	-	-	-	-	-	2	2	-	-	3	-	-
CO5	3	2	-	-	3	-	-	3	2	-	2	3	2	-

BACLE102	Environmental Engineering	L	T	P	C
		3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

The objectives of this course are:

1. To inculcate the basic principles and concepts to design and develop the unit operations and processes involved in water and wastewater treatment
2. To evaluate the performance of water and wastewater treatment plants and sludge Management.
3. To learn air and noise pollution and its effects.

Course Outcomes

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

1. Outline the significance of water quality, water conservation, and relevant environmental legislation in promoting environmental sustainability.
2. Design the different unit operations and processes involved in water treatment plants
3. Design the different unit operations and processes involved in wastewater treatment plants
4. Identify the effects of air and noise pollution and its control measures
5. Perform the characterization of water and wastewater samples, and demonstrate the air quality and noise levels.

Module: 1	Water quality, quantity and pipe network	10 hours

Water resources: Demand, Estimation, Quality index; Water supply: Distribution, Pipe network analysis; Water conservation: Rainwater harvesting, Sanitary and storm water sewers, Design; Reclamation of used water; Environmental legislation

Module: 2	Water Treatment	8 hours

Objectives of water treatment; Unit operations of processes: Sedimentation, Coagulation and flocculation, Filtration, Disinfection, Water softening, Ion exchange, Removal of iron and manganese, Fluoridation.

Module: 3	Primary and Secondary Wastewater Treatment	10 hours

Objectives of wastewater treatment; Characteristics of sewage: Wastewater quantity and flow variation, Septic tank design; Primary treatment: Screens, Grit chambers, Oil & grease, flocculation and coagulation, Sedimentation; Secondary treatment: Selection of treatment

methods: Principles, Functions, Suspended growth system, Attached growth systems, Disinfection.		
Module: 4	**Advanced wastewater Treatment and Sludge management**	**9 hours**
Nutrient removal: Advanced oxidation process, MBR, UASB; Sludge management: Characteristics of sludge, Treatment methods and disposal methods.		
Module: 5	**Air and Noise Pollution**	**6 hours**
Air pollution: Sources, Classification, Impacts, Meteorological factors, Prediction and forecasting. Air pollution control: systems and strategies; Concepts of noise pollution and its control.		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture Hours		**45 hours**

Text Book(s)

1 Peavy, H., Rowe, D., Tchobanoglous, G. , "Environmental Engineering", McGraw Hill Education, USA, 1st Edition, 2017

2. Davis, M.L., Cornwell, D.A., "Introduction to Environmental Engineering", McGraw-Hill, 6th Edition, 2023

3. Garg S.K., "Environmental Engineering, Vols. I and II", Khanna Publishers, New Delhi, 20th Edition, 2024

Reference Books

1. Metcalf and Eddy, Inc., Tchobanoglous, G., Burton, F. , "Wastewater Engineering, Treatment and reuse, 4th Ed., 2017.", McGraw Hill, USA, 5th Edition, 2015

2. Hammer, M.J. Sr., Hammer, M.J. Jr., " Water and Wastewater Technology, ", Pearson Education India, 7th Edition, 2015

3. Gurjar, B., & Tyagi, V. K, ". Sludge Management", CRC Press, Taylor and Francis Group, UK , 1st Edition, 2017

Indicative Experiments

1.	Determination of pH and hydrogen ion concentration in a given water sample	2 hours
2.	Estimation of alkalinity and acidity in a given water sample.	4 hours
3.	Assessment of temporary and permanent hardness in a given water sample.	4 hours
4.	Find out the concentration of chloride and salinity in a given water sample.	2 hours
5.	Determination of turbidity and optimum dosages of various coagulants.	4 hours
6.	Estimation of dissolved Oxygen and BOD.	4 hours
7.	Determination of solid concentration and correlating specific conductivity and establishing its relationship with TDS.	2 hours
8.	Determination of COD from given sample.	4 hours
9.	Determination of indoor air and noise pollution measurements.	2 hours
10.	Advanced instrumentation for water and wastewater analysis.	2 hours
Total Laboratory Hours		**30 hours**

Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Oral Examination, Seminar, Group Discussion, Presentation.

Recommended by Board of Studies	28-5-2025		
Approved by Academic Council	No. 78	**Date**	12-6-2025

CO-PO Mapping:

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CO2	-	3	2	-	-	-	-	-	-	-	2	3	-	2
CO3	-	3	2	-	-	-	-	-	-	-	2	3	-	2
CO4	3	-	-	-	-	-	-	-	-	-	2	3	-	2
CO5	3	-	-	-	-	-	-	-	-	-	2	3	-	2

BACLE103	Mechanics of Solids	L	T	P	C
		3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

The objectives of this course are:

1. To provide the basic concepts and principles of deformable bodies.
2. To enable the students to calculate stresses and deformations of members under external loadings
3. To enable the students to apply solid mechanics in engineering design problems

Course Outcomes

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

1. Compute the moments of inertia for different sections of rigid bodies, find stress and strain behaviour of deformable bodies and analyse the truss
2. Draw shear force, bending moment diagrams for determinate beams and compute bending stress, shear stress of beams and torsion of shafts.
3. Analyse the deflection of the beams using different methods
4. Determine the buckling and crushing load of the long and short column with different end conditions
5. Compute the mechanical properties of building materials and determine the strength of beams and columns through experiments.

Module: 1	Statics of Rigid Bodies and Properties of Surfaces	9 hours

Equilibrium of rigid bodies in two and three dimensions; Types of beams, supports and reactions; Principle of virtual work; First moments of areas and lines, Centroids of composite areas and lines; Second moment of area; Parallel axis theorem, Rectangular and Polar moments of inertia of composite areas; Radius of gyration; Product of inertia; Principal axes and principal moments of inertia; Mass moments of inertia of thin plates.

Module: 2	Stresses and Strains on Deformable Bodies	9 hours

Hooke's Law; Stress under tension, compression and shear; Relation between elastic constants: Poisson's ratio, Bulk modulus; Generalized Hooke's law; Mohr's circle; Principal stresses and strains; Stress tensor; Stresses in thin-walled pressure vessels; Failure theories; Analysis of truss: Method of joints, Method of section.

Module: 3	Bending Moment and Shear Force- Theory of Bending and torsion	9 hours
Bending of beams; Types of loading and support conditions; Shear force and bending moment of statically determinate beams; Simple bending theory; Bending stress and shear stress; Torsion of shaft.		
Module: 4	**Deflection of Beams**	**9 hours**
Slope and deflection of simply supported and cantilever beams; Double integration method; Macaulay's method; Moment area method; Conjugate beam method.		
Module: 5	**Theory of Columns**	**7 hours**
Long and short column; Stability of columns; Equivalent length of column; Euler's formula and its limitation; Rankine's formula; Secant formula; Combined bending and direct stresses on column.		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture Hours		**45 hours**

Text Book(s)

1. Beer, F.P., Johnston, E.R., DeWolf, J.T. and Mazurek, D.F. , "Mechanics of materials,", McGraw-Hill Education, 8th Edition, 2020

Reference Books

1. Bansal, R. K. A textbook of , "Strength of Materials", Laxmi Publications, 6th Edition, 2018

2. Goodno, B. J., Gere, J. M. , "Mechanics of Materials", Cengage Learning India Pvt. Ltd., 9th Edition, 2019

3. Subramanian, R. Strength of Materials, "Strength of Materials", Oxford University Press, 3rd Edition, 2016

Indicative Experiments

1. Compression test on Building materials: Solid block	2 hours
2. Compression test on Building materials: Paver block	2 hours
3. Compression test on Building materials: Brick	2 hours
4. Tension test on steel bar	4 hours

5. Determination of rigidity modulus of a steel rod	4 hours
6. Double shear test	2 hours
7. Calculation of bending stress of wooden beam	2 hours
8. Deflection of steel beam with different end conditions	4 hours
9. Load carrying capacity of short columns	4 hours
10. Load carrying capacity of long columns	4 hours
Total Laboratory Hours:	**30 hours**

Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Oral Examination, Seminar, Group Discussion, Presentation.

Recommended by Board of Studies	28-5-2025		
Approved by Academic Council	No. 78	**Date**	12-6-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	2	-	-	-	3	-	-

BACLE201	Fluid Mechanics and Hydraulic Machines	L	T	P	C
		2	1	2	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

The objectives of this course are:

1. Understand fluid properties, behaviour, and governing equations for different flow conditions.
2. Analyze and evaluate fluid flow systems, including energy losses, and apply concepts in the design and performance assessment of hydraulic machines.
3. Apply fluid mechanics principles to analyze and design hydraulic structures, particularly for evaluating forces on dams and other water-retaining systems.

Course Outcomes

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

1. Identify fluid properties and their influence on fluid behavior under both static and dynamic conditions.
2. Apply fundamental fluid mechanics concepts to estimate energy losses and flow parameters in pipes.
3. Assess the performance and efficiency of hydraulic turbines and pumps based on operational requirements.
4. Analyze hydrodynamic forces and structural loads to verify the structural stability of hydraulic components.
5. Analyze flow parameters, head losses, and flow regimes using flow-measuring devices, and draw the operational performance of hydraulic machinery through experimental data.

Module:1	Fluid Statics and Buoyancy	5 hours

Definition of fluid, Concept of continuum, Fluid properties, Rheological classification, Pascal's Law and Hydrostatic pressure and its measurement -Manometry. Hydrostatic forces on Plane, Inclined and Curved surfaces, Buoyancy, Condition of Equilibrium for Submerged and Floating Bodies, Centre of Buoyancy

Module:2	Fluid Kinematics and Dynamics	5 hours

Description of fluid motion – Lagrangian and Eulerian approach, Types of flows, Control volume, Material derivative and acceleration, Streamlines, Pathlines and Streaklines, Stream function and velocity potential function, The Reynolds transport theorem. The continuity equation, The Euler and Bernoulli equations – Venturimeter, Orificemeter, Pitot tube, Momentum equation and its application – forces on pipe bends, moment of momentum, The Navier–Stokes Equations.

Module:3	Flow through pipes and Dimensional Analysis	6 hours

Major loss-Friction factor Minor losses-Solution to pipe flow problems-single path and multi path systems Fully developed Laminar flow in pipe-Laminar flow between parallel plates when both plates at rest-Laminar flow between parallel plates when upper plate moving with constant speed-Turbulent flow–shear stress distribution and velocity profiles- Dimensional homogeneity, Rayleigh's method, Buckingham π theorem, Non-dimensional numbers, Model laws and distorted models Modelling and similitude

Module:4	Hydraulic Machines	6 hours
Introduction - Centrifugal pumps – Work done - Head developed - Pump output and Efficiencies - priming - minimum starting speed - performance of multistage pumps - Cavitation - methods of prevention - Pump characteristics – Classification of hydraulic turbines - Pelton wheel - Francis turbine - Kaplan and Propeller turbines - - Specific speed- Theory of draft tube - Governing - Performance characteristics - Selection of turbines		
Module:5	**Dams and Components of Hydroelectric Scheme**	**6 hours**
Types of dams-Selection of the type of dam–Factors governing selection of dam Construction of Modern Dams–Gravity dam–Forces acting on a gravity dam–Modes of failure and criteria for structural stability–Elementary profile of gravity dam-Design of gravity dam-Earthen dams and rock fill dams–Types-causes of failure-Spillway-Location of spillway -Types of Spillway-Classification of Hydel plants–Principal components of a hydroelectric scheme-Hydropower potentials of India		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**30 hours**
	Total Tutorial Hours	**15 hours**

Textbook(s)

1. Fox and McDonald, "Introduction to Fluid Mechanics", Wiley, 10th Edition, 2020
2. Subramanya K, "Hydraulic Machines", Tata McGraw Hill New Delhi, 1st Edition, 2017
3. Santosh Kumar Garg, "Irrigation Engineering and Hydraulic Structures", Khanna Publisher New Delhi, 35th Edition, 2019

Reference Books

4. Som S K, Gautam Biswas, Chakraborty S, "Introduction to Fluid Mechanics and Fluid Machines", McGraw Hill, 3rd Edition, 2017
5. Rajput, R. K, "Fluid Mechanics and Hydraulic Machines", S Chand and Company Ltd, 6th Edition, 2016
6. Government of India, Central Water Commission, Central Dam Safety Organization, "Guidelines for Preparing Operation and Maintenance Manual for Dams", Dam Safety Rehabilitation Directorate, 1st Edition, **2018.**

Indicative Experiments

1. Determination of coefficient of discharge of an orifice and mouthpiece	2 hours
2. Determination of coefficient of discharge of a rectangular and triangular notch.	2 hours
3. Determination of coefficient of discharge of a venturi meter and orifice meter	2 hours
4. Estimation of friction factor of a pipe.	2 hours
5. Estimation of minor losses in pipe fittings.	2 hours
6. Determination of state of flow in a closed conduit using Reynold's experiment and flow rate using current meter	4 hours

7. Performance characteristics of a centrifugal pump (Rated Speed).	4 hours
8. Performance characteristics of a self-priming pump	4 hours
9. Determine the efficiency of a submersible pump	4 hours
10. Load test on Pelton turbine and Francis turbine/ Kaplan turbine	4 hours
Total Laboratory Hours	**30 hours**

Mode of Evaluation: Continuous Assessment Test, Quiz / Case studies / Project, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment

Recommended by Board of Studies	24-10-2025		
Approved by Academic Council	No. 80	**Date**	20-11-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	3	2	-	-	3	-	-

BACLE202	Soil Mechanics and Foundation Engineering	L	T	P	C
		3	0	2	4
Prerequisite	NIL	Syllabus Version			
		1			

Course Objectives

The objectives of this course are:

1. To acquire a comprehensive understanding of the basic principles of soil mechanics, including compaction, consolidation, and bearing capacity.
2. To cultivate the ability to apply the design principles of foundations and assess the stress generated within the soil medium.
3. To develop knowledge about the methods and principles required to examine the stability of slopes.

Course Outcomes

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

1. Compute the various index and engineering properties, hydraulic conductivity and seepage behaviour of the soil.
2. Analyze the stress distribution at any point below ground level and determine the shear strength of soil.
3. Select the suitable soil investigation methods for advanced explorations and calculate the safe bearing capacity of shallow foundations.
4. Determine the load carrying capacity of pile foundations and the lateral earth pressure.
5. Conduct standard laboratory testing to determine index, hydraulic and strength parameters of soil.

Module:1	Soil Characteristics and Compaction	7 hours

Three Phase relations; Plastic Characteristics, Grain size distribution & Index properties; Soil classification (IS). Compaction, Laboratory compaction tests & Factors affecting compaction

Module:2	Principles of Effective Stress and Permeability	6 hours

Principle of effective stress; Capillarity; Seepage force and quicksand condition; One-

dimensional flow; Darcy's law; Laboratory methods for permeability determination.

Module:3	Stress Distribution, Consolidation and Shear Strength Behaviour of Soil	12 hours

Boussinesq stress distribution theory and Newmark's chart Compressibility of soils, Normally consolidated and over-consolidated clay; Terzaghi's theory of one-dimensional consolidation; Evaluation of compressibility and consolidation parameters.

Mohr's stress circle; Mohr-Coulomb failure criterion; Laboratory tests for shear strength determination; Effective and total stress shear strength parameters; Shear strength characteristics of clays and sands.

Module:4	Soil Exploration Techniques, Bearing Capacity and Settlement of Shallow Foundations	9 hours

Objective of site investigation; Detailed site investigation; Methods and depth of exploration; Factors governing location and depth of foundation; Types of Foundations, Selection of Foundation; AI driven systems and automated sensors for soil explorations and machine learning models to predict the engineering properties of soil. Terzaghi's theory of bearing capacity, General and local shear failure; Plate load test, Standard Penetration Test; Design of Footings, Settlement of footings, Immediate and Time dependent settlement, Permissible limits of total and differential Settlement.

Module:5	Pile Foundations, Stability of Slopes, Earth Pressure and Retaining Wall	9 hours

Classification and selection of piles, Static and dynamic formulae for single pile capacity, Efficiency and capacity of pile groups, Design of Pile group, Settlement of Pile Groups. Failure of infinite and finite slopes, Swedish circle method, Factor of safety, Landslide – mechanism and mitigation techniques.
Earth pressure at rest, Rankine's active and passive earth pressures, Types of retaining walls.

Module:6	Contemporary Issues	2 hours
	Total Lecture Hours:	**45 hours**

Text Book(s)

1. Arora, K. R, "Soil mechanics and Foundation Engineering", Standard Publishers Distributers, New Delhi, 7th Edition, 2019
2. Das, B. M, "Principles of Geotechnical Engineering", Cengage learning Pvt. Ltd, India., 10th Edition, 2022
3. Holtz, R. D, Kovacs, W. D., Sheahan, T. C., "An Introduction to Geotechnical Engineering", Prentice Hall, Pearson Education, India, 3rd Edition, 2022

Reference Books

1. Ranjan, G., Rao, A. S. R, "Basic and Applied Soil Mechanics", New Age International Private Limited, India, 4th Edition, 2022
2. Tomlinson, M., Woodward, J., "Pile Design and Construction Practice", CRC Press, United Kingdom, 6th Edition, 2015
3. Chowdhury, R., Flentje, P., Bhattacharya, G, "Geotechnical Slope Analysis", CRC Press, United Kingdom, 2nd Edition, 2023

Indicative Experiments

Grain size Analysis – Mechanical Method	4 hours
5. Consistency Limit • Liquid Limit • Plastic Limit	4 hours
3. Compaction Test	2 hours
Determination of Field Density • Core Cutter Method • Sand Replacement Test	4 hours

5. Coefficient of Permeability – Constant Head & falling head Method	4 hours
6. Direct Shear Test	2 hours
7. Unconfined compression Test	2 hours
8. Consolidation Test	4 hours
9. California Bearing Ratio Test	2 hours
10. Relative Density Test	2 hours
Total Laboratory Hours:	**30 hours**

Mode of Evaluation: Continuous Assessment Test, Quiz / Case studies / Project, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment

Recommended by Board of Studies	24-10-2025		
Approved by Academic Council	No. 80	**Date**	20-11-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	2	-	-	-	2	-	-	2	2	-	2	3	2	-
CO4	3	2	-	-	2	-	-	2	3	-	2	3	2	-
CO5	3	-	-	3	-	-	-	3	2	-	2	3	-	-

BACLE203	Structural Analysis	L	T	P	C
		3	1	0	4
Pre-requisite	BACLE103 - Mechanics of Solids	Syllabus Version			
		1			

Course Objectives

The objectives of this course are:

1. To understand the principles of static and kinematic indeterminacy in beams and frames.
2. To apply analytical methods for evaluating bending moment and shear force in indeterminate structures using energy and displacement approaches.
3. To analyze and interpret the behaviour of cables and arches under various loading conditions.

Course Outcomes

1. Determine the static and kinematic indeterminacy and analyse the beam using three moment equation method
2. Analyse the indeterminate beams and draw bending moment and shear force diagram using strain energy method
3. Analyse the indeterminate beams and construct bending moment and shear force diagram using displacement method
4. Formulate the influence line diagram for determinate and indeterminate beams with different loading conditions
5. Analyse the cables and arches under different loading conditions .

Module:1	Three Moment Equation Method	9 hours

Static indeterminacy, Kinematic indeterminacy; Determinate and indeterminate beam; Pin jointed and rigid jointed frames; Three moment equation method; Analysis of fixed beam; Propped cantilever beam and Continuous beam for different types of loading; Shear force diagram and Bending moment diagram.

Module:2	Strain Energy Method	8 hours

Determination of deflection; Castigliano's First Theorem: continuous beams, pin jointed frames and rigid jointed frames; Castigliano's Second Theorem to determine the reactions of continuous beams, pin jointed frames and rigid jointed frames.

Module:3	Displacement method structural analysis	10 hours

Slope Deflection Method: Computation of slope and deflection; Analysis of continuous beams and portal frames with and without sway; Shear force diagram and Bending moment diagram; Moment distribution method: Stiffness calculation, Distribution factors,

Analysis of continuous beam, portal frames with and without sway; Shear force diagram and Bending moment diagram.

Module:4	Rolling Loads and Influence Lines	8 hours

Rolling loads; single concentrated load and uniformly distributed load; maximum shear force diagrams; maximum bending moment diagram; Influence line diagram for different loading conditions: Muller Breslau principle, Influence line diagram for determinate and indeterminate beams.

Module:5	Cables and Arches	8 hours

Cables: Equilibrium of cable, Uniformly loaded cable, Expression for horizontal reaction, length of cable, sag and tension; Three hinged arches: equation of a parabolic arch - normal thrust, bending moment and shear force. Two hinged arches: normal thrust, bending moment and shear force.

Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**
	Tutorial Hours	**15 hours**

Textbook(s)

1. Reddy, C.S. "Basic Structural Analysis", Tata McGraw Hill, New Delhi, 3rd Edition, 2017
2. Wang, C.K., "Intermediate Structural Analysis", Tata McGraw Hill, New Delhi, 1st Edition, 2020

Reference Books

3. Menon, D., "Structural Analysis", Alpha Science International Ltd, 2nd Edition, 2017
4. Hibbeler, R. C, "Structural Analysis", Pearson Education, UK, 9th Edition, 2017 Hanson, J, "Structural Analysis: Skills for Practice", Pearson Education, New Delhi, 1st Edition, 2016

Mode of Evaluation: Continuous Assessment Test, Quiz / Case studies / Project, Final Assessment Test

Recommended by Board of Studies	24-10-2025		
Approved by Academic Council	No. 80	**Date**	20-11-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	3	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	3	-	-
CO5	-	3	-	-	-	-	-	-	-	-	-	3	-	-

BACLE204	Transportation Engineering	L	T	P	C
		3	0	2	4
Pre-requisite	BACLE101 - Digital Surveying	Syllabus Version			
		1			

Course Objectives

The objectives of this course are:

1. To develop understanding of transportation systems, modes, and planning processes in transport project preparation.
2. To apply engineering standards and design principles for highway geometric elements, traffic facilities, and pavement systems.
3. To acquaint with engineering properties and testing methods of materials used in highway construction for quality and performance assessment.

Course Outcomes

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

1. Apply general concepts on transportation system in planning and evaluation of transportation projects.
2. Design highway geometrical elements using appropriate design principles and guidelines.
3. Apply traffic engineering principles to design and manage safe and accessible traffic facilities.
4. Apply pavement engineering principles to evaluate materials and design pavements.
5. Conduct standard tests and field studies to evaluate pavement materials and traffic characteristics.

Module:1	Transportation system and planning	7 hours

Modes of passenger and goods transport; private, public and intermediate public transportation; urban and inter-urban transportation; roadway network development in India; urban and rural highway classification. Transport planning process; evaluation of transport projects; engineering surveys and project preparation – feasibility study, detailed project report.

Module:2	Design of highway geometry	10 hours

Identifying most suitable highway alignment; Geometric design parameters and constraints; Properties of traffic engineering elements; design guidelines from IRC, MoRTH and AASHTO; design of highway cross-section elements; sight distance; design of horizontal alignment; design of vertical alignment; Practice: Geometric design.

Module:3	Traffic engineering and management	10 hours

Traffic characteristics; traffic data collection methods; consideration of safety and inclusiveness in design of traffic facilities; common causes of crashes; accessibility needs of women, children, old people and persons with disability; design of safe and

accessible roads and intersections; safer traffic movement through signs and markings; design of basic signal timing for isolated intersection.

Module:4	Characteristics of highway pavement materials	7 hours

Characteristics of materials used in highway pavements- soils, aggregates, bituminous material, bituminous paving mixes, portland cement and cement concrete, tests for evaluation of suitability of aggregate and bitumen for pavements. Road roughness measurement; Practice: Evaluation of material properties in lab sessions.

Module:5	**Analysis and design of highway pavements**	**9 hours**
Components of flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC, Components of rigid pavements; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC.		
Module:6	**Contemporary Issues**	**2 hours**
Lectures by invited industry experts.		
	Total Lecture Hours:	**45 hours**

Textbook(s)

1. Chakraborty, P., Das, A., "Principles of Transportation Engineering", Prentice Hall India Learning, Pvt. Ltd., 2nd Edition, 2017
2. Khanna S.K., Justo C.E.G., Veeraragavan A. "Highway Engineering", Khanna Publishers, 10th Edition, 2016
3. Kadiyali L.R. "Traffic Engineering and Transport Planning", Khanna Publishers, 9th Edition, 2018

Reference Books

4. Kuhn B. K., "Transportation Engineering: A Practical Approach to Highway Design, Traffic Analysis, and Systems Operation", McGraw-Hill Education, 1st Edition, 2019
5. Kadiyali L.R., "Highway Engineering", Khanna Publishing House, 1st Edition, 2025

Indicative Experiments

6. Tests on Aggregate: Gradation, shape test.	4 hours
2. Tests on Aggregate: Impact test.	4 hours
3. Tests on Aggregate: Los Angeles abrasion test	4 hours
4. Tests on Aggregate: specific gravity test, water absorption test.	2 hours
5. Tests on Bitumen: penetration test, viscosity test	4 hours
6. Tests on Bitumen: flash and fire point test, ductility test.	2 hours
7. Tests on Bitumen: softening point test, specific gravity test.	2 hours
8. Pavement evaluation: pavement unevenness using MERLIN, roughness measurement using Android App.	2 hours
9. Traffic studies: traffic volume studies for mid-block and intersection.	4 hours
10. Traffic studies: spot speed study, headway distribution study, parking usage study	2 hours
Total Laboratory Hours	**30 hours**

Mode of Evaluation: Continuous Assessment Test, Quiz / Case studies / Project, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment

Recommended by Board of Studies	24-10-2025		
Approved by Academic Council	No. 80	**Date**	20-11-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	2	-	2	-	-	2	2	-	2	3	2	-
CO3	3	-	2	-	-	-	-	-	-	-	-	2	-	-
CO4	3	-	2	-	-	-	-	2	2	-	2	3	-	-
CO5	3	2	-	-	2	-	-	2	2	-	2	2	-	-

BACLE205	Design of Steel and Reinforced Concrete Structures	L	T	P	C
		3	0	2	4
Pre-requisite	BACLE203 - Structural Analysis	Syllabus Version			
		1			

Course Objectives

The objectives of this course are:

1. To understand the design philosophies, code provisions, and behaviour of reinforced concrete and steel members.
2. To develop competency in proportioning and detailing reinforced concrete and steel flexural and compression members, including footings and connections.
3. To analyze and assess the strength and serviceability of steel structural members and their connections.

Course Outcomes

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

1. Interpret the design philosophies and codal provisions governing the behaviour of reinforced concrete and steel structures.
2. Design and detailing of Reinforced concrete flexural members
3. Design reinforced concrete columns and footings under axial and combined bending actions following limit state criteria.
4. Determine the load-carrying capacities of axial members and flexural members and assess the serviceability of steel beams.
5. Analyze the structural behavior of concrete and steel members through laboratory testing, and design a residential building using appropriate structural modelling and design principles.

Module:1	Properties of Reinforced concrete and structural steel materials and Design Philosophies	6 hours

Concrete: Types of failures and strength under direct compression, Stress-strain curve under compression, Modulus of Elasticity, Tensile strength, Flexural strength, Modulus of rupture, Poisson's ratio, Shear strength, Shear modulus, Shrinkage and creep. Structural Steel: Manufacturing process of hot rolled steel, Yield strength, ultimate strength, Elastic Modulus, 0.2% proof strength, Ductility, Toughness, Residual stresses. Design Philosophies: Working strength method, Ultimate strength method, Limit state method, Uncertainties in design, Reliability methods.

Module:2	Analysis and Design of Reinforced concrete flexural members	10 hours

Equilibrium conditions, Limiting moment of resistance; Concrete stress block at limit state, Neutral axis depth, Rectangular and T-Beam; Singly reinforced beam, Doubly reinforced

beam, Design for shear, Simple and continuous beams, Behaviour of one way and two way slabs, Design for simply supported and continuous slabs, Detailing of reinforcements: beams, slabs.

Module:3	Design of reinforced concrete columns and foundations	8 hours

Behaviour of short and long columns, Minimum eccentricity, Effective length, Unsupported length; Design of short columns: Axial load, axial load with uniaxial bending moment, Axial load with biaxial bending moment, Reinforcement detailing: Longitudinal reinforcement and transverse reinforcement. Foundations: Isolated and combined footings, Plan area: axially loaded column, Axial load with uniaxial bending moment, Eccentricity; depth: One way shear, Two way shear, Moment of resistance; Detailing of reinforcement.

Module:4	**Design of steel connections, Tension members and compression members**	**10 hours**
Steel connections: Types of connections; Bolted connections: simple connection, lap joints, butt joints with cover plates; Welded connections: Thickness of weld, Throat thickness, Length of weld, simple connection, lap joint and butt joint with cover plates. Tension members: Yielding, Rupture of critical section, Block shear, Shear lag. Compression members: Axially loaded members, Imperfection factors, Buckling classes, Column buckling curves, Effective lengths.		
Module:5	**Design of steel beams**	**9 hours**
Section classifications and types: Out-standing element, Internal element, Elastic and plastic section modulus, Moment of resistance, Laterally-supported and laterally unsupported beams, Elastic and plastic web shear buckling, Combined shear and bending moment.		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours:	**45 hours**

Textbook(s)

1. Unnikrishna Pillai, S., Menon, D. , "Reinforced Concrete Design, ", McGraw Hill Education India Private Limited; 4th Ed., 2022., 4th Edition, 2022
2. Ramchandra. S., Ghelot, V. , "Design of Steel Structures,", Scientific Publishers, New Delhi, 2011., 1st Edition, 2016

Reference Books

3. Subramanian, N., "Design of Reinforced Concrete Structures", Oxford University Press, New Delhi, 1st Edition, 2015
4. Varghese, P. C. , "Limit State Design of Reinforced Concrete, ", PHI Publishers, New Delhi, 2nd Edition, 2015
5. Subramanian, N. Steel Structures , "Design and Practice", Oxford University Press., 1st Edition, 2015
6. Duggal, S.K., " Limit State Design of Steel Structures", , Tata McGraw Hill Publishing Company, New Delhi, 1st Edition, 2015

5. Bureau of Indian standards, "IS 456: 2000 Plain and Reinforced Concrete - Code of Practice.", Bureau of Indian standards, 4th Edition, 2024
6. Bureau of Indian standards, "IS 800: 2007 General Constructions in Steel - Code of Practice.", Bureau of Indian standards, 3rd Edition, 2022

Indicative Experiments

1. Tests on compression and tensile strength of concrete cube and cylinder specimens	4 hours
2. Tests on tensile strength of concrete cube and cylinder specimens	4 hours
3. Tests on flexural strength and Modulus of elasticity	4 hours
4. Tests on flexural capacity of singly reinforced rectangular beam.	4 hours
5. Tests on steel connections - Bolted connection.	4 hours
6. Tests on steel connections – Welded connection.	2 hours
7. Tests on buckling of Columns.	2 hours
8. Modelling of a G+3 Residential building.	2 hours

9. Analysis of a G+3 Residential building.			2 hours
10. Design of a G+3 Residential building.			2 hours
Total Laboratory Hours:			**30 hours**
Mode of Evaluation: Continuous Assessment Test, Quiz / Case studies / Project, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment			
Recommended by Board of Studies	24-10-2025		
Approved by Academic Council	No. 80	**Date**	20-11-2025

CO- PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	3	3	-	-	-	-	-	-	-	-	-	3	-
CO3	-	3	3	-	-	-	-	-	-	-	-	-	3	-
CO4	-	3	3	-	-	-	-	-	-	-	-	-	3	-
CO5	-	3	3	-	3	-	-	2	2	-	-	-	3	-

BACLE206	ESTIMATION, COSTING AND DRAWING	L	T	P	C
		3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

The objectives of this course are:

1. To develop an understanding of building regulations, planning principles, and drawing conventions as per national standards.
2. To make learners to estimate quantities, prepare cost documents, and analyze rates for various building works.
3. To familiarize students with quantity estimation and cost analysis for infrastructure works such as roads and culverts.

Course Outcomes

1. At the end of this course, the students will be able to:
2. Apply the general building requirements, and principles of planning of various building components as per National Building Code (NBC) .
3. Compute quantities for different items of building works using standard methods of estimation and prepare detailed and abstract estimates.
4. Analyze the rates of various items of works involved in construction activities.
5. Compute the quantities and prepare the abstract estimates for infrastructure projects.
6. Prepare a plan, elevation and sectional drawings for various buildings and its components.

Module:1	General Building Requirements	5 hours

Various terminologies as per NBC; Classification of buildings; Principles of planning; Building bye-laws; General building requirements; Requirements of parts of building; Land use classification; Building size limitations; Greenbelts and landscaping; Specifications: Standard sizes, Notations.

Module:2	Planning and Drawing of Buildings	10 hours

Plan, elevation and sectional drawings of load bearing structure: Framed Structure, Bar bending, Foundations, Plinth beam, Column, Beam, Slab, Lintel, Staircase, Doors and windows, Multi-storey buildings, Flat & pitched roof buildings.

Module:3	Estimation of Buildings	10 hours

Estimation of Building: Short wall method and Long wall method, Centre line method; RCC Slab, Beam, Column, Footings; Documentation; Detailed and abstract Estimates

Module:4	Rate Analysis	10 hours

Analysis of rates for various items of work: Earthwork, Brick work masonry, P.C.C flooring work, R.C.C slab work, Plastering work, Flooring work, Painting work

Module:5	Quantity Estimation and Cost Analysis for Roads and Culverts	8 hours

Earthwork Estimation: Fully in banking and cutting, Partly cutting and partly filling; Box culvert; Detailed estimate

Module:6	Contemporary Issues	2 hours
	Total Lecture Hours	45 hours

Text Book(s)

1. Dutta B. N, "Estimating and Costing in Civil Engineering: Theory and Practice, Including Specifications and Valuations", CBS Publishers and Distributors Pvt Ltd, 28th Edition, 2020
2. Kumara Swamy N., Kameswara Rao A, "Building Planning and Drawing", Charotar Publishing House Pvt Ltd, 9th Edition, 2019

Reference Books

3. Vazirani V. N., Chandola S. P, "Civil Engineering: Estimating, Costing and Valuation (Including Quantity Surveying, Contracting & Account)", Khanna Publishers, 6th Edition, 2015
4. Cartlidge D, "Quantity Surveyor's Pocket Book", Routledge, 3rd Edition, 2017 CPWD-PAR, "Central Public Works Department (CPWD). Plinth Area Rates", Authority of Director General CPWD New Delhi, 1st Edition, 2021
5. BIS SP 7, "National Building Code of India 2016 ", Govt of India New Delhi, 1st Edition, 2017
6. IS 962, "Code of Practice for Architectural and Building Drawings", Bureau of Indian Standards, 1st Edition, 2017
7. IS 5525, "Recommendations for detailing of reinforcement in reinforced concrete works", Bureau of Indian Standards, 1st Edition, 2018

Indicative Experiments

Load bearing structure	4 hours
2. Framed structure	4 hours
3. Sloped roof	4 hours
4. Lean-to-roof	4 hours
5. Staircase.	4 hours
6. Doors and windows	2 hours
7. Shopping complex	2 hours
8. Educational building	2 hours
9. Primary health centre	2 hours
10. Steel roof structures	2 hours
Total Laboratory Hours:	**30 hours**

Mode of Evaluation: Continuous Assessment Test, Quiz/ Project/ Case Studies, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment.

Recommended by Board of Studies	24-10-2025		
Approved by Academic Council	No. 80	**Date**	20-11-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	-	-	-	3	-	-	-	3	-	-	-	3	-

BACLE207	Artificial Intelligence and Machine Learning in Civil Engineering	L	T	P	C
		3	0	2	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives:

The objectives of this course are:

1. To develop understanding of the fundamental principles, reasoning mechanisms, and scope of Artificial Intelligence and its applications in civil engineering.
2. To enable students to apply machine learning concepts and algorithms for analysing civil engineering data and identifying useful patterns.
3. To familiarize learners with ensemble and probabilistic learning methods for building reliable, interpretable, and data-driven models in civil engineering.

Course Outcomes

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

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

1. Illustrate the basic concepts, scope, and problem-solving strategies of Artificial Intelligence and their relevance to civil engineering.
2. Apply Neural Networks and Fuzzy Logic to solve suitable problems in Civil Engineering based on their architecture, functioning, and learning processes.
3. Apply the Machine Learning principles to analyse civil engineering data and recognize patterns.
4. Use supervised and unsupervised learning techniques in modelling and prediction in civil engineering problems.
5. Apply ensemble and probabilistic learning methods to develop reliable and interpretable civil engineering models.

Module:1	Artificial Intelligence	8 hours

Definition and scope of AI; History and evolution of AI; Types of AI; AI vs. human intelligence; Concepts of AI; Knowledge representation; Reasoning; Problem-solving and search strategies; AI and logic; Propositional and First-Order logic; Expert systems and Rule-based AI; Applications of AI in civil engineering.

Module:2	Artificial Neural Networks (ANN) and Fuzzy Logic	8 hours

Introduction to neural networks; Definition and fundamental concepts; Model of a Neuron; Activation functions; Least mean square algorithm; Feed forward ANN; Back propagation- optimization; Advantages of ANN; Introduction to Fuzzy logic; Fuzzy sets, Fuzzy relations, Fuzzy rule and decision making; hybrid soft computing; Neuro Fuzzy; Applications of ANN and Fuzzy Logic in civil engineering.

Module:3	Machine Learning	10 hours

Introduction to Machine Learning (ML): Basic Concepts and Applications: Types of learning; Understanding pattern recognition; Key concepts: Bias-Variance trade-off; Overfitting vs. underfitting; Basic probability and statistics for ML: Distributions, Mean, Variance; Simplified Probably Approximately Correct (PAC) Learning.

Module:4	Supervised and Unsupervised Learning	10 hours

Decision Trees; Regression models, Neural networks in supervised learning, Clustering, Gaussian Mixture Models (GMMs) & Expectation-Maximization (EM); Applications of unsupervised and supervised machine learning algorithms in civil engineering.		
Module:5	**Ensemble and Probabilistic Learning**	**7 hours**
Basic concept of Ensemble Methods; Model combination schemes: Bagging, Boosting, Stacking; Introduction to Bayesian Learning, Bayes Optimal Classifier, Naïve Bayes Classifier, Introduction to Bayesian Belief Networks (BBN), Association Rule Mining, Introduction to Frequent Pattern Mining, Applications of Ensemble and Probabilistic Learning models in civil engineering.		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Textbook(s)

1. Naser, M. Z., "Machine Learning for Civil and Environmental Engineers: A Practical Approach to Data-driven Analysis, Explainability, and Causality", Wiley, 2023
2. Bekdas, G., Nigdeli, S. M., & Yücel, M, "Artificial Intelligence and Machine Learning Applications in Civil, Mechanical, and Industrial Engineering", IGI Global, 2019

Reference Books

3. Bahga, A., Madisetti, V., "Internet of Things: A Hands-on Approach", University Press, 2015
4. Russell, S.J., Norvig, P. , "Artificial Intelligence: A Modern Approach", Pearson, 2016

Indicative Experiments

Structural Health Monitoring integrating AI/ML approach	4 hours
2. Classification of Soil integrating AI/ML approach	2 hours
3. Prediction of Air Quality integrating AI/ML approach	2 hours
4. Traffic flow prediction integrating AI/ML approach	2 hours
5. Prediction of Rainfall integrating AI/ML approach	2 hours
6. Flood Forecasting integrating AI/ML approach	4 hours
7. Water quality monitoring and management integrating AI/ML approach	2 hours
8. Water Resources Mapping integrating AI/ML approach	4 hours
9. Reservoir optimization integrating AI/ML approach	4 hours
10. Climate change monitoring integrating AI/ML approach	4 hours
Total Laboratory Hours:	**30 hours**

Mode of Evaluation : Continuous Assessment Test, Quiz / Case studies / Project / Seminar, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment

Recommended by Board of Studies	24-10-2025		
Approved by Academic Council	No. 80	**Date**	20-11-2025

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	-	-	-	-	-	-	2	2	-	3	3	-
CO5	3	2	2	-	3	-	-	-	-	2	3	3	3	-

Concentrations in Built System

BACLE301	CONSTRUCTION MATERIALS AND TECHNIQUES	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus version			
		1			

Course Objectives

The objectives of this course are:

1. To understand the composition, properties, classification, and testing of conventional construction materials used in civil engineering.
2. To inculcate knowledge of modern and advanced construction materials and their applications in sustainable construction.
3. To enable learners to apply construction techniques and equipment effectively for different construction types and special engineering works.

Course Outcomes

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

1. Identify suitable construction materials for various construction application based on their properties.
2. Select suitable metals and timber for structural and architectural applications.
3. Choose appropriate materials for modern construction practices.
4. Use the appropriate construction methods, materials, and equipment for various buildings.
5. Apply the appropriate construction techniques for special construction works.

Learning Modules

Module 1	**Basic Construction Materials**	**9 hours**
Stones: Sources, properties, and tests; Cement: Manufacturing process, chemical composition, physical properties, types, and tests; Aggregates: Classification, properties, and tests; Bricks: Manufacturing process, properties, classification, and tests; Water: pH value and limitations for construction purposes.		
Module 2	**Metals and Timber**	**9 hours**
Ferrous Metals - Classification; Iron and steel – manufacturing process and applications, Tests - Various forms of steel sections; Non-Ferrous Metals- Aluminium and copper – properties and applications; Timber- Structure and classification, Defects, Seasoning, Properties and tests, Timber products and their applications.		
Module 3	**Modern Construction Materials**	**9 hours**
Glass, Rubber and Neoprene, Ceramics, Fibre Reinforced Materials, Polymers, Bituminous Materials, Composite Materials, Mineral and Chemical Admixtures - Types, properties, testing methods, and applications		
Module 4	**Building Components and Equipment**	**8 hours**
Foundations, Masonry Construction, Concrete construction, Floors and Roofs, Lintels, Arches and Staircases, Waterproofing, Formwork and Scaffolding, Plastering and Pointing- Construction equipment's		
Module 5	**Advanced Construction Techniques**	**8 hours**
Tunnelling, Piling Techniques, Diaphragm Wall Construction, Steel construction, Precast Concrete Systems, Modular Construction, Pavements- Techniques and Equipment's		
Module 6	**Contemporary Issues**	**2 hours**
	Total Lecture hours	**45 hours**

Textbooks

1. Edward Allen, Joseph Iano. Fundamental Building Materials. 2014. 6th Edition. John Wiley & Sons Inc., USA.
2. Irvine, J. Advanced Construction Techniques. 2023. 1st Edition. California Rocketry,

	USA.
3.	Varghese, P. C. Building Construction. 2016. 2nd ed. Prentice Hall India, India
Reference Books	
1.	Varghese, P. C., Building Materials, 2015, Second Edition, PHI Learning Pvt. Ltd., New Delhi.
2.	Duggal, S. K. Building Materials. 2017. 1st ed. Taylor & Francis, UK.
3.	Mehta, M. L., Scarborough, W., Armpriest, D., Building Construction: Principles, Materials, and Systems, 2017, Third Edition, Pearson, London.

Mode of Evaluation: Continuous Assessment Test, Quiz / Case studies / Project, Final Assessment Test.

Recommended by Board of Studies	24-10-2025		
Approved by Academic Council	No. 80	**Date**	20-11-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	3	-	-

BACLE302	CONCRETE TECHNOLOGY	L	T	P	C
		3	0	2	4
Pre-requisite	NIL	Syllabus version			
		1			

Course Objectives

The objectives of this course are:

1. To introduce the composition, properties, and roles of various ingredients used in concrete and their influence on performance.
2. To demonstrate the mix design principles, testing methods, and performance evaluation of fresh and hardened concrete.
3. To familiarize with durability concepts and special concretes used for sustainable and advanced construction applications.

Course Outcomes

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

1. Identify the characteristics of different concrete ingredients and supplementary materials influencing concrete performance.
2. Design the concrete mix proportion using BIS and ACI methods and assess the fresh properties of concrete.
3. Assess the mechanical behavior of hardened concrete through destructive and non-destructive testing methods.
6. Analyse the various durability properties of concrete and to select suitable special concretes for modern construction practices.
7. Determine the material properties of concrete ingredients and prepare concrete mix to assess the fresh and hardened properties of concrete.

Learning Modules

Module 1	Concrete Ingredients	10 hours

Cement- Fine aggregate- Coarse aggregate - Lightweight and Recycled Aggregates Chemical admixture – Types as per ASTM C494/C494M - Fly ash, Ground Granulated Blast Furnace Slag (GGBS), Silica Fume, Rice Husk Ash, and Metakaolin – Physical and Chemical properties, and Influence on concrete performance.

Module 2	Mix Design and Fresh Concrete Properties	8 hours

Concept of grades of concrete and their material requirements -Optimization of chemical admixtures for desired performance- Proportioning concrete mixes using methods like BIS and ACI standards- Fresh concrete - Workability Tests: Slump test, flow table test, compacting factor test – Rheology - Preparation and Handling of Concrete: Batching, mixing, transporting, and placing of concrete- Compaction-Curing methods

Module 3	Evaluation of Hardened Concrete	10 hours

Testing of hardened concrete: Compression test; Flexure test; Split tensile strength test; Porosity - Gel/space ratio- Modulus of elasticity -Fatigue Strength-Impact strength - Non-destructive testing (NDT) of concrete

Module 4	Durability of Concrete	9 hours

Permeability, Carbonation, Chloride ingress, Sulphate attack, Salt attack, Acid attack, Alkali–Silica Reaction (ASR) and Alkali–Aggregate Reaction (AAR) - Freezing and thawing effects- Corrosion of reinforcement-Shrinkage in Concrete

Module 5	**Special Concrete**	**6 hours**
Introduction to various types like High performance and High Strength Concrete-Self compacting concrete - Light - weight concrete - Fiber-reinforced Concrete - Polymer concrete composites - Recycled aggregate concrete- Geopolymer Concrete – Bacterial (Self-healing) Concrete and Nano-modified Concrete		
Module 6	**Contemporary Issues**	**2 hours**
	Total Lecture hours	**45 hours**

Textbooks

1.	Neville A. M., Brooks, J. J., Concrete Technology, 2017, Second Edition, Pearson, London, UK.
2.	Mehta, P. K., Monteiro, P. J. M., Concrete: Microstructure, Properties and Materials, 2014, Fourth Edition, McGraw Hill Education, New York, USA.

Reference Books

1.	Gambhir, M. L., Concrete Technology: Theory and Practice, 2013, Fifth Edition, McGraw Hill Education, New Delhi, India.
2.	Shetty, M. S., Concrete Technology: Theory and Practice, 2013, Revised Edition, S. Chand Publishing, New Delhi, India.

Mode of Evaluation: Quiz, Design Project, Case Study, Seminar, CAT and FAT

List of Experiments (Indicative)

1.	Tests on various properties of Cement: Fineness of cement, Standard consistency	
2.	Tests on various properties of Cement: Initial and Final Setting Time	
3.	Tests on various properties of Fine aggregate	
4.	Tests on various properties of Coarse aggregate	
5.	Fresh properties of Concrete- Slump Cone test, Compaction factor test, Vee-Bee Consistometer	
6.	Concrete mix design (IS and ACI method)	
7.	Compressive strength of concrete	
8.	Flexure and spilt-tensile strength of concrete.	
9.	Modulus of Elasticity/stress-strain curve in concrete	
10.	Non-destructive testing–Tests on existing Beam, Column & Slabs.	
	Total Laboratory Hours	**30 hours**

Mode of Evaluation: Continuous Assessment Test, Quiz / Case studies / Project, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment

Recommended by Board of Studies	24-10-2025		
Approved by Academic Council	No. 80	**Date**	20-11-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	3	-	2	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	2	2	-	-	3	-	-

BACLE303	DIGITAL MANAGEMENT AND PRACTICES IN CONSTRUCTION	L	T	P	C
		3	0	2	4
Pre-requisite	NIL	Syllabus version			
		1			

Course Objectives

The objectives of this course are:

1. To introduce fundamental concepts and workflows of Building Information Modeling (BIM) in digital construction.
2. To develop the ability to create, coordinate, and analyse BIM models using modern software tools.
3. To familiarize with emerging digital technologies such as Digital Twins, AI, and VR in construction.

Course Outcomes

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

1. Demonstrate the use of BIM terminology, 3D–7D dimensions and digital transformation approaches in construction project.
2. Develop BIM models for project scheduling, cost estimation, and construction management applications using collaborative techniques.
3. Apply digital twin architectures and data exchange methods to develop solutions for practical applications in the built environment.
4. Implement emerging technologies to enable innovations in digital construction.
5. Use BIM to create architectural, structural, and MEP models for infrastructure projects.

Learning Modules

Module 1	Building Information Modeling	8 hours

History and evolution of Computer Aided Design (CAD) to Building Information Modeling (BIM), Need for digital transformation in construction, BIM terminology and components, dimensions of BIM (3D to 7D), BIM standards and protocols, Overview of ISO19650,
Benefits and challenges of BIM adoption.

Module 2	Modelling and Collaboration	10 hours

BIM authoring tools overview, 3D modelling concepts, levels of development (LOD), LOD matrix, Level of Detail and Information, Common Data Environment (CDE), model coordination, clash detection, interoperability and open BIM (IFC format), Collaborative
workflows.

Module 3	Digital Construction Management	9 hours

BIM Maturity levels, 4D, 5D and nD BIM, BIM-based quantity take-off, Different data
inputs for BIM, Construction simulation and visualization, BIM execution plans and lifecycle data management.

Module 4	Digital Twins	9 hours

Definition and evolution of digital twins, Cyber-Physical systems, Digital twin types, Digital twin architecture, Data exchange in twin systems, Applications and use cases of digital twins, Challenges in digital twin implementation.

Module 5	Emerging Trends in Digital Construction	7 hours

Scan-to-BIM processes, Reality capture, Laser scanning and photogrammetry, Use of AI
and machine learning in digital construction, Virtual and augmented reality (VR/AR) for visualization, Blockchain and cloud-based BIM, Digital construction and sustainability.

Module 6	Contemporary Issues	2 hours
	Total Lecture hours:	**45 hours**

Textbooks:

1.	Sacks, R., Lee, G., Burdi, L., and Bolpagni, M. BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility
	Managers, 4th Edition, Wiley, USA, 2025.
2.	Parn, E., Sacks, R., Brilakis, I., Soibelman, L., and Enzer, M. Twin Systems: Digital Twins of the Built Environment, 1st Edition, Twin Systems Publisher, UK, 2024.

Reference Books

1.	ISO 19650 Series, Organization and digitization of information about buildings and civil engineering works, Including building information modelling (BIM) – International Organization for Standardization (ISO), 2018–2022.
2.	Succar, B., and Kassem, M. Building Information Modelling: Framework for Collaboration,1st Edition, Routledge, 2021.
3.	Andrzej Bargiela and Witold Pedrycz, Digital Twins for Digital Transformation: Emerging Enabling Technologies and Applications, 1st Edition, Springer, 2023.

List of Experiments (Indicative)

1.	Importing CAD data and Basic 3D Modeling	2 hours
2.	Architectural Modelling – Creation of walls, doors, windows, roofs, and stairs for a small building project.	2 hours
3.	Structural Modelling – Modelling structural components such as beams, columns, and foundations.	2 hours
4.	MEP Modelling – Basic HVAC, plumbing, and electrical layout modelling.	2 hours
5.	Interdisciplinary Model Coordination – Linking architectural, structural, and MEP models, checking interferences.	2 hours
f	BIM based quantity take off for a project.	4 hours
7.	Clash Detection – Importing models, performing clash detection, and generating coordination reports.	4 hours
8.	4D and 5D BIM Simulation – Linking information model with project schedule and cost data.	4 hours
9.	Scan-to-BIM using 3D Laser Scanner – Capturing point cloud data, importing and creating BIM model from scanned data.	4 hours
10.	VR/AR integration for BIM models and presenting project walkthroughs.	4 hours
	Total Laboratory Hours	**30 hours**

Mode of Evaluation: Continuous Assessment Test, Quiz / Case studies / Project, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment

Recommended by Board of Studies	24-10-2025		
Approved by Academic Council	No.80	**Date**	20-11-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	3	-	-	-	-	-	-	-	-	2	2	3	2	-
CO3	3	-	-	-	-	-	-	-	-	2	2	3	2	-
CO4	3	-	-	-	-	-	-	-	-	2	2	3	2	-
CO5	3	-	-	-	3	-	-	-	3	2	2	3	2	-

BACLE401	HYDROLOGY AND WATER RESOURCES ENGINEERING	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus version			
		1			

Course Objectives

The objectives of this course are:

1. Develop fundamental understanding of hydrologic processes, including rainfall, runoff, infiltration, and flood forecasting techniques.
2. To analyze and design surface and groundwater systems for effective utilization and management of water resources.
3. Apply hydrological and hydraulic principles in the design of irrigation structures and in addressing issues such as soil reclamation and reservoir sedimentation.

Course Outcomes

4. At the end of this course, the students will be able to
5. Analyze hydrological data using suitable methods to develop a sustainable water management system.
6. Estimate stream flow, storm design, floods and droughts under various hydrological conditions.
7. Select suitable irrigation methods for efficient and sustainable water utilization.
8. Design minor irrigation structures such as canals, distributaries, and field channels using hydraulic and hydrological principles.
9. Assess and mitigate reservoir sedimentation problems using modern monitoring and
10. management techniques.

Learning Modules

Module 1	Measurement of Rainfall and Hydrologic Abstractions	10 hours

Hydrologic cycle and Water budget - Precipitation variability, rainfall and snow measurement techniques-Design of precipitation gauging network-Hydrologic Abstractions-
Infiltration-Evaporation-Evapotranspiration interception and depression storage-Rainwater harvesting-Design procedure.

Module 2	Estimation of Stream Flow and Runoff Analysis and Flood	10 hours

Measurement of stream flow-Factors affecting stream flow-Hydrograph analysis, base flow separation, unit hydrograph and curve number methods of stream flow determination, synthetic unit hydrograph-Hydrological modelling for stream flow estimation-Methods for peak discharge estimation. Design flood estimation-Frequency analysis, design storm, risk, reliability safety factors-Flood routing - Flood migration-Flood damage analysis-Droughts-
Definition and Classification-Drought management.

Module 3	Irrigation Practices	8 hours

Need for Irrigation in India, Scope, National Water Policy, Physical properties of soil that influence soil moisture characteristics–Concept of soil water potential and its components, Crop water requirements-Irrigation Scheduling Irrigation efficiencies–Duty-Delta-base period-Surface and subsurface methods of Irrigation-Standards for irrigation water quality, water logging and consequences–Salinity and alkalinity Reclamation.

Module 4	Canal Irrigation & Minor Irrigation Structures	9 hours

Classification of canals-Alignment of canals-Design of rigid boundary canals-Lacey's and Tractive force concepts in canal design-Lining of canals-Sediment transport in canals, River training, Lining and maintenance of canals– Surplus weir, Canal Regulator, Tank
sluice with tower head and Canal drop.

Module 5	Erosion and Reservoir Sedimentation	6 hours

Erosion process-Estimation of sheet erosion-Channel erosion-Sediment yield from watersheds-Trap efficiency Distribution of sediment deposits-Reservoir sedimentation control-Erosion and reservoir sedimentation problems in India.		
Module 6	**Contemporary Issues**	**2 hours**
	Total Lecture hours	**45 hours**
	Total Tutorial hours	**15 hours**

Textbooks:

1.	Subramanya. K., Engineering Hydrology, 2020, Fifth Edition, McGraw Hill Education Pvt. Ltd., New Delhi.
2.	Santosh Kumar Garg (2019), Irrigation Engineering and Hydraulic Structures, Vol. II, Thirty fifth Edition, Khanna Publisher, New Delhi.

Reference Books

1.	Chin, D. A., Water Resources Engineering, 2020, Fourth Edition, Pearson, USA.
2.	Mays, L. W. Water Resources Engineering, 2019, Third Edition, John Wiley and Sons, USA.
3.	Handbook on Irrigation System Operation Practices, Central Water Commission, 1990

Mode of Evaluation: Continuous Assessment Test, Quiz / Case studies / Project, Final Assessment Test

Recommended by Board of Studies	24-10-2025		
Approved by Academic Council	No. 80	**Date**	20-11-2025

CO-PO Mapping:

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CO3	3	2	-	-	-	-	-	-	2	-	-	3	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	3	-	-

BACLE402	ENGINEERING GEOLOGY	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

The objectives of this course are:

1. To understand the geological processes and geomaterials influencing the design and stability of civil engineering structures.
2. To acquire a comprehensive understanding of how to integrate sustainability and climate resilience principles into engineering geological practices and decision-making.
3. To enable students to apply remote sensing, GIS, and AI/ML tools effectively for geological investigation, subsurface analysis, and hazard prediction.

Course Outcomes

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

1. Enumerate geological processes and their significance in civil engineering applications.
2. Classify minerals, rocks, and geomaterials and evaluate their engineering properties and suitability for construction.
3. Analyze structural geological features, soils, and subsurface conditions for civil engineering applications.
4. Assess groundwater conditions and geological hazards using appropriate risk assessment and geospatial techniques.
5. Apply geoinformatics, AI/ML, and field investigation techniques for sustainable and resilient engineering geological solutions.

Learning Modules

Module 1	Earth System and Geological Processes	7 hours

Importance of geology in civil engineering; structure and composition of the Earth; geological time scale; plate tectonics, earthquakes, and volcanoes; weathering and geomorphic processes; engineering significance of geological processes through global case studies (e.g., dams, tunnels, bridges).

Module 2	Minerals, Rocks, and Engineering Geomaterials	9 hours

Classification and identification of minerals and rocks; engineering significance of igneous, sedimentary, and metamorphic rocks; physical and mechanical properties; rock strength and durability; field identification and simple lab tests on geomaterials; application in construction material selection.

Module 3	Structural Geology, Soils, and Subsurface Exploration	9 hours

Folds, faults, joints, and fractures and their effects on foundations, tunnels, and slopes; soil formation, clay mineralogy, and engineering classification; site investigation methods – drilling, sampling, bore logs, and geophysical surveys (resistivity, seismic refraction, GPR); interpretation of geological features for foundation design, tunnel alignment, and slope stability assessment.

Module 4	Groundwater, Geological Hazards, and Risk Assessment	9 hours

Groundwater occurrence, aquifers, recharge and discharge; hydrological cycle; landslides, earthquakes, floods, and subsidence – causes, impacts, and mitigation; GIS and remote sensing in hazard mapping, IoT-based real-time hazard monitoring, ML-based landslide and flood susceptibility models; case studies on urban resilience and infrastructure safety.

Module 5	Geoinformatics, AI Applications, Field Work and Sustainable Practice	9 hours

GIS and remote sensing in terrain and site analysis; UAV (drone) mapping and LiDAR; data analytics for geological datasets (spatial & temporal); AI/ML techniques – classification, regression, clustering for geological data; integration of digital twins for infrastructure-geology interaction; field geological mapping and contouring; preparation of GIS-based site investigation reports; sustainable practices in construction, slope stabilization, and water management		
Module 6	**Contemporary Issues**	**2 hours**
Guest lectures from industry/research experts on emerging technologies.		
	Total Lecture hours	**45 hours**
Tutorial		
Tutorial Class Module 1: Using global earthquake and volcano data, students plot tectonic plate boundaries and analyse the relationship between plate movement and seismic activity.		3 Hours
Tutorial Class Module 2: Students examine hand specimens or images of common rocks and minerals, classify them, and relate their formation to geological processes.		3 Hours
Tutorial Class Module 3: Students analyse field data from a vertical electrical sounding (VES) to determine subsurface layer resistivities and thicknesses using curve matching or plotting methods.		3 Hours
Tutorial Class Module 4: Students analyse a real or simulated disaster event (e.g., flood or landslide) to evaluate geological risk factors and propose mitigation measures using GIS.		3 Hours
Tutorial Class Module 5: Students explore how Artificial intelligence / machine learning models can predict groundwater potential zones or landslide susceptibility using geospatial datasets**.**		3 Hours
	Total Tutorial hours	**15 Hours**

Textbooks	
1.	Genske, D.D. Engineering Geology: An Introduction, 2nd Ed., Springer Nature, Germany, 2024
2.	Parthasarathy, A., Panchapakesan, V., Nagarajan, R. Engineering Geology (As per AICTE Syllabus), 1st Ed., Wiley India, New Delhi, 2021.
3	Bangar, K.M. Principles of Engineering Geology, Revised Ed., Text Shala Publications, India, 2022.
Reference Books	
1.	F.G.H. Blyth & M.H. de Freitas, A Geology for Engineers, Arnold–London, 2017.
2.	Goodfellow, M. & Higgins, A., Artificial Intelligence in Geotechnical and Geological Engineering, Elsevier, 2021

Mode of Evaluation: Continuous Assessment Test, Quiz / Case studies / Project, Final Assessment Test.

Recommended by Board of Studies	24-10-2025		
Approved by Academic Council	No. 80	**Date**	20-11-2025

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	2	-	-	-	-	2	3	-	-
CO5	3	-	-	-	-	2	-	-	-	-	2	3	-	-

Concentrations:
Integrated Building System Design for L & T Powered

BACLE416	BUILDING INFORMATION MODELLING IN CONSTRUCTION	L	T	P	C
		3	0	2	4
Pre-requisite	BAEEE101 Basic Engineering	SyllabusVersion			
		1			

Course Objectives

To understand the fundamental principles, processes, and benefits of Building Information Modelling in the construction industry.

To apply Workflow of BIM 3D Model Creation using Revit and Development of Federated Models

To analyze Detection of Clashes During Design Coordination Using BIM Tools (e.g., Navisworks)

Course Outcomes

1. Interpret the basic principles of BIM evolution and concept of BIM in lifecycle of project.
2. Create discipline-based and federated BIM models of buildings using appropriate software tools to identify and rectify clashes.
3. Develop BIM models, identify clashes, and rectify them using appropriate software tools.
4. Apply emerging BIM trends and digital twin concepts to address practical applications in the built environment.
5. Apply BIM tools to develop multidisciplinary models, manage project data, and extract quantities, materials, and project timelines.

Module:1	Introduction to BIM	8 hours

Building Information Modelling - Evolution of Engineering from 2D drawings to BIM Model, Isometric view - Examples and Limitation, Building Information Modelling - Introduction & Process, Application. Design Authoring - Concepts and workflow, Introduction to stages of BIM Modelling process as per ISO 19650.

Introduction to Revit, User Interface in Revit - Architecture - Structure - Systems - Insert - Annotate - View - Manage - Modify.

Module:2	Design Authoring in Revit Tool	9 hours

Revit Architecture - File setup, creating levels and grids, Modelling Architectural elements, Schedules and Annotation, Sheet creation, Parameter creation. Revit Structure - File setup, creating levels and grids, modelling structural elements, Schedules and Annotation, Sheet creation, Parameter creation, Remove warnings. Revit Systems - File setup, creating levels and grids, HVAC, plumbing and piping, Fire line and sprinklers, Electrical lightings, Cable trays and parametric creation.

Federated model - Concept, Strategy and benefits, Linking of Revit files and reload of links in Revit, exporting file formats, Rendering and Animation.

Module:3	Visualization Clash check and LOD	9 hours
Views in BIM Model, Visualization - Walkthrough - Fly through -Layers & Properties, Concept of viewpoints, Sectioning and Visualization through Tablet and Mobile, Concept of BIM Kiosk & BIM Rooms, Visualization through Augment Reality (AR), Virtual Reality (VR) & Mixed Reality (MR) Clash Check - Types, Clash avoidance process, Clash Detection Process, Clash Detection Priority Matrix and Report generation, Clash Detection Rules, Report, Grouping, Clash Detection using software tool. Documentation and CDE (Common Data Environment) - Concept of Cloud Computing, Concept and Application of CDE, Setting up the workflow and process for CDE. Concept of LOD (Level of Development), preparation of LOD matrix and Progression matrix, LOD-Chart, Matrix, and Model Progression Matrix		
Module:4	**4D Field BIM Its Applications**	**9 hours**
Introduction to 4D / Field BIM - Concept of 4D, Project scheduling using Gantt Chart and its limitation, Demo - Synchronization of 4D BIM Model with project schedule, reviewing project progress, planned dates and actual dates, Generation of Reports Application of Field BIM/ 4D BIM - Understanding concept and usage of BIM in field for coordination- 3D Coordination and Visual Communication, Site utilization planning and Construction analysis, Application of wearables in coordination. 3D Control and planning Other Applications of Field BIM/ 4D BIM - Concept and usages of BIM in field for safety, disaster and risk analysis, digital fabrication and scan to BIM, Existing Condition Modeling, Phase Planning, As-built/ Record Models		
Module:5	**5D BIM and Beyond BIM Emerging Trends**	**8 hours**
5D BIM - Introduction concepts of 5D BIM, BIM Maturity LOD and General Practice of QTO, Cost Breakup structures, 5D BIM and cost control AIM: Introduction to Asset Information Model (AIM), COBie structures and Asset requirement- Discipline wise Infrastructure System, Classification code and Information Exchange, Information Exchange with Facility Management Beyond BIM - Concepts of Industrialisation, IoT, Big Data, Data Analytics and their applications in BIM: Industrialisation of Construction through BIM- DfMA, IoT in BIM, BIM and Big data, Data Analytics using AI & ML Future scope of BIM Applications: Smart Infrastructure and the need for connected infrastructure, Digital twins- Concepts and benefits, National Digital Twin or a City level Digital Twin in a Smart City, Fundamental requirements for the success of a Digital Twin and its uses, Digital Twin applications in diverse industries. Integration of BIM data with AI		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**
Text Book(s)		
LMS, "L&T EduTech", LMS, 1st Edition, 2026		

Rafael Sacks, Ghang Lee, Luciana Burdi & Marzia Bolpagni,, " â€œBIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managersâ€", John Wiley Sons, 4th Edition, 2025

Yibin Ao, Yan Wang, Panyu Peng & Jianjun Zhao, "â€œBuilding Information Modeling (BIM) Adoption: Learning, Competition, and Practiceâ€,", Springer Nature Singapore, 1st Edition, 2025

Reference Books

ISO 19650, "Organization and Digitization of Information about Buildings and Civil Engineering Works â€" Information Management using BIM", International Organization for Standardization Geneva, 1st Edition, 2018

SP 7:2016, "National Building Code of India 2016", Bureau of Indian Standards New Delhi, 1st Edition, 2016

Daniel John Stine, " â€œDesign Integration Using Autodesk Revit 2024: Architecture, Structure & MEPâ€, ", SDC Publications, 1st Edition, 2023

Indicative Experiments

1. Coordination of project data and collaboration across all design stages.	2 hours
2. Creating separate discipline-specific templates and setups.	4 hours
3. Setting project coordinates and linking external models.	2 hours
4. Defining reference planes and placing building components.	2 hours
5. Studying solar movement for lighting and shading design	2 hours
6. Developing detailed Architectural, Structural, and MEP models.	6 hours
7. Preparing drawing layouts and documentation sheets	4 hours
8. Managing project data with Common Data Environment and Levels of Detail.	2 hours
9. Extracting quantities, materials, and timelines from the model.	2 hours
10. Identifying conflicts and creating reusable parametric components.	4 hours
Total Laboratory Hours	**30 hours**

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study	
Recommended by Board of Studies :	25-02-2026
Approved by Academic Council : No. 81	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	2		3	2	-
CO2	3	-	-	-	-	-	-	-	-	2	2	3	2	-
CO3	3	-	-	-	-	-	-	-	-	2	2	3	2	-
CO4	3	-	-	-	-	-	-	-	-	2	2	3	2	-
CO5	3	-	-	-	3	-	-	-	3	2	2	3	2	-

BACLE417	SUSTAINABILITY PRACTICES IN DESIGN OF BUILDINGS	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

1. To understand the principles of sustainable building design and the environmental, social, and economic dimensions of sustainability.
2. To apply sustainable design strategies, materials, and technologies for energy-efficient and resource-conserving buildings.
3. To analyze building performance in terms of energy use, water efficiency, indoor environmental quality, and life-cycle impacts.

Course Outcomes

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

1 Apply sustainability principles and relevant SDGs to infrastructure development, considering environmental, social, and economic aspects.
2. Identify suitable materials and techniques for sustainable construction
3. Prepare suitable sustainable building plan for urban infrastructure
4. Apply the assessment methods and analyse the sustainable building rating systems
5. Illustrate the role of national and international sustainability policies, green financing, carbon credits, net-zero concepts, and AI in sustainable infrastructure development.

Module:1	Introduction to Sustainability Climatology and heat transfer in buildings	8 hours

Overview of Sustainability and Green buildings, Selection of site - preservation and planning, Influence of climate on buildings, Basics of climatology, Earth - Sun relationship, Solar angles and sun path diagram, Design of shading systems. Basics of Thermodynamics, Convection/radiation heat transfer, Heat gain through various elements of a building.

Module:2	Comfort in Buildings	9 hours

Thermal Comfort - Psychrometry and its applications, Thermal comfort models and case studies.

Acoustics - Buildings acoustics, measures, defects and prevention of sound transmission, Indoor Air Quality - Effects, Design Consideration and integrated approach for IAQ management.

Visual Comfort - Enhancement strategies for Daylighting and Artificial lighting.

Module:3	Resource and waste management in buildings	9 hours

Energy Efficiency- Energy efficiency in building envelope, energy simulation, Energy Management System- lighting and renewable energy and Energy Audit.

Water Efficiency- Planning and Design of Water Management System, Rainwater harvesting, Water Efficient design and fixtures, Treatment and reuse and Water efficient landscape system.

Waste management - Types of waste and its treatment methods, Construction and demolition waste management, Waste management in residential, commercial buildings, healthcare facilities.

Materials- Green product certifications, Features of Sustainable building materials and sustainable alternatives.

Usage of data analytics for enhancing building efficiency.

Module:4	**Life Cycle Assessment of Buildings and Green project management**	**9 hours**

Life Cycle assessment and its types - Modelling and Analysis, Greenhouse gas emission. Different phases of Green building project management

Module:5	**Sustainable rating systems**	**8 hours**

Green building rating systems- LEED, BREEAM and others, Indian Green building rating systems - IGBC & GRIHA, IGBC criteria for certification.

Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**
	Tutorial Hours	**15 hours**

Text Book(s)

L&T , " **EduTech** ", LMS, 1st Edition, **2026**

IGBC Green new building rating system , "**version 3.0** ", Abridged reference guide, 1st Edition, **2026**

Reference Books

SP 7:2016, "**National Building Code of India 2016**", Bureau of Indian Standards New Delhi, 1st Edition, **2016**

Bureau of Energy Efficiency, "**Energy Conservation and sustainable Building Code** ", Bureau of Energy Efficiency New Delhi, 1st Edition, **2024**

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Based Design Project, Case Study

Recommended by Board of Studies :		25-02-2026
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	2	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	2	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	2	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	2	-	-	-	-	-	3	-	-

BACLE418	CONCRETE BUILDING SYSTEM DESIGN	L	T	P	C
		3	0	2	4
Pre-requisite	BACLE203 - Structural Analysis	Syllabus Version			
		1			

Course Objectives

1. Develop design basis requirements by analyzing site-specific conditions ensuring structural functionality, durability, and appropriate material selection
2. To compute all relevant structural loads and apply relevant design codes and standards for the analysis and design of various concrete building system.
3. To analyze structural systems for safety, serviceability, and sustainability in real-world building design applications using a modelling software.

Course Outcomes

1. Interpret the behavior and design philosophy of reinforced concrete building systems as per IS codes and prepare design basis report.
4. 2. Compute different loads acting on various elements and design the appropriate structural system
5. 3. Analyse the multi-storeyed reinforced concrete building using Modelling and analysis software
6. 4. Design the various structural systems using Modelling and analysis software
7. 5. Prepare detailing of Structural Elements and obtain Bill of quantities

Module:1	Introduction and Codes Design Basis Parameters and Report	8 hours

Indian & International Codes for Reinforced concrete Design, Design loads and detailing of reinforcement, Handbooks for reinforced concrete design, National Building Code 2016, Practical building examples, drawing sizes and scales, Reading Drawings - Architectural & Structural. Introduction to DBR Parameters - Geometric Parameters, Occupancy Categories, Site location and associated parameters, Design life of structures, Material Specifications - Grade of concrete for vertical and floor elements - Grade of reinforcing steel, Exposure and cover requirements, Fire rating requirements, Load Combinations, Serviceability Requirements, Analysis tools, Design Basis Report, Concept explanation with example buildings

Module:2	Loads Setting the Structural Scheme	9 hours

Introduction to dead, imposed, wind, earthquake, snow loads etc., Loads from MEP Services and architectural considerations like faÃ§ade loads. Scheme Design, Concrete floor systems, Sizing and design of various slab systems, Dimensioning & designing of drop panels, Beams, Reinforced Concrete Columns - Location and Shape, Design Axial Load, Sizing, Lateral Load Systems, IS 1893-Requirements, Shear Walls - Location and thickness. Estimating relative stiffness of core walls

Module:3	Structural Models	9 hours
ETABS software demonstration for correct modelling and design of Vertical and Lateral Introduction to Analysis & Modelling, Modelling of Cantilever, Portal Frame, three bay Portal Frame, 3D structural models - Geometry, gravity loads, defining earthquake loads, defining wind loads, Modelling Shear walls, Practical Structural Model of building, Structural models of Floor System, Direct design method for Flat Slabs, Analysis of two-way slabs using moment coefficient method, Application of moment coefficient method, Estimation of deflections loading systems like Shear Walls demonstration for correct modelling and design of Vertical and Lateral loading systems like Shear Walls		
Module:4	**Design of Structural Elements**	**9 hours**
Design of structural elements - Design of Beams - Design of flat slabs - Design of two-way continuous slabs. Design of Reinforcements in Columns - Cardinal rules in scheme design of buildings, Coordination with other Engineering disciplines. Design of shear walls - Calculation of design forces, moment capacity of vertical distributed reinforcement, Design of boundary elements and boundary zone. Sizing elements based on Constructability aspects like formwork, concrete placement and compaction, rebar arrangement to satisfy economy and optimum utilization.		
Module:5	**Detailing of Structural Elements Bill of quantities and conclusion**	**8 hours**
Development length of rebars, detailing of various structural elements - flat slabs, two-way continuous slabs, beams, columns and shear wall, detailing and documentation of practical example building. Bill of quantities - Concrete and steel indices for RC buildings, Reinforcement consumption in RC members, BOQ of practical example building. Design and detailing optimization using algorithms		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)

L&T, "**L&T EduTech LMS**", EduTech, 1st Edition, **2025.**
N. Krishna Raju, "**Design of Reinforced Concrete: IS:456-2000**", CBS Publishers and Distributors Pvt. Ltd., 4th Edition, **2016.**

Reference Books

IS 456, IS 1893, IS 875 (Part 1-5), "**IS 456, IS 1893, IS 875 (Part 1-5), SP 16, SP 34, IS 13920**", IS 13920, 1st Edition, **2000.**
National Building Code, "**National Building Code**", Vol 1 and 2, 1st Edition, **2016.**

Indicative Experiments

1. To prepare Design Basis Report for a project	2 hours
2. To set the Structural Scheme	2 hours
3. To calculate various loads acting on the structural system	2 hours
4. To estimate the preliminary sizing for the structural elements	2 hours
5. To Model and analyse Multi-storeyed concrete building	4 hours
6. Design of Beams	4 hours
7. Design of Columns	4 hours
8. Design of Slabs	4 hours
9. Detailing of Structural Elements	4 hours
10. To prepare the Bill of Quantities	2 hours
Total Laboratory Hours	**30 hours**

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Oral Examination, Course Based Design Project, Case Study

Recommended by Board of Studies :		25-02-2026
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO- PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PSO2	PSO3
CO1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**
CO2	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**
CO3	**-**	**3**	**2**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**-**
CO4	**-**	**3**	**2**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**-**
CO5	**3**	**2**	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

BACLE419	STRUCTURAL STEEL BUILDINGS - DESIGN AND PRACTICES	L	T	P	C
		3	0	2	4
Pre-requisite	BACLE205 Design of Steel and Reinforced Concrete Structures	Syllabus version			
		1			

Course Objectives

The objectives of this course are:

1. To understand the fundamental principles of structural steel design, material properties, and construction practices.
1. To apply design codes and standards for analysis and design of steel structural components and systems.
2. To analyze the performance of steel building systems under various loads and optimize their structural efficiency.

Course Outcomes

2. At the end of this course, the students will be able to
3. Examine site specific aspects of the structure and prepare design basis report.
4. Compute Vertical, Lateral & Special Loads and Load combinations in line with industry practices
5. Select Load Resisting System and analysis & design of structural systems using modelling and analysis software
6. Design and detail steel connections, members, and bracing systems for safe and efficient structural performance.
7. Design of an industrial steel building using analysis and design software tool.

Learning Modules

Module 1	Analysis & Design Philosophies, Codes of Practice and General Design Aspects	8 Hours

Structural steel and its Mechanical Properties, Hot Rolled steel sections, Structural Steel sections and section classification. Analysis and design of buildings as per Codes of Practice, design philosophies. Inputs for the design of a steel building - Design Basis Report - Methods of designing a steel building, Design life of a building, Exposure conditions and corrosion protection, Gravity and lateral load resisting elements and systems, Concrete and reinforcement, Block work, floors and Roofs, Structural steel, bolts, welds, fireproofing and Painting materials

Module 2	Computation of Vertical, Lateral & Special Loads and Load combinations	9 Hours

Calculating various loads acting on a steel building - Vertical & lateral loads - Effects of each loads separately and in combination – Dead, superimposed dead, live, temperature, MEP service loads - Lateral loads due to wind and seismic effects

Design of wind speed and pressure, Pressure and Force coefficient method, Deflection and drift limits, Drag, interference and dynamic effects, floor Vibration, fire resistance, Analysis and design methods

Module 3	**Selection of Load Resisting Systems, Structural Modelling, Analysis & Design**	**9 Hours**
Studying the layout plans of the structure – Codes and Reference drawings, Selection of load resisting systems - Load flow in each system - Satisfying stability & strength of the structure - Vertical and lateral load resisting systems, Integration of MEP services and its supporting structures in buildings. Overview of BIM and its importance in structural modelling. Computer aided modelling, analysis & design (STAAD Pro) - Analysis & design of a multi-storeyed building from a project for comprehending the design from a practical standpoint. Structural System optimization using data analytics		
Module 4	**Design of Various Elements & Connections of a Steel Building**	**9 Hours**
Manual & software aided design – Beams, columns, floors, bracings, purlins/girts & facades, base plates & anchor bolts – different conditions of supports, exposure, and purpose of use - Design of connections between the members – Bolted and welded, moment and shear connections to be adopted in various locations of a building. Tension members in buildings – Types and grades of tension members, Design of mullions and transoms. Special connections for equipment and other services like staircases, roof, terrace, and other special elements.		
Module 5	**Design of an Industrial Building & Detailing, Fabrication and Erection aspects**	**8 Hours**
Design of an industrial building - Selection of sections as per requirements - Configuration of the elements and their connectivity - Functional requirements. Beam design Approach for buildings – Manual and software Design of beams - Simplified floor vibration analysis - Column Design Approach for buildings - design of column, Addressing failures and optimization in column design. Beam-Column design approach for buildings - Design of beam-columns, Base plate and anchor bolts. Study of General Assembly drawings, Fabrication drawings and Good Design, Detailing and construction Practices.		
Module 6	**Contemporary Issues**	**2 Hours**
	Total Lecture hours	**45 hours**

Text Books		
1.	L&T EduTech LMS	
2.	N Subramanian. “Design of Steel Structures: Limit State Method”, 2Ed by Oxford University press, 2016	
Reference Books		
1.	IS 800:2007, IS 1893, IS 875 (Part 1-5), SP6, NBC (Part 1 & 2) : 2016	
List of Experiments		
1.	To prepare Design Basis Report for a project	(4 Hours)
2.	To set the Structural Scheme	(4 Hours)
3.	Modelling and Analysis of steel structures	(8 Hours)
4.	Design of Beams	(2 Hours)
5.	Design of Columns	(2 Hours)
6.	Design of Tension members	(2 Hours)

7.	Design of Bracings	(2 Hours)
8.	Design of Base Plate/Anchor Bolt	(2 Hours)
9.	Detailing of Structural Elements	(2 Hours)
10.	To prepare Bill of Quantities	(2 Hours)
	Total Laboratory Hours	**30 hours**

Mode of Evaluation: Quiz, Design Project, Case Study, CAT and FAT		
Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO3	-	-	3	-	3	-	-	-	-	-	-	-	3	-
CO4	-	-	3	-	3	-	-	-	-	-	-	-	3	-
CO5	-	-	3	-	3	-	-	-	-	-	-	-	3	-

BACLE420	PRECAST CONSTRUCTION – MEMBERS AND SYSTEMS	L	T	P	C
		3	0	2	4
Pre-requisite	BACLE203 - Structural Analysis	Syllabus Version			
		1			

Course Objectives

1.To understand the principles, types, and advantages of precast concrete construction systems.
2.To apply design codes and techniques for precast members, connections, and structural systems.
3.To analyze precast building systems for structural performance, constructability, and sustainability.

Course Outcomes

1.Identify the different types of precast elements used in commercial and industrial application.
2.Use the appropriate precast structural systems and planning for production and logistics
3.Design of precast Structural system and elements, analysis and modelling using software.
4.Analysis of connections and joints for structural integrity and durability in precast systems as per code standards
5.Apply precast construction systems for safety and constructability in building projects

Module:1	Introduction to Precast and its elements	8 hours

Introduction - current scenario and constraints, the difference between precast vs conventional construction methods, needs, types, features, Advantages (for owners, architects, engineers, contractors, end users) and Limitations, Residential, Commercial & Industrial Applications of precast, Materials used, Code provisions and clauses. Major elements (Beam, slab, wall, column, foundation, staircase, roof elements, faÃ§ade) : Classification, Types and shapes, selection, application, erection, advantages, Infra works -Pipes & drains, duct bank, baggage handling tunnel, culvert and sleeper, facia element, pavement and channel.

Module:2	Precast Structural Systems Production Storage Logistics	8 hours

Structural System: Skeletal System, Portal Frame system, Large Panel system, Cell Block system and hollow block system, Guide lines of selection - Residential & office buildings, Industrial Buildings, Commercial buildings, Structural Stability and Structural Behaviour Plant and Production: Introduction -Types & Process, Production - Design and shop drawings, check lists, Moulding, Casting and its types, Concreting, Curing, Demoulding and inspection. Storage, Delivery, Handling- introduction and types of equipment, lifting devices, Erection and installation - Horizontal components, vertical components, special elements, Quality Inspection and Tolerance.

Module:3	Modelling Analysis and design of Wall system	9 hours

Design Basis Criteria: Geometric parameters and Occupancy, Location and Associated Parameters, Systems and material specifications, analysis tools, Loads and Load Combinations - gravity loads, lateral loads (seismic and wind) ETABS software, Modelling, Analysis and Design of structural elements for RC Wall system: Design of RC wall, beam, slab & staircase, Design for stripping, stacking, transportation and erection for all elements.		
Module:4	**Joints Connections for RC Wall system Modelling Analysis Design of the Frame system**	**9 hours**
Joints connections for RC wall system - Wall to foundation, wall to wall horizontal connection, wall to wall vertical connection, beam to wall connection, beam to beam connection, slab to wall - progressive collapse, diaphragm action & slab to beam connection, staircase to beam or wall connection. Modelling, Analysis and design for Frame system and its connections: ETABS Modelling, Analysis and Design for frame system (foundation, column, beam, slab etc.) Precast Member Generative design and erection safety		
Module:5	**Prestressed concrete and Preventive Measures and case studies**	**9 hours**
Prestressed Concrete, Various types of slab design and its check, Slab to beam connection Preventive Measures - Testing requirements, water tightness, temporary supports, MEP-related preventive measures, progressive collapse - introduction and design, common defects and remedies. Case Studies - Residential Project, Commercial Project		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**
Text Book(s)		
Kim S. Elliott, "L&T EduTech LMS", CRC Press Taylor Francis Group, 2nd Edition, 2019 Kim S. Elliott, , "Precast Concrete Structures", CRC Press, 2nd Edition, 2016		
Reference Books		
IS 15916 â€“ 2020, "Building Design and Erection Using Prefabricated Concrete" Code of Practice, Bureau of Indian Standards BIS New Delhi, 1st Edition, 2020 IS 13920 : 2016, "Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces" Code of Practice, Bureau of Indian Standards, 1st Edition, 2016		
Indicative Experiments		
1. To prepare Design Basis Report for a project		2 hours
2. To set the Structural Scheme		2 hours

3. To calculate various loads acting on the structural system	2 hours
4. To estimate the preliminary sizing for the structural elements	2 hours
5. To Model and analyse Multi-storeyed concrete building	6 hours
6. Design of Beams	4 hours
7. Design of Columns	4 hours
8. Design of Slabs	4 hours
9. Detailing of Structural Elements	2 hours
10. To prepare the Bill of Quantities	2 hours
Total Laboratory Hours	**30 hours**

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Oral Examination, Seminar, Course Project, Case Study

Recommended by Board of Studies :		25-02-2026
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	-	3	3		3	-	-	-	-	-	-	-	3	-
CO4	-	3	-	-	3	-	-	-	-	-	-	-	3	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-

Open Elective Courses
for L & T Powered

BACLE319	ESSENTIALS OF DATA SCIENCE AND AI FOR CIVIL ENGINEERS	L	T	P	C
		2	0	0	2
Pre-requisite	BASIC MATHEMATICS	Syllabus Version			
		1			

Course Objectives

The objectives of this course are:

3. To introduce foundational concepts of Data Science, AI, ML and Python programming for civil engineering.
4. To enable data handling, manipulation and visualization using Python libraries for construction and infrastructure analysis.
5. To explore the basic concepts of AI and ML, Deep Learning and Prompt Engineering for civil engineering applications.

Course Outcomes

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

8. Illustrate the fundamentals of Data Science, Artificial Intelligence (AI), Machine Learning (ML) and Python programming in the context of civil engineering applications.
9. Utilize Python libraries such as NumPy, Pandas, Matplotlib, Seaborn, and Plotly for effective data processing, analysis, and visualization in construction and infrastructure projects.
10. Apply data-driven techniques to interpret, model, and optimize engineering processes and project performance.
11. Apply AI and ML concepts and Prompt Engineering for solving civil engineering challenges.
12. Apply computational tools and intelligent systems into design, planning, and decision-making processes within civil engineering.

Module:1	Fundamentals of Data Science, AI/ML & Programming for Civil Engineers	5 hours

Overview of Need and significance of DS, AI/ML in Civil Engineering, Understanding Data Science, Basics of AI and Machine Learning, Types of Machine Learning, Role of Data in ML and Machine Learning Project Life Cycle, The Importance of Data Science and AI in Civil Engineering. Python for Civil Engineers, Getting Started with Jupyter, Data Types, Expressions and Variables Conditions, Branching and Loops, Functions, Objects and Classes, Data Types in Construction Industry, Data Structures: Lists & Tuples, Dictionaries & Sets

Module:2	Data Handling and Visualization using Python Tools for Civil Engineers	6 hours

NumPy Library: Creating Arrays, Accessing Array Elements, Operations on Arrays; Pandas Library: Creating & Accessing Series Elements, Selecting Data from Data Frame, Setting Values

into DataFrame, Missing values & Pivot Table; Construction Site Work Analysis with NumPy, Construction Project Cost Analysis with Pandas, Traffic Flow Analysis in a city using NumPy and Pandas Visualization Concepts, Plot Libraries in Python, Matplotlib: Simple Line Plots & Area Plots, Bar Charts & Pie Charts, 2D & 3D Contour Plots; Introduction to Seaborn, Seaborn: Histograms & Box Plots, Scatter Plots & Bubble Plots, Heatmaps, Pair plots & Radar Plots; Ploty & Dash: Interactive Dashboards and Maps		
Module:3	**EDA Concepts & ML Algorithms in Civil Engineering Applications**	**6 hours**
Exploratory Data Analysis (EDA), Statistical Methods: Mean, Median, Variance, Various phases of EDA in DS/AI/ML. Core Machine Learning Concepts in Civil Engineering, Supervised Learning Techniques, Regression Concepts & it's types (Add Metrics), Linear Regression Model, Regularization Techniques, Non-linear Regression Model, Classification Concepts - Types of Classifiers, Measures/ Metrics of Classification and Unsupervised Learning Techniques.		
Module:4	**Deep Learning and AI Model tools for Civil Engineers**	**5 hours**
Introduction to Deep Learning, Neural Networks Basics, Artificial Neural Networks (ANNs), Perceptron and Multi-Layer Perceptron (MLP), Traffic signs and Traffic analysis use cases Developing and Enhancing Custom ML Tools with a GUI, Model Fine-Tuning and Customization, Testing and Debugging Machine Learning Tools, Evaluating Model Performance and Optimization, Innovations Google Colab, Teachable Machine (by Google)		
Module:5	**AI Techniques and Future Directions in Civil Engineering**	**6 hours**
Data Integration, Predictive Analytics (Equipment Maintenance), Descriptive Analytics (Traffic Patterns), Prescriptive Analytics (Project Management), Real-time Safety Monitoring, Risk Forecasting and Water Quality Assessment. Selection Strategies for DS and AI. Future Trends: Introduction to IOT in Construction, Intelligent Parking systems, Smart lighting systems, Disaster Deduction/Management, Smart solid Waste Management, Smart irrigation systems, Smart Air Quality monitoring		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**30 hours**
Text Books		
Data Science for Engineers and Scientists by Julie Bergner and Nicholas Czarnecki		
Data Science for Civil Engineering: Structures and Applications" by Khaled Shahata		
Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig		
Reference Books		

Understanding Machine Learning: From Theory to Algorithms- Shai Shalev-Shwartz and Shai Ben-David
"Artificial Intelligence in Civil Infrastructure: Applications and Future Directions" edited by M. Shabbir Ahsan, Zachary G. Grasley, and Mark F. Teply
Artificial Intelligence and Machine Learning Techniques for Civil Engineering (Advances in Civil and Industrial Engineering) by Vagelis Plevris, Afaq Ahmad, Nikos D. Lagaros.
Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment, Oral Examination, Seminar, Course Project, Case Study

Recommended by Board of Studies :		25-02-2026
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	2	2
CO2	3	2	-	-	3	-	-	-	-	3	2	3	2	2
CO3	3	2	-	-	3	-	-	-	-	3	2	3	2	-
CO4	3	2	-	-	3	-	-	-	-	3	2	3	2	-
CO5	3	2	-	-	3	-	-	-	-	3	2	3	2	-

BACLE422	CRITICAL THINKING, DESIGN THINKING, LEADERSHIP AND TEAMWORK	L	T	P	C
		2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

The objectives of this course are:

1. To understand the principles of critical thinking, design thinking, leadership, and teamwork in professional settings.
2. To apply design thinking frameworks and collaborative strategies in engineering and multidisciplinary projects.
3. To analyze impact of design thinking against innovative, effective, and sustainable solutions through team-based approaches.

Course Outcomes

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

1. Illustrate the concepts and processes of critical thinking, design thinking, leadership, and teamwork.
2. Apply structured problem-solving techniques to address real-world engineering challenges.
3. Use critical thinking principles to analyze complex problems.
4. Demonstrate effective collaboration and leadership skills in team-based projects
5. Analyze team performance and decision-making processes to enhance project outcomes and professional effectiveness.

Learning Modules

Module 1	Design Thinking Fundamentals and Framework	5 hours

Fundamentals of Design Thinking, Complex Problem Solving, 7-stages of Design Thinking, C-K Theory, Techniques of Empathy building, Integration of Design Thinking and Storyboarding, Design Thinking practicing Case-studies, Design Thinking for Professional, Coding, Co-Curricular and Blog Writing skills, Design Thinking for Capstone and Industrial Projects

Module 2	Design Thinking in Creativity & Innovation	5 hours

Unique characteristics of Design Thinking, Difference between Creativity and Innovation, Resilience in problem-solving, Process Models, Agile process integrated with Design Thinking, Design Thinking based Product development - Design Methodology, Prototyping, UX design, Value Proposition.

Module 3	Critical Thinking	6 hours

Introduction, Benefits, Styles and Challenges of Critical Thinking, Identifying & Clarifying Issues and Arguments, Types of Arguments, Reasoning and its Types, Fallacies and its Types, Critical Thinking Models, Principles of Decision making, De Bono's Thinking hats

Module 4	Leadership and Teamwork	6 hours

Understanding Leadership and Leadership Styles, Integrity and Growth Mindset in Leadership, Understanding Teamwork and Stages of Team Development, Managing Team Dynamics and Conflict Resolution, Giving and Receiving Feedback (Feedback and Feedforward), Building Resilience and Well-being for Effective Teams		
Module 5	**Verbal and Non-Verbal Communication**	**6 hours**
Verbal and Non-Verbal Communication, Active Listening and Assertive Communication, Interpersonal and Cross-Cultural Communication, Emotional Intelligence and Self-Awareness, Personality development, Time management and Goal setting		
Module 6	**Contemporary Issues**	**2 hours**
	Total Lecture hours	**30 hours**

Textbooks

1.	Geoff Thwaites and John Butterworth, "Thinking Skills - Critical Thinking and Problem Solving", Cambridge University Press, Second Edition, 2013
2.	Gregory Bassham William Irwin, Henry Nardone, James M. Wallace, "Critical Thinking A Student's Introduction", McGraw-Hill Humanities Social, Fourth Edition, 2010
3.	Peter G. Northouse, "Leadership: Theory and Practice", Sage Publications, Second Edition, 2001
4.	Peter F. Drucker, "Innovation and Entrepreneurship", Taylor & Francis Group, 2007

Reference Books

1.	Richard Paul and Linda Elder, "Critical Thinking: Tools for Taking Charge of Your Learning and Your Life", Bloomsbury Publishing PLC, 2021
2.	Stephen R. Covey, "The 7 Habits of Highly Effective People", Simon & Schuster, 12th Edition, 2019
3.	Nigel Cross, "Design Thinking: Understanding How Designers Think and Work", Bloomsbury Publishing India Private Limited, 2011
4.	Steven Johnson, "Where Good Ideas Come From: The Seven Patterns", Penguin UK, 2011

Mode of Evaluation: Quiz, Case Study, CAT and FAT		
Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	3	-	-	-	-	-	-	-	2	-	2	3	-	-
CO3	3	-	-	-	-	-	-	-	2	-	2	3	-	-
CO4	3	-	-	-	-	-	-	-	2	-	2	3	-	-
CO5	3	-	-	-	-	-	-	-	2	-	2	3	-	-

BACLE423	CAREER READINESS IN DIGITAL ERA	L	T	P	C
		2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1			

Course Objectives

The Objectives of this course are:

1. To understand the evolving world of work by analyzing the impact of digitalization on careers and identifying essential future-ready skills for professional success.
2. To enhance employability through career readiness, focusing on career exploration, networking, workplace etiquette, effective communication, and interview techniques.
3. To strengthen cognitive and problem-solving abilities by developing numerical, analytical, and logical reasoning skills for effective decision-making.

Course Outcomes

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

1. Identify the impact of digitalization, emerging job roles, and required skills for career growth.
2. Apply career planning, networking, and professional etiquette strategies in workplace scenarios.
3. Demonstrate effective communication, resume writing, and interview skills for professional success.
4. Solve aptitude problems accurately using appropriate mathematical concepts.
5. Analyze patterns and draw logical conclusions with clarity and accuracy.

Learning Modules

Module 1	Impacts of Digitalization in Job Market	5 hours

Impact of Technology on Job Market, Emerging Career Opportunities, Skills in Demand, Personal Branding & Online Portfolio, Adaptive Learning, Social and Professional Networking, Job Market Trends & Projections

Module 2	Navigating Career Options & Workplace Readiness	5 hours

Researching Companies & Job Roles, Internship & Referral Opportunities, Mentorship & Networking, Corporate Etiquette, Conflict Management, Importance of Professional Ethics, Adaptability & Integrity, Emotional Intelligence, Empathy, Presentation & Meeting Etiquette

Module 3	Communication Techniques & Interview Mastery	6 hours

Resume & Cover Letter Writing, Group Discussion Techniques, Interview Skills, Confidence & Assertiveness, Job Requirement Analysis, Active Listening, Constructive Feedback & Storytelling, Exploring Referrals, Mock Interviews		
Module 4	**Quantitative Ability**	**6 hours**
Number System, Series & Sequence, Ratio & Proportions, Percentages, Average, Problems on Ages, Profit & Loss, Mixture & Allegations, Simple Interest & Compound Interest, Time, Speed & Distance (Basics)		
Module 5	**Logical Reasoning**	**6 hours**
Directions, Blood Relations, Coding & Decoding, Data Arrangement, Clocks, Calendar, Cryptarithmetic Problems, Ranking and Ordering, Venn Diagrams, Logical Deduction, Data Sufficiency		
Module 6	**Contemporary Issues**	**2 hours**
	Total Lecture hours	**30 hours**

Textbooks	
1.	Kenneth Roman and Joel Raphaelson, "Writing That Works: How to Communicate Effectively in Business", Collins Reference, 2000
2.	L. Xavier Cano. "Resumes That Stand Out!", Xlibris Corporation, 2014
3.	Reid Hoffman and Ben Casnocha, "The Start-Up of You: Adapt to the Future, Invest in Yourself, and Transform Your Career", Random House Business, 2013
4.	Aggarwal, R.S., "Quantitative Aptitude for Competitive Examinations", 37th Edition, S. Chand Publishing, 2024.
Reference Books	
1.	William Strunk Jr. and E.B. White, "The Elements of Style", Macmillan, 2022
2.	Martin Yate, "Knock 'em Dead Job Interview: How to Turn Job Interviews into Paychecks", Jumpingdude Media 2014
3.	Lisa McGrimmon,"The Resume Writing Guide: A Step-by-Step Workbook for Creating a Winning Resume", Createspace Independent Publishing Platform, 2014
4.	Sharma, Arun, "Excel in Reasoning (Verbal & Non-Verbal)", 1st Edition, McGraw Hill Education India, 2024

Mode of Evaluation: Quiz, Case Study, CAT and FAT		
Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	3	-	-	-	-	-	-	-	2	-	2	3	-	-
CO3	3	-	-	-	-	-	-	-	2	-	2	3	-	-
CO4	3	-	-	-	-	-	-	-	2	-	2	3	-	-
CO5	3	-	-	-	-	-	-	-	2	-	2	3	-	-

BACLE421	FOUNDATION ENGINEERING PRACTICES	L	T	P	C
		2	0	0	2
Pre-requisite	BACLE202 Soil Mechanics and Foundation Engineering	Syllabus version			
		1.0			

Course Objectives

The objectives of this course are:

1. To understand the techniques of conducting site investigation, geotechnical report writing and interpretation of soil reports.
2. To apply design methodologies for shallow and deep foundations based on soil properties and loading conditions using IS Codes and numerical tools.
3. To analyze earth pressure and retaining structural systems for slope stability.

Course Outcomes

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

1. Select the suitable soil investigation methods for advanced explorations.
2. Prepare geotechnical report and identify suitable foundations as per the soil condition.
3. Determine the soil bearing capacity and settlement using various tests for shallow foundations.
4. Estimate the dimensions of raft foundation, combined footing, grade slabs and load carrying capacity of pile foundations.
5. Calculate the various earth pressures acting on different retaining walls, including mechanically reinforced walls.

Learning Modules

Module 1	Introduction and IS Code Provisions	5 hours

Introduction to Indian standard codes for laboratory and Field testing with overview of testing equipment, Standard penetration tests, Dynamic cone Penetration tests, Plate load tests, Drilling and boring methods, Stages of investigation, Soil and Rock sampling methods and Real-time soil profile reports.

Module 2	Preparation and interpretation of geotechnical reports	5 hours

Data interpretation and soil classification, Rock Classification, liquefaction of soil- Case studies from construction projects, Evaluation and Mitigation, Selection of foundation- Factors governing selection and preparation of a geotechnical report, Analysis and preparation of soil profile. Case studies.

Module 3	Bearing capacity of shallow foundations	6 hours

Types, Advantages and limitations of shallow foundations, General considerations to shallow foundations- Isolated, combined, raft foundation. Bearing capacity of shallow foundation- in soil using IS 6403, Bearing capacity of shallow foundation in rock, Calculation of bearing capacity based on SPT, PLT and SCPT values.

Bearing capacity calculations and Settlement analysis in cohesive and cohesionless soils. Methods to reduce total and differential settlements, Overview of software for settlement calculations, Bearing capacity and settlement analysis of shallow foundation using software. Analysis of Geotechnical data using AI algorithm.

Module 4	Raft, Piles, Special foundations	7 hours

Introduction, construction and types of raft foundations, Concept of proportioning footings and contact pressure distribution, Code provisions, application of software. Need for special foundations, Combined footing analysis using Software, Design requirements of grade slabs for point loads, line loads and uniformly distributed loads, Design of joints and case studies and foundation drawings.

Code provisions and construction procedures of Bored Cast In-Situ piles, Driven Piles, Under Reamed Piles and Precast driven piles, Case studies - Computation of vertical and lateral capacity of piles and pile

group efficiency, Settlement analysis of pile foundation and Pile cap analysis using software. Testing on piles, Pile integrity tests and Overview of software for pile foundation		
Module 5	**Retaining walls, earth pressure theories**	**5 hours**
Types of retaining structures, Forces on Retaining walls- Active, Passive and at rest conditions, Types of earth pressures & drainage types, Code provisions as per IS 14458 Part I, Rankine and Coulomb's active and passive earth pressure theory. Effect of Uniform surcharge and line load & Other methods, Frictional circle method, Drainage of Backfill materials, Introduction to Mechanically reinforced walls, Overview of Other Retaining Structures, Applications & Stability of Retaining walls.		
Module 6	**Contemporary Issues**	**2 hours**
	Total Lecture hours	**30 hours**

Text Books & E-Resource	
1.	L&T EduTech LMS Platform
2.	Das, B.M, "Principles of Foundation Engineering", 7th Edition, Cengage Learning, 2010.
3.	Bowles, J. E, "Foundation analysis and design", 5th Edition, McGraw-Hill, New York, 1996.
Reference Books	
1.	IS 6403: 2021, Code of practice for determination of bearing capacity of shallow foundations, Bureau of Indian Standards, New Delhi
2.	IS 2911 (Part 1 to 4): 2021, Code of practice for the design and construction of pile foundations, Bureau of Indian Standards, New Delhi
3.	IS 8009 (Part I & II): 2020, Code of practice for calculation of settlements of foundations, Bureau of Indian Standards, New Delhi
Mode of Evaluation: Quiz, Project, Case Study, CAT and FAT	

Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	3	-	-

BACLE424	PROJECT MANAGEMENT FOR PROFESSIONALS	L	T	P	C
		2	0	0	2
Pre-requisite	BAEEE-101 Basic Engineering	Syllabus version			
		1.0			

Course Objectives

1. To understand fundamental project feasibility, management concepts and best practices applicable to professional projects.
6. To apply cost analysis techniques, Quality Management System for effective project execution.
7. To analyze project performance and implement strategies for risk management.

Course Outcomes

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

13. Identify the key concepts of contracts, feasibility study and phases of project management.
14. Apply project management tools for planning, scheduling, and resource allocation to real-world projects.
15. Demonstrate effective cost analysis techniques and importance of project quality, Health, Safety and Environment.
16. Analyse stakeholder performance, identify bottlenecks, and recommend corrective actions for successful delivery.
17. Implement appropriate response strategies based on project progress to improve project efficiency and ensure successful project delivery.

Learning Modules

Module 1	Contract Management and Scope Management	5 hours`

Introduction to Project Management, Project and Project Lifecycle – Process, Phases, Organization, Project Financial Feasibility Methods, Non-numerical Feasibility Methods.

Basic Concepts of Contract Management, Essential elements, Contract Types, Tendering and Proposal Preparation, Key Commercial Terms and Conditions, Bid Evaluation and Contract Award, Contract Administration, Claim Management. Work Breakdown Structures - Creation & Case Study.

Module 2	Schedule and Resource Management	6 hours

Approach to schedule management, Charts, Sequencing and Dependency, Network Diagram, Activity Duration, Critical Path Method, Float, Case study, Relationships, Case Study, Precedence Diagramming Method.

Resource Allocation and Resource Levelling, Case Study on Schedule Compression, PERT to Predict the Probability of Project Completion.

Module 3	Project Cost and Quality Management	6 hours

Cost Estimation, Budget and Variance Analysis, Monitoring and Control, Cash Flows, Case Study.

Occupational Health, Safety and Environment, Barriers, Quality Management System – Dimensions - Chart and tools.

Module 4	**Procurement, Subcontracts and Stakeholder Management**	**6 hours**
Supply Chain Management, Logistics and Transportation, Vendor and Inventory Management. Stakeholder Analysis and Engagement, Project Communication, Dealing with Difficult Stakeholders.		
Module 5	**Project Risk Management and Project Monitoring**	**5 hours**
Process, Terminology, Identification, Analysis and Response Strategy; Analysis Techniques, Monitor and Control Schedule, Cost, Resources, Quality and risks; Creating schedules, Assigning Resources, Cost, Evaluation, Optimization and Tracking. Asset management and Risk Mitigation using algorithms. MS Project Demo - Project management and monitoring.		
Module 6	**Contemporary Issues**	**2 hours**
	Total Lecture hours	**30 hours**

Textbooks

1.	L&T EduTech LMS Platform.
2.	John M. Nicholas, Herman Steyn, "Project Management for Engineering, Business and Technology", 6th Edition, Taylor & Francis, 2020.
3.	Albert Lester, "Project Management, Planning and Control", 6th Edition, Elsevier/Butterworth-Heinemann, 2014.
4.	Gahlot P S, Dhir B M, "Construction Planning and Management", 3rd Edition, New Age International (P) Ltd., New Delhi, 2024.

Reference Books

1.	Project management institute, "Guide to the Project Management Body of Knowledge (PMBOK® Guide)", 7th Edition, 2022.
2.	Shrivastava, U.K, "Construction Planning and Management", Galgotia Publication Pvt Ltd., New Delhi, 2000.

Mode of Evaluation: Quiz, Project, Case Study, CAT and FAT

Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	3	-	-	3	-
CO2	3	-	-	-	-	-	-	-	-	3	-	-	3	-
CO3	3	-	-	-	-	-	-	-	-	3	-	-	3	-
CO4	3	-	-	-	-	-	-	-	-	3	-	-	3	-
CO5	3	-	-	-	-	-	-	-	-	3	-	-	3	-

Open Elective Courses

BACLE308	PREFABRICATED STRUCTURES	L	T	P	C
		3	1	0	4
Pre-requisite	BACLE203 - Structural Analysis	Syllabus Version			
		1			

Course Objectives

To study the advancement of prefabrication in the construction industry

To acquire knowledge on design principles of precast concrete building systems and foundations and mechanism of joints and connections in prefabricated systems.

To obtain adequate knowledge in handling equipment and erection schemes to streamline the assembly process of prefabricated elements.

Course Outcomes

1. Apply the principles of modular coordination and standardization to optimize building design for industrialization.
2. Select appropriate materials to produce the precast products.
3. Apply the design principles in the precast elements for various building systems.
4. Identify the suitable joints and connections for precast systems.
5. Select appropriate handling devices and erection machinery based on component weight, geometry, and site constraints.

Module:1	Prefabrication Systems An Overview	6 hours

Principles of prefabrication, Need for prefabrication, Types of Prefabrication, Modular coordination, Standarization, Industrialized Building System (IBS), Complexities in Precast Construction, Prefabrication Building Construction - Case Studies

Module:2	Materials Production and Quality Control and Assurance in precast products	10 hours

Materials requirements for production of precast products include concrete, steel, and chemical admixtures; special products - Lightweight aggregate concrete, Aerate concrete, hollow core slabs, Acoustic control panels and floors, Thermal insulation panels. Production Set up & Planning - Type of Precast Concrete Products - Moulds for Beams, columns, slabs and walls; Production, Mould Tolerances, Concreting & Vibration, Demoulding Techniques, Precast Concrete Products Tolerances, Curing and Storage - Quality control and Assurance in precast products.

Module:3	Precast Concrete Building Systems	9 hours

Design Principles; Different types of Structural Systems - Skeletal Frame System, Large Panel System, Cell System; Systems for Lateral Load Resistance - Low-Rise Portals and Frames, Multi-Storied Frames, Wall System; Roof and floor system; Components -Beams, Columns, Slabs, Walls and Foundation units.

Module:4	**Joints and Connections**	**10 hours**

Typical Joint system, - compression joint - shear joint - tension joint; Different types of connection - Column to foundation connection - Socketed connection, Bolted or Base plate Connections, Mechanical Splice Connection, Grouted Connections; Wall Panel to Foundation Connections - Beams to Column Connections; Dry Connections - Hidden Connections, Visible Connections - Beam to Column Head Connection, Connections with Mechanical Couplers, Connections with Corbel, Connection Materials; Tolerances.

Module:5	**Handling Erection and Machineries**	**8 hours**

Transportation, Handling Equipment for Precast Components, Handling Devices for Lifting; Erection Schemes and Supports, Total prefabricated buildings assembly Process; Machineries and equipment for prefabrication.

Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**
	Tutorial Hours	**15 hours**

Text Book(s)

Indian Concrete Institute (ICI) - Technical Committee (ICI - TC / 02), "Handbook on Precast Concrete Buildings", ICI Publication, 1st Edition, 2016

Kim S. Elliot, "Precast Concrete Structures", CRC Press Taylor Francis Group Boca Raton Florida USA, 2nd Edition, 2016

Krishna Raju, N, Arghadeep Laskar , "Prestressed Concrete", McGraw Hill New Delhi, 7th Edition, 2025

IS: 1343: , "Indian Standard code of practice for Prestressed concrete", BIS New Delhi, 2nd Edition, 2012

N. Rajagopalan, "Prestressed Concrete", Narosa Publishers, 2nd Edition, 2017

Reference Books

Kim S. Elliott and Zuhairi Abd. Hamid, "Modernisation, Mechanisation and Industrialisation of Concrete Structures Precast Concrete Structures", Wiley Blackwell UK, 1st Edition, 2017

Hubert Bachmann, Alfred Steinle, "Precast Concrete Structures", Ernst Sohn Germany, 1st Edition, 2011

Shamsher Bahadur Singh, "Analysis and Design of Prestressed Concrete Structures", Wiley, 2nd Edition, 2023

Arthur H. Nilson, "Design of Pre-stressed Concrete", John Wiley Sons Canada , 2nd Edition, 1987

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Seminar, Group Discussion, Course Project, Case Study

Recommended by Board of Studies :		25-02-2026
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	3	-	-

BACLE309	PRE-STRESSED CONCRETE AND INDUSTRIAL STRUCTURES	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

Learn the principles, materials, methods and systems of pre-stressing.
Apply the various concepts for analysis and design of pre-stressed concrete beams.
Acquire the knowledge on applications of pre-stress in industrial and prefabricated

Course Outcomes

1.Calculate the different types of losses in pre-stress and deflections in beams.
2.Analyse the pre-stressed concrete beams under various stages of loading.
3.Design pre-stressed concrete beams for flexure, shear and torsion at ultimate limit state.
4.Apply the principle of linear transformation in Multi-span floor systems and Shell Structures.
5.Analyse the behaviour of precast and prestressed structural members during handling and erection

Module:1	Introduction to Pre stressed Concrete and Losses in Pre stress and Deflection	10 hours

Introduction-Development of Pre-stressed Concrete-General Principles of Pre-stressed Concrete-Classification and types of pre-stressing-Stages of loading-Materials-Concrete and Steel stress-strain characteristics - End anchorages - Losses in Pre-stress-Immediate losses-Time dependant losses-Calculation of deflection in un-cracked section-Immediate deflection and long-term deflection

Module:2	Analysis of Members	7 hours

Analysis for elastic flexural stresses at various stages of loading in determinate beams- Stress, strength and load balancing concepts-Permissible stresses-Cracking moment-Kern limits-Location of thrust line.

Module:3	Design for Flexure Shear and Torsion	12 hours

Basis of design-Fully pre-stressed beams-Flexural design based on limit state of serviceability-Flexural design based on limit state of collapse (as per IS Code) - Diagonal shear and flexural shear failures-Resistance against shear-Cracked section- Uncracked section-Calculation for transverse reinforcement-Equilibrium torsion & compatibility torsion-Modes of failure under combined bending, shear and torsion.

Module:4	Applications in Industrial Structures	8 hours

Applications of Pre-stressed concrete-Multi-span floor system-Circular pre-stressing-Liquid storage tanks, silos, Folded plates, Cylindrical shell structures, Composite construction-Bridge decks		
Module:5	**Applications in Prefabricated Structures**	**6 hours**
Introduction to pre-fabricated structures-Advantages of prefabricated structures-Types of precast and pre-stressed members-Handling and erection stresses-Connections details- Shear friction method for connection design.		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**
	Tutorial Hours	**15 hours**
Text Book(s)		
Krishna Raju, N, Arghadeep Laskar, , "Prestressed Concrete, ", McGraw Hill New Delhi, 7th Edition, 2025 IS: 1343: , "Indian Standard code of practice for Prestressed concrete, ", BIS New Delhi, 1st Edition, 2025 N. Rajagopalan.,, " Prestressed Concrete,", Narosa Publishers, 2nd Edition, 2017		
Reference Books		
Shamsher Bahadur Singh,, " Analysis and Design of Prestressed Concrete Structures,", Wiley, 1st Edition, 2023 Edward G. Nawy, ,, "Prestressed Concrete â€“ A fundamental approach ", Prentice Hall, 5th Edition, 2005 Arthur H. Nilson,, " Design of Pre-stressed Concrete", John Wiley Sons Canada, 1st Edition, 1987		
Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Seminar, Group Discussion		
Recommended by Board of Studies :		25-02-2026
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	2	-	-	-	-	3	-	-
CO2	-	3	-	-	-	-	2	-	-	-	-	3	-	-
CO3	-	2	3	-	-	-	2	-	-	-	-	3	-	-
CO4	3	2	-	-	-	-	2	-	-	-	-	3	-	-
CO5	3	2	-	-	-	-	2	-	-	-	-	3	-	-

BACLE310	ADDITIVE MANUFACTURING FOR CONSTRUCTION	L	T	P	C
		3	1	0	4
Pre-requisite	BACLE302 - Concrete Technology	Syllabus Version			
		1			

Course Objectives

To study the fundamental principles of additive manufacturing and categorize the diverse 3D printing technologies.

To assess the requirement of printable materials and properties of fresh and hardened 3D printing concrete.

To study the mechanics of printer, extrusion & casting process, and application & impact of 3D printing in industry.

Course Outcomes

1. Apply the 3D printing technology in 3D printing construction.
2. Compare different material extrusion and intrusion-based 3D printing technologies
3. Analyze the mechanics of machine design and delivery systems of 3D concrete printers and optimize its components.
4. Apply suitable tests to assess the properties of fresh and hardened properties of 3D printable concrete.
5. Examine the time-dependent rheological changes and interlayer bonding mechanisms in the 3D printing process to mitigate defects.

Module:1	Additive Manufacturing Technology An Overview	6 hours

General considerations for 3D printing and additive fabrication - Main concepts of 3D printing - 3D printing of cement-based materials - general classification of printing technologies, emerging objects - advantages of 3D Printing - future direction and challenges - Case Studies.

Module:2	3D Printing Methods	10 hours

Material Extrusion Types - Concrete 3D printing - Contour crafting - Shortcrete 3D printing - Mesh molding - Injection 3D printing - Advantages - Limitations; Material Intrusion Types - Selective binder activation - Effects of process and material technology in particle bed 3D printing - Selective paste intrusion - Shape accuracy - Homogeneity of layers - Porosity and pore size

distribution - Sand sintering- Advantages - Limitations. D-Shape 3D Printing technique - process and applications - Wire and arc additive manufacturing - process and applications.		
Module:3	**Printing Technologies Mechanics of Machine Design and Components of 3D Concrete printers**	**9 hours**
Gantry printers - Delta Printers - Robotic arm printers - Crawler boom printers - Polar printer - Optimal selection of printers - Mechanics of Machine Design - motion along the axes, nozzle design - working mechanism of tank and pump - Material Delivery System - Control system - Printing parameters - Components of 3D Concrete Printers - Concrete pump and mixing unit - Production Unit- Control Unit - Types of extruder - Ram Extruder - Pneumatic Extruder - Types of nozzle - Effect of nozzle shape, size, and orientation.		
Module:4	**Raw Materials Properties of fresh and hardened 3DCP**	**10 hours**
Raw materials - supplementary cementitious materials, admixtures, fibres, cement and aggregates, mix design - performance requirement of 3DCP - printability, extrudability, open time and buildability - Testing measurements for 3D printable fresh concrete - Performance of the cement materials using extrusion and deposition methods - mechanical behaviour of 3D printed materials - non fibrous material and fibrous materials - Effect of printing parameters on Mechanical properties hardened 3DCP.		
Module:5	**Extrusion and Casting**	**8 hours**
Stages of 3D printing process - Criteria for pumping material in a fresh state - effect of time intervals between successive deposits and effect of water content - Change of rheology: physico-chemical activity over time - pumping - extrusion - Other problems occurring during concrete extrusion printing - effect of bond between layers - Shrinkage and cracking during drying of concrete.		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**
	Tutorial Hours	**15 hours**
Text Book(s)		
Biranchi Panda, Pshtiwan Shakor, Vittoria Laghi, "Additive manufacturing for construction", Emerald Publishing UK, 1st Edition, 2024 Arnaud Perrot, " 3D Printing of Concrete ", John Wiley Sons Inc USA, 1st Edition, 2019		
Reference Books		

Luca Caneparo, "Digital Fabrication in Architecture, Engineering and Construction", Springer Dordrech Springer Netherlands, 1st Edition, 2014 Jay G. Sanjayan, Ali Nazari, Behzad Nematollahi, "3D Concrete Printing Technology: Construction and Building Applications", Butterworth Heinemann Elsevier United Kingdom, 1st Edition, 2019
Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Seminar, Course Project, Case Study

Recommended by Board of Studies :		25-02-2026
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	3	-	-

BACLE311	CONSTRUCTION QUALITY AND SAFETY	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus version			
		1			

Course Objectives:

The objectives of this course are:

18. Understand the basic principles of quality management and safety practices in construction
19. Familiarize with essential quality control techniques and safety requirements applicable to construction sites
20. Develop awareness of common construction hazards and basic prevention measures

Course Outcomes:

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

21. Apply appropriate quality inspection methods and basic quality control techniques in construction projects to maintain quality documentation and records.
22. Implement quality management practices at construction sites using appropriate quality control techniques and audit procedures to ensure the quality requirements.
23. Apply construction safety regulations and management practices to identify and control hazards and ensure safe working conditions.
24. Formulate safety systems for effective accident prevention and management in construction projects.
25. Implement the digital technologies for integrated quality and safety management in construction projects.

Learning Modules

Module 1	**Foundations of Construction Quality**	**9 hours**
Basic concepts of quality in construction; Importance of quality management; Types of quality inspections; Roles and responsibilities of various stakeholders (architects, engineers, contractors); Basic quality control techniques; Quality documentation and record keeping		
Module 2	**Quality Management Systems**	**8 hours**
Quality planning fundamentals; Basic quality standards in construction; Inspection of materials and equipment; Simple quality control tools; Quality audits for construction projects; Implementation of quality management on construction sites		
Module 3	**Construction Safety Fundamentals**	**10 hours**
Safety concepts in construction; Common hazards on construction sites; Legal framework in India: BOCW Act 1996 and CESS rules; Role of DGFASLI and safety officers; NBC guidelines for safety; Personal protective equipment (PPE); Basic safety regulations and standards; Safety training requirements; Site management practices for safety; Emergency procedures and first aid		
Module 4	**Accident Prevention and Management**	**9 hours**
Common construction accidents and their causes; Basic accident investigation techniques; Preventive measures for common hazards; Safety signage and communication; Safety documentation and reporting; Cost implications of construction injuries; Introduction to workers' compensation; Challenges specific to Indian construction sites		
Module 5	**Digital Technologies for Quality and Safety Management**	**7 hours**
Digital transformation in construction; BIM applications for quality control and safety planning; IoT technologies for real-time monitoring; Emerging tools: Digital Twins, XR, and wearable devices		
Module 6	**Contemporary Issues**	**2 hours**
	Total Lecture hours	**45 hours**
	Total Tutorial hours	**15 hours**

Textbooks

1.	Gambatese, J. A., Hinze, J., & Tucker, R., Construction Safety and Quality: Integrating Management Systems, 2015, 1st Edition, Wiley, Hoboken, USA.

2.	Alexander, D. T., Construction Safety Management: Principles and Practices, 2015, 1st Edition, Wiley, Hoboken, USA.
Reference Books	
1.	Rumane, A. R., Construction Quality Management: Principles and Case Studies, 2011, 1st Edition, CRC Press, Boca Raton, USA.
2.	Hughes, P., Ferret, E. Introduction to Health and Safety in Construction: The Handbook for the NEBOSH National Certificate in Construction: Health and Safety, 2015, 5th Edition, Routledge, UK.
3.	ISO 45001:2018 – International Standard for Occupational Health and Safety (OH&S) management systems.

Mode of Evaluation: Continuous Assessment Test, Quiz / Case studies / Project, Final Assessment Test		
Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	3	-	-	-	-	-	-	2	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	2	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	2	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	2	-	-	-	3	-	-

BACLE312	GROUNDWATER ENGINEERING	L	T	P	C
		4	0	0	4
Pre-requisite	BACLE201-Fluid Mechanics	Syllabus Version			
		1			

Course Objectives

1.Understand the principles of groundwater occurrence, aquifer types, and hydrological cycle.

2.Analyse groundwater flow, well hydraulics, and pumping test data for design purposes.

3.Apply groundwater management and sustainable development techniques for practical engineering problems.

Course Outcomes

1.Classify different types of aquifers and groundwater systems

2.Compute aquifer parameters and develop flow net

3.Estimate aquifer parameters using well hydraulics

4.Illustrate groundwater well development and groundwater quality standards

5.Predict groundwater flow and manage groundwater for sustainability

Module:1	Introduction to Groundwater	12 hours

Groundwater hydrologic cycle - Aquifers, confined, perched aquifer, semi-confined - Hydraulic properties of soils, Porosity, permeability, transmissivity, storativity - groundwater occurrence, recharging methods

Module:2	Groundwater Flow Principles through Porous Media	10 hours

Darcy's law and assumptions - Steady and Unsteady radial flow to wells -Groundwater flow equations - confined and unconfined aquifer analysis - Flow nets.

Module:3	Well Hydraulics and Pumping Tests	12 hours

Types of wells and their construction - Steady and unsteady flow in a confined and unconfined aquifer - Slug tests - Pumping test, constant rate, step-drawdown test - well losses - interference of wells -Unsteady flow analysis, Theis, Cooper-Jacob methods.

Module:4	**Groundwater Development and Management**	**12 hours**
Well design and optimization - Artificial recharge methods - Artificial recharge methods - Groundwater quality assessment and protection - Sustainability and conjunctive use of surface and groundwater		
Module:5	**Groundwater modelling and Case studies**	**12 hours**
Measure Numerical and analytical modelling of groundwater systems- MODFLOW overview and applications - Groundwater contamination and remediation - Cases studies from India, Irrigation and municipal water supply.		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**60 hours**

Text Book(s)

David K Todd and Larry W. Mays, "Groundwater Hydrology", John Wiley and Sons Singapore , 3rd Edition, 2013

Raghunath H.M (2022), , "Groundwater", Wiley Eastern Limited New Delhi, 2nd Edition, 2022

Rastogi, R.K., " Applied Groundwater Hydrology", Applied Groundwater Hydrology, 1st Edition, 2011

Reference Books

C.W. Fetter, C.W. "Applied Hydrogeology", Prentice Hall, 4th Edition, 2001

Chahar, B.R. , "Hydrology of Groundwater", Pearson Education, 2nd Edition, 2024

R. Allan Freeze & John A. Cherry (1999), "Groundwater", Prentice Hall USA, 1st Edition, 1979

Mode of Evaluation: Continuous Assessment Test, Final Assessment Test, Seminar, Course Project, Case Study

Recommended by Board of Studies :		25-02-2026
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	2	-	-	-	2	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	2	-	-	2	-	-	-	2	-	-	2	-	-

BACLE313	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		4	0	0	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

To understand the legal and procedural framework of EIA and ERA in Indian and international contexts.

To apply impact prediction methods and tools across physical, biological, social, and economic environments, and prepare Environmental Management Plans with sustainability considerations.

To design Environmental Management Systems to ISO 14001:2015 and evaluate circular economy strategies for sustainable environmental management.

Course Outcomes

1.Illustrate the structure and regulatory framework for EIA and ERA

2.Assess impacts on physical, biological, cultural, and socio-economic environments, using EIA prediction methods and tools

3.Prepare an Environmental Impact Statement and Environmental Management Plan using established quality review frameworks and monitoring protocols.

4.Apply Environmental Management System and environmental audit to implement effective environmental management practices.

5.Apply circular economy principles and industrial ecology strategies for sustainable development

Module:1	Overview of EIA and Environmental Risk Assessment	8 hours

Evolution of EIA and EIS structure. ERA framework including hazard identification, dose response, and risk characterization. Legal framework: EIA Notification 2006, EPA 1986, and CRZ rules. Project categories, ToR, and EAC roles. Professional ethics and international frameworks.

Module:2	Methods of EIA	9 hours

EIA process from screening to monitoring. Impact identification using Leopold matrix, checklists, and GIS assessment. Health Impact Assessment (HIA) and climate change screening. Impact prediction for air (AERMOD), water (MODFLOW), soil, and noise (Sound PLAN). Public hearing procedures and Sustainability in method selection.

Module:3	Quality and Monitoring	9 hours

Quality review frameworks: IEMA, ANSEA, and World Bank criteria. AI applications in document screening. EIS preparation as per MoEFCC guidelines. Environmental Management Plan (EMP) structure, mitigation hierarchy, and **Management** of construction and operational impacts.

Module:4	**EMS and Audit**	**9 hours**

ISO 14001:2015 principles and High Level Structure (HLS). Leadership, risk-based planning, and operational controls. Integration with ISO 9001 and ISO 45001. Audit types, performance indicators (EPIs), and Sustainability reporting (GRI, BRSR). Corporate stewardship and ethics.

Module:5	**Industrial Ecology**	**8 hours**

Material flows, decarbonization, and eco-design principles. Life Cycle Assessment (LCA) phases and industrial symbiosis. Circular Economy models and India's 2022 EPR rules. Carbon foot printing (Scopes 1, 2, and 3) and Science Based Targets (SBTi) linked to Sustainability and SDGs.

Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**
	Tutorial Hours	**15 hours**

Text Book(s)

Canter, Larry W., "Environmental Impact Assessment", McGraw Hill, 2nd Edition, 1996

Glasson, John, Riki Therivel, and Andrew Chadwick, "Introduction to Environmental Impact Assessment", Routledge, 5th Edition, 2019

Mareddy, Anjireddy, "Environmental Impact Assessment: Theory and Practice", B S Publications, 1st Edition, 2017

Reference Books

Anjaneyulu, Y., and Valli Manickam, "Environmental Impact Assessment Methodologies", B S Publications, 2nd Edition, 2007

Eccleston, Charles H., "Environmental Impact Assessment: A Guide to Best Professional Practices", CRC Press, 1st Edition, 2011

Petts, Judith (Ed.). , "Handbook of Environmental Impact Assessment: Vols. 1 and 2", Blackwell Science, 1st Edition, 1999

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Seminar, Course Project, Case Study

Recommended by Board of Studies :		25-02-2026
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	2	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	2	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	2	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	2	-	-	-	-	-	3	-	-

BACLE314	INDUSTRIAL WASTE MANAGEMENT	L	T	P	C
		4	0	0	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

Understand the sources, characteristics, and environmental implications of industrial wastes generated from different industrial sectors.

Apply engineering, and sustainability principles to evaluate and select appropriate industrial waste treatment, disposal, and resource recovery options.

Develop awareness of regulatory frameworks, and contemporary challenges in industrial waste management with reference to Indian and global contexts.

Course Outcomes

1.Identify industrial wastes and explain their impacts on environment eand public health.

2.Analyze industrial waste characteristics using standard assessment and audit methods.

3.Select suitable technologies for liquid, and gaseous waste management.

4.Select suitable technologies for industrial solid and hazardous waste management.

5.Interpret waste minimization options, environmental regulations, and case studies related to industrial waste management.

Module:1	Introduction	8 hours

Introduction to industrial waste management - Types of industries and sources of industrial wastes - Classification of industrial wastes. Environmental and health impacts of improper industrial waste disposal. Concept of waste hierarchy, Linear and Circular approach. Overview of Indian environmental regulations related to industrial waste. Introduction to sustainable industrial development.

Module:2	Industrial Waste Characterization and Assessment	10 hours

Physical, chemical, and biological characteristics of industrial wastes. Sampling strategies for solid waste, effluent, sludge, and stack emissions. Waste Audit. Basics of Life Cycle Assessment (LCA) in industrial waste management.

Module:3	Industrial Effluent and Gaseous Waste Management	15 hours

Industrial wastewater sources and characteristics. Effluent treatment processes - Primary, secondary, and tertiary treatment - Physico-chemical and biological treatment systems. Advanced treatment techniques. Zero Liquid Discharge (ZLD) concept. Industrial air pollution - Sources and control technologies.		
Module:4	**Industrial Solid and Hazardous Waste Management**	**10 hours**
Industrial solid waste handling, segregation, storage and transportation. Hazardous waste - identification and labelling. Treatment technologies - Solidification and Stabilization - Thermal treatment: incineration, pyrolysis, plasma treatment. Secured landfills. Co-processing of industrial wastes.		
Module:5	**Waste Minimization Circular Approach and Case Studies**	**15 hours**
Waste minimization techniques and Cleaner production approaches. Circularity approach for industrial waste management. Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP). Corporate Environmental Responsibility and ESG principles. Case Studies - Best practices in sustainable industrial waste management.		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**60 hours**

Text Book(s)

Ranade, V. V., & Bhandari, V. M., "Industrial Wastewater Treatment, Recycling and Reuse", Butterworth Heinemann, 2nd Edition, 2022

Vesilind, P. A., Eckenfelder, W. W., & Lautz, D. L., "Solid and Hazardous Waste Management", Cengage Learning, 2nd Edition, 2020

Hammer, M. J., & Hammer, M. M., , "Water and Wastewater Technology", Pearson, 8th Edition, 2021

Reference Books

Noel de Nevers , "Air Pollution Control Engineering", Waveland Pres, 3rd Edition, 2020

Graedel, T. E., & Allenby, B. R., "Industrial Ecology and Sustainable Engineering", Pearson, 2nd Edition, 2022

CPCB & MoEFCC,, "Guidelines and Manuals on Industrial and Hazardous Waste Management", Govt of India, 1st Edition, 2016

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Seminar, Course Project, Case Study	
Recommended by Board of Studies :	25-02-2026
Approved by Academic Council : No. 81	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	3	2	-	-	-	-	-	-	-	-	2	3	-	2
CO3	3	2	-	-	-	-	-	-	-	-	2	3	-	2
CO4	3	2	-	-	-	-	-	-	-	-	2	3	-	2
CO5	3	-	-	-	-	-	-	-	-	-	2	3	-	2

BACLE315	AIR AND NOISE POLLUTION CONTROL	L	T	P	C
		4	0	0	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

To assess the physicochemical characteristics of air pollutants and the acoustic properties of noise and evaluate their cumulative impacts on human health and the environment.

To analyze atmospheric dispersion using meteorological principles and Gaussian modeling for air quality assessment and regulatory compliance.

To design and evaluate sustainable engineering control systems for air and noise pollution, with due consideration of engineering ethics, management practices, and life-cycle sustainability.

Course Outcomes

1. Characterize the physicochemical properties of air pollutants and physical properties of noise, and their impacts.
2. Analyze meteorological factors governing pollutant dispersion, air quality, stack design to meet regulatory compliance.
3. Design engineering control systems for particulate matter
4. Analyze suitable treatment systems for gaseous emissions.
5. Suggest mitigation strategies and acoustic control measures for noise pollution

Module:1	Pollutant Characterization	8 hours

Atmospheric composition and vertical structure; physicochemical properties of air pollutants (particle size distribution, reactivity, solubility); classification of primary and secondary pollutants; indoor vs. outdoor air quality considerations; physical properties of noise, sound pressure level, frequency spectrum, and acoustic indices (Leq, L10, L90); dose-response relationships; health impacts of air pollution and noise on humans and engineering materials; applicable ambient air quality and noise standards (NAAQS, IS 3483, WHO guidelines).

Module:2	Atmospheric Dispersion and Air Quality Modelling	10 hours

Atmospheric stability classes and lapse rates; temperature inversions and their role in pollutant accumulation; wind rose interpretation; Gaussian plume dispersion model- assumptions, mathematical derivation, and regulatory application; effective stack height (Briggs equations); estimation of ground-level concentrations under various meteorological conditions; fumigation,

coning, fanning, and looping plumes; use of dispersion modelling in environmental impact assessment and industrial permitting.		
Module:3	**Particulate Matter Control**	**15 hours**
Engineering design of gravity settling chambers, cyclone separators, fabric filters (baghouses), and electrostatic precipitators (ESPs); collection efficiency analysis as a function of particle size and density; pressure drop calculations; comparative evaluation on technical performance, energy consumption, O&M cost, and sustainability criteria; ethical responsibility of engineers in specifying control equipment; life-cycle cost analysis as a management decision tool.		
Module:4	**Gaseous Emission Control**	**10 hours**
Design and operation of absorption (wet scrubbers), adsorption (activated carbon, zeolites), and combustion (thermal and catalytic oxidation) systems; control strategies for SOx (wet and dry FGD), NOx (SCR, SNCR, low-NOx burners), CO, and VOCs; selection rationale based on chemical reactivity, inlet concentration, and regulatory limits; green chemistry principles in gaseous emission control; economic and environmental trade-offs in technology selection.		
Module:5	**Noise Measurement and Control**	**15 hours**
Physics of sound: propagation, reflection, absorption, and transmission loss; community and occupational noise impact assessment methodologies; noise mapping and monitoring instrumentation; design of sustainable mitigation measures - acoustic barriers, sound-absorbing materials, active noise control, vibration isolation, and enclosures; land-use planning for noise management; hearing conservation programs; noise regulations (IS 3483, CPCB guidelines, OSHA PEL, EU Environmental Noise Directive).		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**60 hours**
Text Book(s)		
Joshua S. Fu and Wayne T. Davis, "Air Quality", Routledge, 6th Edition, 2022 Murphy, Enda, and Eoin A. King. , "Environmental Noise Pollution: Noise Mapping, Public Health, and Policy.", Cambridge MA Academic Press, 2nd Edition, 2021 Vallero, Daniel A. , "Fundamentals of Air Pollution", Cambridge MA Academic Press, 6th Edition, 2025		
Reference Books		
De Nevers, Noel. , "Air Pollution Control Engineering", Long Grove IL Waveland Press, 3rd Edition, 2010		

Bies, David A., and Colin H. Hansen. , "Engineering Noise Control: Theory and Practice.", Boca Raton FL CRC Press, 6th Edition, 2024 Kumar, Prashant, and Lidia Morawska (Eds.), "Airborne Nanoparticles: Control and Health Impacts.", Boca Raton FL CRC Press, 1st Edition, 2021	
Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Seminar, Course Project, Case Study	
Recommended by Board of Studies :	25-02-2026
Approved by Academic Council : No. 81	**Date** 12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	3	2	-	-	-	2	-	-	-	-	2	3	-	-
CO3	-	3	2	-	-	2	-	-	-	-	2	3	-	-
CO4	-	3	2	-	-	2	-	-	-	-	2	3	-	-
CO5	3	-	-	-	-	2	-	-	-	-	2	3	-	-

BACLE316	SOLID WASTE MANAGEMENT	L	T	P	C
		4	0	0	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

To provide a deep understanding of the generation, characterization, collection, and transportation logistics of solid, hazardous, and biomedical wastes.

To equip students with the technical skills to design and manage engineered systems for waste minimization, material recovery, thermal conversion, and sanitary landfilling.

To integrate circular economy principles, Life Cycle Assessment (LCA), and Sustainable Development Goals (SDGs) into the management of specialized and industrial waste streams.

Course Outcomes

1. Identify the physical, chemical, and biological characteristics of waste for effective solid waste management
2. Apply mechanical, biological, and thermal processing techniques for effective resource recovery.
3. Classify hazardous and biomedical waste streams to determine appropriate treatment and disposal strategies.
4. Outline the sources and characteristics of emerging waste to develop recycling and recovery strategies.
5. Choose appropriate circular economy strategies to support the achievement of the Sustainable Development Goals (SDGs).

Module:1	Solid Waste Management Generation Collection and Transportation	12 hours

Introduction, Sources and generation of solid waste; composition and characteristics: Physical, Chemical and Biological characteristics; factors affecting waste generation; on-site handling, segregation and storage; collection systems and equipment; routing and transfer stations; transportation logistics and efficiency improvement

Module:2	Processing and Disposal of Solid Waste	12 hours

Engineered systems for waste minimization and material recovery; Reuse, recycling, and mechanical processing techniques - hand sorting, screening, magnetic and air separation, shredding, pulping, and crushing. Composting: principles, methods, and influencing factors; biogas recovery; Incineration - process, products, and heat recovery; Energy production from waste (Waste-to-Energy systems); Landfilling: introduction, Policy and regulatory framework: overview of

Solid Waste Management Rules. Site selection, design and operational methods, leachate and gas management, and post-closure care; Landfill gas recovery and utilization.		
Module:3	**Hazardous and Biomedical waste Management**	**12 hours**
Classification and characteristics of hazardous wastes; Sources and generation, storage, handling, and transportation protocols; Treatment and disposal technologies: Secure landfill for hazardous waste; Regulatory framework under Hazardous and Other Wastes (Management and Transboundary Movement) Rules.. Biomedical waste: definition, categories, and sources; Segregation, colour coding, and labelling; Collection, storage, and transportation procedures; Treatment and disposal methods; Regulatory framework under Biomedical Waste Management Rules; Case studies on safe management practices		
Module:4	**Specialized Waste Streams**	**12 hours**
Construction and Demolition (C&D): Generation rates, methods of recycling, and managing as per C&D Waste Management Rules; E-Waste: Definition, characterization, health hazards, and recycling/disposal as per E-Waste (Management) Rules; Plastic Waste-Types; generation trends Characterization and environmental impacts; Recycling Technologies. Household Hazardous Waste: - definition, classification, and disposal precautions. Recovery Programs: Reuse and redistribution programs case studies - Soles 4 Souls.		
Module:5	**Circular Economy and Sustainable Waste Systems**	**10 hours**
Introduction to the circular economy; transition from linear to circular production-consumption models; closed-loop supply chains and integrated waste management; resource efficiency for reuse and recycling; linkages with Sustainable Development Goals (SDGs); global and national circular-economy policies and best practices. Life Cycle Assessment (LCA) basics; Environmental, Social, and Governance (ESG) in waste systems		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**60 hours**
Text Book(s)		
Rajeev Pratap Singh, Ibha Suhani, Norli Ismail, Vaibhav Srivastava, "Solid Waste Management: Challenges and Recent Solutions", Taylor Francis, 1st Edition, 2024 John Pichtel , "Waste Management Practices: Municipal, Hazardous, and Industrial", Taylor and Francis Books India Pvt Ltd, 2nd Edition, 2024		

Sadhan Kumar Ghosh,, "Circular Economy: Global Perspectives, Practices and Challenges", Springer Publication, 1st Edition, 2020
Reference Books
Arora P. & Singh H.,, "Biomedical Waste Management and Handling", CBS Publishers, 1st Edition, 2021 F. Pacheco-Torgal, Francesco Colangelo, Rabin Tuladhar, Yining Ding, "Advances in Construction and Demolition Waste Recycling: Management, Processing and Environmental Assessment", Woodhead Publishing Elsevier, 1st Edition, 2021 Michael Z. Hauschild, Ralph K. Rosenbaum, and Stig I. Olsen, "Life Cycle Assessment: Theory and Practice", Springer Publication, 1st Edition, 2019
Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Seminar, Course Project, Case Study

Recommended by Board of Studies :		25-02-2026
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	-	2	3	-	2
CO3	3	2	-	-	-	-	-	-	-	-	2	3	-	2
CO4	3	2	-	-	-	-	-	-	-	-	2	3	-	2
CO5	3	-	-	-	-	-	-	-	-	-	2	3	-	2

BACLE406	RESOURCE MANAGEMENT AND CIRCULAR ECONOMY	L	T	P	C
		4	0	0	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

To understand the dynamics of resource scarcity, planetary boundaries, and the systemic transition from linear to circular economic models.

To apply circular design principles, Life Cycle Assessment (LCA), and waste valorization techniques to minimize environmental impact and maximize resource recovery.

To implement circular business models, ESG frameworks, and digital tracking technologies while adhering to global and national environmental policies.

Course Outcomes

1. Demonstrate the principles of resource management, carrying capacity, and the mapping of Circular Economy (CE) to Sustainable Development Goals (SDGs).
2. Apply Circular Design strategies and Life Cycle Assessment (LCA) methodologies to engineering products and specialized waste streams.
3. Utilize the 9R framework, and Urban Mining concepts to optimize resource recovery from electronic, biological, and construction waste.
4. Implement circular business models, reverse logistics, and ESG frameworks to improve corporate sustainability and economic circularity.
5. Illustrate the role of digital enablers (IoT, AI, Blockchain) and global policy frameworks in facilitating a just transition toward circular cities.

Module:1	Resource Management Fundamentals and SDGs	12 hours

Resource Management Fundamentals: Meaning and scope of resource management - classification of resources - renewable and non-renewable resources - biotic and abiotic resources - resource scarcity and depletion - carrying capacity - sustainable resource management principles - resource conservation techniques - resource efficiency and productivity - environmental and economic importance - basic resource assessment methods - The Linear vs. Circular Model: The 'Take-Make-Dispose' trap; Principles of Circular Economy (CE). Planetary Boundaries and SDGs: Mapping Circular Economy to Sustainable Development Goals -. Drivers for Change: Economic, environmental, and regulatory drivers; transition drivers and barriers.Case Study: Resource depletion and conservation practices (Simple case study).

Module:2	Circular Design and Life Cycle Thinking	12 hours

Circular Design: Design for Longevity, Design for Repair, and Design for Disassembly (DfD). Life Cycle Assessment (LCA): Methodology (Goal, Scope, Inventory, and Impact Assessment). Material Selection:

Sustainable materials; substitution of hazardous substances; modular design. Case Study: Applying design principles and Environmental Product Declarations (EPD) to modern engineering sectors... Specialized Streams: Construction and Demolition (C&D) waste; Household hazardous waste precautions ; E-waste hazards and recycling; Plastic waste trends and recycling technologies, Solar PV recycling. Recovery Programs; Case studies on reuse programs (e.g., Soles 4 Souls).		
Module:3	**Sustainable Resource Management and Industrial Symbiosis**	**12 hours**
The Waste Hierarchy: Beyond recycling; the 9R framework (Refuse to Recover). Urban Mining: extracting value from e-waste and construction debris. Industrial Symbiosis: Concepts of eco-industrial parks (e.g., Kalundborg model); sharing resources (heat, water, waste) across industries. Bio-Economy: Bio-based materials; cascading use of biomass; composting and anaerobic digestion.- economic and environmental benefits - sustainability assessment methods - Case Study: Recycling and circular material flow system.		
Module:4	**Circular Business Models and Environmental Social and Governance ESG Economics**	**12 hours**
Business Models: Product-as-a-Service (PaaS); sharing platforms; resource recovery models. Supply Chain Management: Reverse logistics; green procurement; closed-loop supply chains. Economic Indicators: Measuring circularity at micro (product) and macro (city/national) levels. The Role of Finance: Circular investment and green bonds; Environmental, Social, and Governance (ESG) frameworks in corporate sustainability.		
Module:5	**Enabling Technologies and Global Policy**	**10 hours**
Digital Enablers: Role of IoT, AI, and Blockchain in tracking resource flows; 'Digital Product Passports'. Global Policy Frameworks: EU Circular Economy Action Plan; India's Plastic Waste Management Rules; Zero Waste policies. Social Dimensions: Just Transition; impact on labor and informal waste sectors. Future Trends: Circular cities and the role of 3D printing in localized, zero-waste production		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**60 hours**
Text Book(s)		
Stahel, W. R., "The Circular Economy: A Userâs Guide", Routledge, 1st Edition, 2020 SillanpÃ¤Ã¤, M., & Ncibi, C. , "The Circular Economy: Case Studies about the Transition from the Linear Economy", Academic Press, 1st Edition, 2021 Lacy, P., Long, J., & Spindler, W., " The Circular Economy Handbook: Realizing the Circular Advantage. ", Palgrave Macmillan, 1st Edition, 2020		

Reference Books		
Kharbanda, V., & Singh, R., "Circular Economy in the Construction Industry: Principles and Practices. ", CRC Press, 1st Edition, 2024 Gallego-Schmid, A. , "Sustainable Construction and the Circular Economy. ", Routledge, 1st Edition, 2023 Santamouris, M. , "Resource-Efficient and Sustainable Civil Engineering.", Springer Nature, 1st Edition, 2023		
Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Seminar, Course Project, Case Study		
Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	2	-	-	3	3
CO2	3	-	-	-	-	-	-	-	2	2	2	-	3	3
CO3	3	-	-	-	-	-	-	-	2	2	2	-	3	3
CO4	3	-	-	-	-	-	-	-	2	2	2	-	3	-
CO5	3	-	-	-	-	-	-	-	2	2	2	-	3	-

BACLE407	TRAFFIC ENGINEERING	L	T	P	C
		4	0	0	4
Pre-requisite	BACLE204-TRANSPORTATION ENGINEERING	Syllabus Version			
		1			

Course Objectives

Identify the traffic stream characteristics and learn the traffic data collection techniques & analyze it.
Learn the concepts of highway capacity and level of service and its importance in traffic engineering
Familiarise with the traffic control devices and traffic management measures and enable them to understand the importance of road safety.

Course Outcomes

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

1) Calculate the various traffic stream parameters and its relationships.

2) Analyze traffic data collected through traffic surveys using probability and statistics concepts.

3) Estimate capacity and level of service of a highway section.

4) Prepare various traffic control and management measures.

5) Analyze accident data and perform accident black spot identification.

Module:1	Introduction to Traffic Engineering & Traffic Stream Characteristics	15 hours

Elements of Traffic Engineering-Traffic components and its characteristics-Road users and Vehicles-Visual characteristics of Drivers-Traffic Stream Parameters-Macroscopic-Flow, Speed and Density-Microscopic-Headways and Spacing- Relationships among the Macroscopic and Microscopic Parameters-Traffic Stream Models-Linear (Greenshields) and Non-linear (Greenberg, Underwood, Northwestern) models-Applications of stream models-Shock waves.

Module:2	Traffic Data Collection, Analysis & Statistical Applications	15 hours

Traffic Data Collection Methodologies-Manual and Automated Traffic Data Collection-Types of Traffic Studies-Use of Loop Detectors, Videos and Sensors for Measurement of Volume, Speed, Density-Moving Observer and GPS Methods for Travel Time and Delay Studies at Mid-Blocks and Intersections-Accident Studies-Parking Studies-Overview of Probability Functions and Statistics-Applications of Discrete and Continuous Probability Distributions in Speed and Accident studies-Poisson and Normal distribution.

Module:3	Highway Capacity and Level of Service	12 hours

Introduction to Highway Capacity and Level of Service (LOS) concept-Computation of Capacity and LOS for Different Types of Facilities using HCM guidelines-Base Capacity and Various Adjustment Factors for Capacity and LOS computation for Freeways-Indian Highway Capacity Manual (Indo-HCM) guidelines-Single Lane, Intermediate Lane and Two-Lane Interurban Bidirectional Roads-Multilane Divided Interurban Highways.

Module:4	**Traffic Control Devices and Traffic Management**	**8 hours**

Traffic Signs, Road Markings and Traffic Signals-Types of Traffic Signal-Warrants for Signalization and Design of Traffic Signal-Traffic Management Measures-Transportation System Management (TSM) and Transportation Demand Management (TDM)-Traffic simulation.

Module:5	**Highway Traffic Safety**	**8 hours**

IRC Road safety code-Accident Statistic-Accident Data Collection and Record Systems- Identification of Accident Hot Spots-Site Analysis-Development of Countermeasures-Road Safety Auditing-Bicycle and pedestrian safety.

Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**60 hours**

Text Book(s)

Roger P. Roess, Elena S. Prassas, William R. McShane, "Traffic Engineering ", Pearson USA, 5th Edition, 2020

Fred L. Mannering, Scott S. Washburn, "Principles of Highway Engineering and Traffic Analysis", John Wiley and Sons Inc USA, 7th Edition, 2020

Reference Books

Beverly Thompson Kuhn, "Transportation Engineering: A Practical Approach to Highway Design, Traffic Analysis, and Systems Operation", McGraw Hill Education USA, 1st Edition, 2019

BRIAN WOLSHON and ANURAG PANDE, "Traffic Engineering Handbook", John Wiley and Sons Inc, 7th Edition, 2015

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study

Recommended by Board of Studies :	25-02-2026

Approved by Academic Council : No. 81	Date	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	2	2	-	2	3	-	-
CO3	3	2		-	-	-	-	2	2	-	-	3	-	-
CO4	3	-	2	-	-	-	-	2	2	-	2	3	-	2
CO5	3	2	2	-	-	-	-	2	2	-	2	3	-	-

BACLE408	GROUND IMPROVEMENT TECHNIQUES	L	T	P	C
		3	1	0	4
Pre-requisite	BACLE202-SOIL MECHANICS & FOUNDATION ENGINEERING	Syllabus Version			
		1			

Course Objectives

Understanding the engineering behaviour of various natural and man-made soil deposits

Understanding the concept of various ground improvement techniques

Selection of site-specific method of improvement and its design

Course Outcomes

Identify the engineering behavior of expansive soils, collapsible soils, organic soils, and lateritic soils.

Apply appropriate procedures to design stone columns and vertical drains for ground improvement under given soil and loading conditions.

Design suitable soil stabilization and dewatering technique based on soil parameters

Analyze the stability of RE walls and confinement systems using appropriate design codes and stability criteria.

Estimate the uplift/pullout capacity of ground anchors under different soil conditions for safe and efficient design

Module:1	INTRODUCTION	7 hours

Need for ground improvement techniques, classification of ground improvement techniques, clay minerology and Identification of problematic soils - expansive soils, collapsible soils, organic soils and laterite soils.

Module:2	DEEP DYNAMIC COMPACTION, PRELOADING WITH VERTICAL DRAINS	9 hours

Dynamics compaction - Basic concept - Suitability - Design considerations -Environmental Impact - Quality control & Assurance; Vibratory probes - Vibro-compaction - mechanism & design principles, stone columns - Load transfer mechanism - Design considerations. Preloading and surcharge fills - Principles - Preloading methods and construction requirements -Vertical drains - Types and construction of vertical drains - Design of vertical drains

Module:3	STABILIZATION, GROUTING TECHNIQUES AND DEWATERING TECHNIQUES	9 hours

Physical stabilization - stabilization using admixtures and industrial wastes - Grouting Techniques -grouting process - types of grouting - grouting materials - rheology of grouts Dewatering - applications - common dewatering methods - well point system - deep well system - vacuum dewatering wells- Design steps for dewatering systems - Electro-kinetic dewatering-electro-osmosis - flow potential - Electrophoresis - Theoretical concept and laboratory measurements of electro-osmosis		
Module:4	**SOIL REINFORCEMENT AND CONFINEMENT USING FORMWORKS**	**9 hours**
Concept of soil reinforcement - Geosynthetics-Functions- Types - Physical and Mechanical properties - Applications - Reinforced earth retaining walls Crip walls - External stability - Internal pressure - Construction aspects - Gabion walls - Design - Construction and maintenance aspects		
Module:5	**GROUND ANCHOR AND SOIL NAILING**	**9 hours**
Ground Anchors - Typical Applications, types and components - Estimation of uplift capacity of anchors - Anchored retaining walls - Rock bolts - Soil Nailing - Analysis of nailed soil - Special considerations for slope stabilization		
Module:6	**CONTEMPORARY ISSUES**	**2 hours**
	Total Lecture Hours	**45 hours**
	Tutorial Hours	**15 hours**

Text Book(s)

Huat B.B.K , "Ground Improvement Techniques ", CRC Press UK, 1st Edition, 2020

Jie Han , "Principles and Practice of Ground Improvement", Wiley India, 1st Edition, 2018

Reference Books

Hausmann, M.P. , "Engineering principles of ground modification", Mc GrawHill Education, 1st Edition, 2013

Peter G. Nicholson , "Soil Improvement and Ground Modification Methods", Butterworth Heinemann Inc, 1st Edition, 2014

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study

Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-26

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PS03
CO1	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	2	-	2	-	-	-	2	-	2	3	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	2	-	2	-	-	-	2	-	2	3	2	-
CO5	3	2	-	-	2	-	-	-	2	-	2	3	2	-

BACLE409	GEOTECHNICAL EARTHQUAKE ENGINEERING	L	T	P	C
		3	1	0	4
Pre-requisite	BACLE202-Soil Mechanics and Foundation Engineering	Syllabus Version			
		1			

Course Objectives

Inculcate the fundamentals of behaviour of soil under earthquake loading.

Evaluate seismic hazard and liquefaction potential of site.

Determine the dynamic properties of the soil.

Course Outcomes

1. Apply the principles of earthquake occurrence to classify regions into seismic zones based on their seismic risk.
2. Determine the seismic hazard of a given site by using suitable ground motion parameters.
3. Illustrate the behaviour of soil under dynamic loading conditions.
4. Analyse the liquefaction potential of a given site.
5. Apply suitable ground improvement technique to mitigate seismic hazard by incorporating the response of the site.

Module:1	Seismology and Earthquakes	8 hours

Seismology and Earthquakes- Effects of Earthquakes- Significant historical earthquakes- Internal structure of the earth-Seismic waves- Plate tectonics- Faults-Elastic rebound theory-Location and size of earthquakes-Nature and types of earthquake loading-Seismic zones of India.

Module:2	Strong Ground Motion and Seismic Hazard Analysis	9 hours

Ground motion measurement -Seismographs -Data acquisition Strong motion instrument arrays, Ground motion intensity measures - Factors affecting ground motion- Ground motion models Development of Attenuation relationships- Spatial Variability of ground motions. Seismic Hazard Analysis -Identification and characterization of earthquake sources - Deterministic Seismic Hazard Analysis (DSHA)- Probabilistic Seismic hazard analysis (PSHA) - Case study of seismic hazard analyses of cities in India -Ground motion selection and modification

Module:3	Dynamic Properties of Soil	10 hours

Stress - Strain Behaviour of soils -Dynamic soil properties- Factors affecting dynamic soil properties- Field tests: Standard Penetration test (SPT), Cone Penetration Test (CPT), Block vibration test, Cyclic Plate load test- Geophysical Tests- Multichannel Analysis of Surface Waves (MASW) test- Case study of seismic site characterization of Coimbatore using MASW test -

Seismic cross hole test, Shake table test. Lab tests: Cyclic triaxial test, simple shear test, bender element test, Resonant column test		
Module:4	**Liquefaction**	**8 hours**
Liquefaction - related phenomena, Flow liquefaction and cyclic mobility-Liquefaction Susceptibility historical, geological, compositional and state criteria, Initiation of Liquefaction- Evaluation of liquefaction potential- Cyclic stress approach-Characterization of earthquake loading-Characterization of liquefaction resistance from Standard Penetration Test (SPT) and Cone Penetration Test (CPT)- Correction factors, Simplified procedure as per IS1893- Case study of evaluation of liquefaction potential of Burj Khalifa tower, Dubai- Consequences of liquefaction		
Module:5	**Ground Response analysis and Soil Improvement**	**8 hours**
Evidence of site-effects, Prediction of site-effects, One dimensional ground response analysis - Linear analysis -undamped soil on rigid rock -damped soil on rigid rock -Equivalent linear approximation of nonlinear response- Site classifications- Effects of local soil conditions on ground motion- Evidence from measured amplification functions and surface motions-Effects of topography-Design parameters and their development. Soil improvement for mitigation of seismic hazards- Densification techniques, Reinforcement techniques- Grouting, Drainage techniques, Verification of soil improvement		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**
	Tutorial Hours	**15 hours**
Text Book(s)		
Kramer, S. L. and Stewart, J. P., "Geotechnical Earthquake Engineering", CRC Press Boca Raton, 2nd Edition, 2025. Towhata, I., "Geotechnical Earthquake Engineering", Springer Berlin, 1st Edition, 2008.		
Reference Books		
Springer, Berlin, "Geotechnical Earthquake Engineering Handbook", McGraw Hill USA, 1st Edition, 2002 Villaverde, R., "Fundamental Concepts of Earthquake Engineering", CRC Press Boca Raton, 1st Edition, 2009		

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study		
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CO-PO Mapping:

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CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	-	2	-	2	-	-	-	-	-	3	2	-
CO5	3	2	-	2	-	2	-	-	-	-	-	3	-	-

Ancillary Courses

BACLE410	AI IN CLIMATE-RESILIENT INFRASTRUCTURE	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	SyllabusVersion			
		1			

Course Objectives

To introduce the fundamentals of climate change impacts on civil infrastructure and the necessity of resilience-based design.

To provide a comprehensive understanding of AI and Machine Learning techniques applicable to structural health monitoring, and sustainable, resilient construction materials.

To integrate ethical considerations, management principles, and sustainability into the lifecycle of AI-driven infrastructure projects.

Course Outcomes

- Identify the fundamentals of climate science, IPCC scenarios, and non-stationarity to contextualize the 4Rs of resilience and traditional engineering safety factors.
- Apply machine learning techniques, feature engineering, and data fusion methods to and perform vulnerability assessments
- Analyze adaptive water resource systems using data-driven hydrologic models for urban drainage and reservoir operations.
- Apply IoT-BIM integration, and Digital Twin frameworks to implement real-time structural health monitoring and anomaly detection.
- Analyze life-cycle assessments, low-carbon materials discovery, and ethical implications including algorithmic bias and governance in AI-driven civil infrastructure management.

Module:1	Climate Change and Infrastructure Resilience	9 hours

Fundamentals of Climate Science for Engineers; RCP/SSP scenarios and IPCC projections; Climate non-stationarity and its impact on traditional engineering safety factors; Introduction to the 4Rs of Resilience (Robustness, Redundancy, Resourcefulness, Rapidity); Distinguishing weather vs. climate predictability; Resilience planning for extreme events.

Module:2	AI Foundations for Infrastructure Data	9 hours

Data acquisition from IoT, Remote sensing and GIS; Fusion of remote and model data with inference; Supervised and Unsupervised learning in Civil Engineering; Neural Networks for pattern recognition in structural damage; Feature engineering for structural data; Principles of classification (SVM, Random Forest) for vulnerability assessment.

Module:3	Adaptive Water Systems and AI Modeling	8 hours

Hydro-Informatics fundamentals and the shift to data-driven water management; Rainfall-runoff modeling using SVM and Random Forest to capture soil moisture and precipitation "memory€□. Machine learning for water resource demand forecasting under climate stress; Smart Urban Drainage Systems (SUDS) and Green Infrastructure integration; Reinforcement Learning for optimizing dam levels and reservoir gate operations.		
Module:4	**Digital Twins & Structural Integrity**	**8 hours**
Real-time Structural Health Monitoring (SHM) using Edge AI; Physics-Informed Neural Networks (PINNs) for structural mechanics; Building Digital Twins for disaster simulation and predictive maintenance; Integration of BIM with real-time IoT; Anomaly detection for transportation networks		
Module:5	**Materials Carbon and Ethics**	**9 hours**
AI for discovery of low-carbon, resilient construction materials; Life-cycle assessment (LCA) fundamentals, limitations, and Net Zero Carbon goals; Ethics in AI: addressing algorithmic bias in urban planning and risk allocation; Data privacy and accountability in automated decision-making; Management of AI-integrated civil projects.		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)

Naser, M.Z. , "Machine learning for civil and environmental engineers: a practical approach to data-driven analysis, explainability, and causality. ", John Wiley and Sons, 1st Edition, 2023

Committee on Adaptation to a Changing Climate. , "Climate-resilient infrastructure: Adaptive design and risk management. Reston", American Society of Civil Engineers , 1st Edition, 2018

Randall, D.A. , "An Introduction to Climate Models", Princeton University Press, 1st Edition, 2023

Reference Books

Plevris, V., Ahmad, A., and Lagaros, N.D. (Eds.). , "Artificial intelligence and machine learning techniques for civil engineering", IGI Global, 1st Edition, 2023

Goodfellow, I., Bengio, Y., and Courville, A. , "Deep Learning", MIT Press, 1st Edition, 2016

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study

Recommended by Board of Studies :		25-02-2026
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CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	3	2	-	-	2	2	-	-	2	-	2	3	2	-
CO3	3	2	-	-	2	-	-	-	2	-	2	3	2	-
CO4	3	2	-	-	2	-	-	-	2	-	2	3	2	-
CO5	2	2	-	-	2	2	-	-	2	-	2	3	2	-

BACLE411	UNMANNED AERIAL SYSTEMS IN TRANSPORTATION ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

To introduce the principles, components, operation, and regulations of Unmanned Aerial Systems (UAS) and their role in transportation engineering applications

To enable students to plan UAS missions and acquire, process, and analyze aerial data for transportation planning, traffic analysis, and infrastructure monitoring.

To familiarize the students with regulatory, ethical and safety principles in UAS deployment.

Course Outcomes

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

1. Apply the knowledge on configuration and operation of unmanned aerial systems to obtain data for transportation projects.
2. Plan UAS missions for transportation data acquisition and infrastructure assessment.
3. Process and analyse aerial data for traffic monitoring and transport system evaluation.
4. Apply UAS for transportation infrastructure monitoring and sustainable asset management.
5. Apply regulatory, ethical, safety, and sustainability aspects in UAS deployment.

Module:1	Fundamentals of Unmanned Aerial Systems and Transportation Applications	9 hours

Evolution and classification of UAV platforms; components of UAS: airframe, propulsion, sensors, flight controller, ground control systems; navigation systems (GPS/GNSS); payloads for transportation engineering; comparison with conventional surveying methods; applications in transportation planning, highway design, and infrastructure monitoring; case studies of UAS use in transportation projects.

Module:2	UAS Regulations Ethics Safety and Operations Management	7 hours

Airspace classification; drone regulations and operational requirements by Directorate General of Civil Aviation; permissions and compliance; operational risk assessment; safety procedures; professional ethics, privacy and data security; mission planning and flight planning; project and operations management in UAS deployment; legal and governance framework.

Module:3	**Data Acquisition Photogrammetry and Geospatial Processing**	**9 hours**
Aerial imaging principles; photogrammetry fundamentals; flight planning parameters; ground control points and georeferencing; orthophoto generation; digital elevation models; 3D mapping; GIS integration; data processing workflows; accuracy assessment; data management practices; Practice on handling and analysing data collected by UAS		
Module:4	**UAS Applications in Traffic Engineering and Transport System Management**	**11 hours**
Traffic data collection using UAS; traffic flow and speed estimation; intersection and corridor analysis; origin-destination estimation; pedestrian and non-motorized transport studies; public transport monitoring; transport system management strategies; smart mobility applications; Application of AI and computer vision for extracting data; Practice on data extraction		
Module:5	**Infrastructure Monitoring Sustainability and Emerging Applications**	**7 hours**
Highway alignment surveys; construction monitoring; pavement and bridge condition assessment; asset management; disaster response and emergency transportation planning; environmental monitoring; UAS for sustainable transportation systems; resilience of infrastructure; AI and computer vision applications; contemporary practices and national initiatives.		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)

Austin, R., " Unmanned Aircraft Systems: UAV Design, Development and Deployment,", Wiley, 1st Edition, 2010

Frazier, Amy and Singh, Kunwar, "Fundamentals of Capturing and Processing Drone Imagery and Data", CRC Press, 1st Edition, 2021

Baum, Michael Scott , "Unmanned Aircraft Systems Traffic Management UTM", AYLOR AND FRANCIS EXCLUSIVE, 1st Edition, 2021

Reference Books

Sharma, J.B. , "Applications of Small Unmanned Aircraft Systems: Best Practices and Case Studies", CRC Press, 1st Edition, 2023

International Organization for Standardization, "Relevant national and international standards for UAS data acquisition and photogrammetry", ISO, 1st Edition, 2019

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study

Recommended by Board of Studies :		25-02-2026
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	2	-	-	-	-	-	-	2	2	-
CO2	3	-	-	-	2	-	-	-	-	-	-	2	2	-
CO3	3	2	-	-	2	-	-	-	-	-	-	2	2	-
CO4	3	-	-	-	2	-	-	-	-	-	-	2	2	-
CO5	3	-	-	-	-	-	2	-	-	-	-	-	-	2

BACLE412	DIGITAL PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

Understand the fundamental principles of digital construction project management and scheduling
Familiarize with digital tools and techniques for construction planning, scheduling, and control
Develop knowledge of lean construction principles and tools

Course Outcomes

1. Demonstrate stakeholder roles and responsibilities, project scope management principles, and digital transformation concepts to construction project execution
2. Apply digital tools for construction planning and scheduling in practical scenarios
3. Identify lean construction opportunities and implement basic lean techniques
4. Analyze construction workflows to eliminate waste and improve value delivery
5. Integrate digital technologies with lean construction principles for enhanced project performance

Module:1	Fundamentals of Digital Construction Project Management	8 hours

Construction project management concepts; Project lifecycle in construction; Traditional vs. digital project management approaches; Roles and responsibilities of project stakeholders; Project scope definition and management; introduction to digital transformation in construction

Module:2	Digital Tools for Construction Planning and Scheduling	9 hours

Traditional scheduling methods (bar charts, CPM); Critical path method calculations and float analysis; Linear scheduling method; Digital scheduling concepts and workflows; Building Information Modelling for scheduling visualization; Introduction to scheduling software interfaces; Case studies of scheduling in real projects

Module:3	Resource Scheduling and Project Control	9 hours

Resource identification basics; Introduction to resource allocation; Basic resource levelling concepts; Project monitoring fundamentals; Introduction to progress tracking; Basic corrective actions for schedule deviations; Practical examples of resource scheduling in construction projects

Module:4	**Basic Lean Construction Fundamentals**	**8 hours**
Introduction: Principles of lean construction; Value stream mapping in construction processes; Waste identification and elimination; Basic lean concepts for construction industry; Value-based project delivery; Case studies of lean implementation in Indian construction projects		
Module:5	**Lean Tools and Simulation Applications**	**9 hours**
Last Planner System for workflow management; Lean construction simulation games; Pull planning techniques; 5S methodology for site organization; Visual management tools; Digital lean tools integration; Hands-on lean simulation exercises		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**
Text Book(s)		
Jha K.N, "Construction Project Management -Theory and Practice ", Pearson, 3rd Edition, 2025 Ballard, G., Howell, G. , "Lean Project Delivery", Lean Construction Institute USA, 1st Edition, 2021		
Reference Books		
Mubarak, S., "Construction Project Scheduling and Control", Wiley New Jersey USA, 4th Edition, 2019. Koskela, L. T, "Theory-Based Production Management: An Explanation and a Review", Lean Construction Institute Finland, 2nd Edition, 2023.		
Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study		
Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	2	-	-	3	-
CO2	3	-	-	-	-	-	-	-	2	2	-	-	3	-
CO3	3	-	-	-	-	-	-	-	2	2	-	-	3	-
CO4	3	-	-	-	-	-	-	-	2	2	-	-	3	-
CO5	3	-	-	-	-	-	-	-	2	2	-	-	3	-

BACLE413	SMART BUILDINGS AND ENERGY PERFORMANCE	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

Understand the basic principles and technologies of smart buildings and energy performance metrics

Familiarise with green building rating systems, particularly GRIHA, and their implementation in building design and operations

Develop knowledge of Building Management Systems and energy efficiency strategies for building operations

Course Outcomes

1.Apply the fundamental concepts and principles of smart, green and sustainable buildings.

2.Analyze the building energy performance and thermal comfort in relation to building design and operating conditions.

3.Apply building management principles and digital technologies for monitoring and controlling building systems.

4.Assess building performance using green building rating, energy auditing and resource management approaches.

5.Use emerging approaches and regulatory frameworks for energy-efficient, sustainable and net-zero buildings.

Module:1	Foundations of Smart and Green Buildings	7 hours

Introduction: Smart building definitions and performance metrics; Evolution of green building concepts with focus on Indian green movement including IGBC and GRIHA initiatives; Sustainable development principles for built environment; Climate-responsive design principles across diverse climate zones

Module:2	Energy Efficiency Principles	8 hours

Fundamentals of heat transfer in building envelopes; Thermal comfort metrics (PMV/PPD); Passive design strategies: orientation, shading, and natural ventilation; Energy-efficient HVAC systems and lighting principles

Module:3	Building Management Systems	9 hours

BMS architecture and components: sensors, controllers, and actuators; Communication protocols: BACnet, Modbus, and KNX; HVAC control systems and lighting management; Data acquisition, monitoring systems, and IoT applications		
Module:4	**Green Building Rating Systems**	**10 hours**
GRIHA framework: structure, criteria, and certification process; Comparative analysis of rating systems: LEED, BREEAM, and GRIHA; Energy audit methodologies (ASHRAE levels); Water conservation, rainwater harvesting, and sustainable material selection		
Module:5	**Implementation and Future Trends**	**9 hours**
Regulatory framework: Energy Conservation Act and policy frameworks; Net-zero energy building concepts; Emerging technologies: digital twins and AI in building management		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**
	Tutorial Hours	**15 hours**
Text Book(s)		
Savla, H., "Green Building: Principles & Practices", Notion Press, Chennai, India., 1st Edition, 2023 Howard, R. B, "Energy-Efficient Building Systems: A Practical Guide", McGraw-Hill, New York, USA., 1st Edition, 2013		
Reference Books		
Southgate, D., Kibert, C. J., & Fitch, J. M, "Green Building Handbook: Principles and Practice", CRC Press, Boca Raton, USA., 1st Edition, 2018 GRIHA Council, "GRIHA Handbook", GRIHA Council, New Delhi, India., 1st Edition, 2019 Bureau of Indian Standards, "IS 14543:2018 â€“ Guidelines for Rating of Integrated Habitat Assessment", BIS, New Delhi, India., 1st Edition, 2018		
Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study		
Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	3	-	-	-	-	1	-	-	3
CO2	3	3	-	-	-	3	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	2	-	-	-	-	2	-	3	-
CO4	3	3	-	-	-	3	-	-	2	2	2	-	-	3
CO5	3	2	-	-	-	3	-	-	2	2	2	-	-	3

BACLE414	STRUCTURAL HEALTH MONITORING	L	T	P	C
		3	0	2	4
Pre-requisite	BACLE203 - Structural Analysis	Syllabus version			
		1.0			

Course Objectives:

The objectives of this course are:

8. To understand the principles and implementation of Structural Health Monitoring (SHM) in civil structures.
9. To study monitoring techniques, sensor technologies, IoT systems and damage assessment strategies.
10. To integrate sustainability, lifecycle monitoring and modern digital tools including basic AI concepts in infrastructure management.

Course Outcomes:

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

1. Illustrate the necessity and framework of SHM for civil infrastructure.
2. Analyse SHM schemes including sensor selection, layout and monitoring strategies.
3. Assess structural condition using static and dynamic monitoring techniques.
4. Analyse case studies of SHM deployment in civil and marine structures
5. Implement sustainability practices and basic AI-supported monitoring processes for the long-term management and maintenance of infrastructure.

Learning Modules

Module 1	Introduction and Fundamentals of SHM	7 hours

Necessity of monitoring civil and marine structures. Challenges in real-time implementation. Factors influencing SHM schemes. Issues in concrete and steel structures. Economic and safety benefits of SHM (short-term and long-term perspectives).

Module 2	Monitoring Techniques and Damage Identification	8 hours

Static and vibration-based monitoring. Long-term, short-term and triggered monitoring. Dynamic monitoring concepts. Damage detection in linear systems. Mode shape analysis, mode shape curvature, crack detection and reliability of damage identification.

Module 3	Sensors, IoT and Wireless Monitoring Systems	8 hours

Embedded and ultrasonic sensors. Sensor technologies for civil and marine structures. Sensor layout design. Component-level monitoring. Wireless sensor networks (WSN). Data acquisition systems and IoT-based real-time monitoring.

Module 4	Non-Destructive Evaluation and Condition Assessment	8 hours

Visual inspection and condition assessment. NDT and NDE tools. Evaluation and correctness assessment. Integration of NDT with SHM schemes.

Module 5	Sustainability, Lifecycle Monitoring and Emerging Applications in SHM	12 hours

Lifecycle assessment (LCA) of civil infrastructure. Service life prediction and durability monitoring. Preventive and predictive maintenance strategies using SHM data. Carbon footprint reduction through condition-based maintenance. Climate resilience and sustainable asset management for bridges, buildings and marine structures.

Case studies: railway bridge monitoring (India), Shanghai Tower (China), vintage bridge monitoring (Russia), Burj Khalifa (Dubai), suspension bridge monitoring (Japan), heritage building monitoring (Siracusa, Italy).

Introduction to Artificial Intelligence in Structural Health Monitoring – general concepts of AI in infrastructure monitoring, anomaly detection overview, digital twins and data-driven monitoring approaches (overview level only).

Module 6	**Contemporary Issues**	**2 hours**
Total Lecture hours		**45 hours**

Textbooks

1.	H.-P. Chen and Y.-Q. Ni, Structural Health Monitoring of Large Civil Engineering Structures, John Wiley & Sons Ltd., 2018.
2.	G. Song, C. Wang and B. Wang (Eds.), Structural Health Monitoring (SHM) of Civil Structures, CRC Press, 2018.
3.	C. R. Farrar and K. Worden, Structural Health Monitoring: A Machine Learning Perspective, John Wiley & Sons Ltd., 2012.

Reference Books

1.	A. De Stefano and G. M. Sabia (Eds.), Damage Detection and Structural Health Monitoring of Concrete and Masonry Structures: Novel Techniques and Applications, Springer, 2025.
2.	D. Balageas, C.-P. Fritzen and A. Güemes, Structural Health Monitoring, ISTE Ltd. / John Wiley & Sons, 2010.
3.	V. M. Karbhari and F. Ansari (Eds.), Structural Health Monitoring of Civil Infrastructure Systems, Woodhead Publishing Ltd., 2009.

List of Experiments:

1.	Visual Inspection and Condition Assessment of Structures	2 hours
2.	Vibration Monitoring of a simply supported steel beam	2 hours
3.	Determine the crack width analysis of simply supported beam	3 hours
4.	Determine the crack width analysis of cantilever beam	3 hours
5.	Strain Measurement of a simply supported steel beam using strain gauges	3 hours
6.	Crack Detection in Concrete using Ultrasonic Pulse Velocity (UPV)	3 hours
7.	Non-Destructive Testing of simply supported concrete beam using Rebound Hammer	2 hours
8.	IoT-Based Real-Time Structural Monitoring of a structure	4 hours
9.	Developing and Training a Convolutional Neural Network (CNN) for Image-Based Crack Detection of simply supported beam	4 hours
10.	Implementation of Linear Regression and Validation Techniques for Damage Prediction of	4 hours
	Total Laboratory Hours	**30 Hours**

Mode of Evaluation: Continuous Assessment Test, Quiz / Case studies / Project, Final Assessment Test, Lab Continuous Assessment, Lab Final Assessment		
Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-		-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	2	-	-	-	-	-	-	2	3	-	2
CO3	3	2	-	2	-	-	-	-	-	-	2	3	-	2
CO4	3	2	-	2	-	-	-	-	-	-	2	3	-	2
CO5	3	2	-	2	3	3	-	-	-	3	2	3	2	-

BACLE415	DIGITAL TWINS IN BUILT ENVIRONMENT	L	T	P	C
		3	1	0	4
Pre-requisite	NIL	Syllabus Version			
		1			

Course Objectives

To provide comprehensive understanding of the digital twin system by knowing the difference between BIM, Digital Model and Digital Shadow and digital twin.
To develop the ability to integrate IoT, sensors and data streams with infrastructure models.
To apply the digital twin concept for lifecycle management and predictive maintenance.

Course Outcomes

1.Demonstrate the applications of Digital Model, Digital Shadow, and Digital Twin in the context of civil infrastructure.
2.Identify the enabling technologies required to develop Digital Twins for built environment assets.
3.Select a conceptual Digital Twin architecture for a selected civil infrastructure asset, integrating physical components, virtual models, and real-time data flow.
4.Apply Digital Twins in lifecycle management, predictive maintenance, sustainability monitoring, and ESG compliance of infrastructure systems.
5.Analyse the practical implementation of a Digital Twin framework for a building, bridge, road, or water supply system.

Module:1	Foundations of Digital Twin in Civil Engineering	8 hours

Evolution of Digital Engineering - Core Digital Twin Concepts - Digital Model vs Digital Shadow vs Digital Twin - Levels of digital twin maturity - Types of Digital Twins - BIM vs Digital Twin

Module:2	Enabling Technologies for Civil Digital Twins	9 hours

Twin System Architecture - IoT & Sensor Systems in Civil Infrastructure: Structural health monitoring (strain, vibration), Environmental sensors, Traffic monitoring systems - Data acquisition systems - Cloud & edge computing basics - BIM-IoT integration - Data standards (IFC, openBIM concepts)

Module:3	Digital Twin Modelling & Integration	9 hours

Converting BIM model to a Digital Twin framework - Data integration workflows - Hybrid twin modelling - API concepts - Data storage & database basics - Interoperability challenges - Twin visualization platforms - Simulation in Civil Infrastructure - Predictive Analytics - Validation & Calibration

Module:4	Digital Twin Applications in the Built Environment	9 hours

Digital Twin for: Buildings, Bridges, Highways, Water supply systems, Smart cities - Predictive maintenance using digital twins - Lifecycle asset management - GIS + Digital Twin integration - Sustainability monitoring		
Module:5	**Governance, Standards & Future Systems**	**8 hours**
Implementation roadmap - Data governance & interoperability - Open standards - Ethics & cybersecurity - ESG integration - Smart cities & Industry 5.0 - Future research directions		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**
	Tutorial Hours	**15 hours**
Text Book(s)		
PÃrn, E. A., Brilakis, I., Sacks, R., Soibelman, L., & Enzer, M., "Twin Systems: Digital Twins of the Built Environment", Springer, Cham, Switzerland., 1st Edition, 2025		
Reference Books		
Lu, Q., "Digital Twins in the Built Environment: Fundamentals, Principles and Applications", Elsevier, Oxford, UK., 1st Edition, 2024 Sepasgozar, S., & Shirowzhan, S, "Digital Twin Adoption and BIM-GIS Implementation", Springer, Singapore., 1st Edition, 2024		
Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study		
Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	3	-	-	-	-	-	-	-	2	2	-	-	3	-
CO3	3	-	-	-	-	-	-	-	2	2	-	-	3	-
CO4	3	2	-	-	-	-	-	-	2	2	-	-	3	-
CO5	3	2	-	-	-	-	-	-	2	2	-	-	3	-

Minor in Environment and Sustainable Infrastructure

BACLE304	INTRODUCTION TO CIVIL ENGINEERING AND BUILT ENVIRONMENT	L	T	P	C
		3	0	0	3
Pre-requisite	BAEEE101-Basic Engineering	Syllabus Version			
		1			

Course Objectives

1.Introduce students to the scope, roles, and ethical responsibilities of civil engineers in society.

2.Provide fundamental knowledge of civil engineering materials and their applications in construction

3.Familiarize students with basic building components, major infrastructure systems and develop understanding of sustainable built environments

Course Outcomes

1.Identify the role of civil engineers in society and the significance of ancient and modern civil engineering marvels across various domains of civil engineering.

2.Differentiate the properties, applications of civil engineering materials including conventional and advanced construction materials.

3.Apply fundamental concepts of building components such as foundations, masonry, structural elements, and relevant building codes in planning and basic building layout

4.Compare the components and functions of major infrastructure systems including bridges, dams, transportation systems, water supply, waste management, and green buildings.

5.Implement the principles of sustainability, energy efficiency, and environmental management in understanding built environments, smart buildings, and conservation practices

Module: 1	OVERVIEW OF CIVIL ENGINEERING	7 hours

Role of civil engineers in society, Ethics in Civil Engineering Practice, The ancient and modern Marvels and Wonders in the field of Civil Engineering. Overview of Structural, Construction, Geotechnical, Environmental, Transportation, Water Resources, Environmental Engineering, Geology and seismology.

Module: 2	CIVIL ENGINEERING MATERIALS	9 hours

Bricks - Stones - Sand - Cement - Concrete - Steel - Timber, Glass - Modern Materials, Thermal and Acoustic Insulating Materials, Decorative Panels, Water Proofing Materials. use of Gypsum.

Module: 3	BUILDING COMPONENTS	9 hours

Building plans - Setting out of a Building - Foundations: Types of foundations - Bearing capacity and settlement - Brick masonry - Stone Masonry - Beams - Columns - Lintels - Roofing - Flooring - Plastering - Prefabricated Building components.		
Module: 4	**INFRASTRUCTURE**	**9 hours**
Types of Bridges and Dams- Water Supply Network - Rainwater Harvesting - Solid Waste Management Systems - Introduction to Highways and Railways Airport, Seasports, River ways, sea canals, Tunnels - Introduction to Green Buildings.		
Module: 5	**BUILT ENVIRONMENT**	**9 hours**
Facilities management, Climate control, energy efficient built environments and LEED ratings, Recycling, Temperatures / Sound control in built environment, Security systems, intelligent / Smart building, Aesthetics of Built environemnt, Role of urban arts commissions, conservation, repairs & Rehabiitation of structures & heritage structures, Innovation and methodologies for ensuring Sustainability		
Module: 6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)

1. Gido, J., & Clements, J., "Construction: Principles, Materials, and Methods ", Cengage Learning, 8th Edition, 2015
2. S. S. Bhavikatti & A K Roopa, " Introduction to Civil Engineering", New Age International Private Limited, 1st Edition, 2021

Reference Books

3. Peurifoy, R. L., Schexnayder, C. J., & Shapira, A., " Construction Materials, Methods and Techniques: Building for a Sustainable Future", Pearson, 9th Edition, 2010.
4. Charles J. Kibert, "Sustainable Construction: Green building and Delivery", Edition Wiley Publications, 5th Edition, 2022.
5. Chudley, R., & Greeno, R, "Building Construction Handbook", Routledge, 10th Edition, 2016.

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study

Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	3	-	-

BACLE305	WATER AND ENVIRONMENTAL SYSTEM	L	T	P	C
		3	0	0	3
Pre-requisite	BACHY101-Environmental Sciences	Syllabus Version			
		1			

Course Objectives

1. To introduce the principles of water resources, water treatment, wastewater management, and environmental protection systems
2. To develop analytical and problem-solving skills for designing and managing water and environmental systems.
3. To create awareness of sustainable practices, environmental regulations, and integrated water resource management

Course Outcomes

1. Illustrate hydrological process for management of water resources systems
2. Characterize water quality parameters for suitable water treatment process
3. Identify water demand and source of water to select water distribution system
4. Analyse wastewater parameters and to choose treatment process
5. Apply sustainability principles and environmental regulations in environmental management.

Module: 1	Water Resources and Hydrological Cycle	7 hours

Hydrological cycle and water balance - Precipitation, runoff, infiltration, evapotranspiration - Surface and groundwater resources - Watershed management - Climate change impact on variability on water resources

Module: 2	Water Quality and Water treatment Systems	8 hours

Physical, chemical, biological parameters of water - Drinking water quality standards (BIS, WHO) - Water treatment process, screening, sedimentation, coagulations, filtration, disinfection - Water distribution systems - Water sampling and analysis- Emerging contaminants.

Module: 3	Water Supply Engineering	10 hours

Estimation of water demand - Sources of water supply, Surface sources, groundwater - Quality of water, Physical, chemical and bacteriological parameters, BIS standards - Conveyance and Distribution, Intake structures, pipelines and storage reservoirs, distribution network layouts - Leak detection

Module: 4	Waste Water Engineering and Environmental Pollution	10 hours

Waste water characteristics - Primary, secondary and tertiary treatment - Activated sludge process - Sludge treatment and disposal - Municipal solid waste management techniques.		
Module: 5	**Environmental pollution control and management**	**8 hours**
Air pollution sources. Classification and control methods - Concept of noise pollution and control methods, Environmental Impact Assessment (EIA) - Environmental legislation (Water Act 1974, Air Act 1981, EPA 1986) - Environmental auditing - Sustainable development and circular economy		
Module: 6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)

1. Warren Viessman Jr., Mark J. Hammer, Elizabeth M. Perez & Paul A. Chadik , "Water Supply and Pollution Control", Pearson , 8th Edition, 2025
2. Peavy, H., Rowe, D., Tchobanoglous, G.(2027), " Environmental Engineering", McGraw Hill Education, 1st Edition, 2017
3. Hussain, S.K., " Water Supply and Sanitary Engineering ,", CBS Publishers and Distributors Pvt. Ltd., 3rd Edition, 2018

Reference Books

1. Metcalf and Eddy, Inc., Tchobanoglous, G., Burton , "Wastewater Engineering, Treatment and reuse", McGraw Hill Education, 5th Edition, 2012
2. Nelson L. Nemerow, Franklin J. Agardy, Joseph A. Salvato , "Environmental Engineering: Water, Wastewater, Soil and Groundwater Treatment and Remediation, ", John Wiley and Sons , 1st Edition, 2009
3. Hussain, S.K., " Water Supply and Sanitary Engineering ", CBS Publishers and Distributors Pvt. Ltd., 3rd Edition, 2017

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study

Recommended by Board of Studies :	25-02-2026	
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CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	3	-	-

BACLE306	TRANSPORTATION SYSTEMS AND URBAN MOBILITY	L	T	P	C
		3	0	0	3
Pre-requisite	BAEEE101-Basic Engineering	Syllabus Version			
		1			

Course Objectives

1. Understand the different transportation systems, its importance in urban mobility and use of various advanced tools for smart urban mobility
2. Apply the 4-stage transportation system planning process (Trip Generation, Distribution, Modal Split, Traffic Assignment) using the travel data collected through various survey techniques.
3. Evaluate various economic evaluation techniques in transportation projects and assess the public transportation systems (BRT, Metro) and NMT facilities

Course Outcomes

1. Identify urban transportation problems and propose solutions based on transportation system concepts.
2. Apply appropriate survey techniques for transportation data collection.
3. Perform travel demand forecasting and economic evaluation of transportation projects.
4. Apply planning principles to public transit and non-motorized transport systems.
5. Apply emerging mobility concepts to solve urban transportation problems.

Module: 1	Introduction to Transportation systems and Urban Mobility	8 hours

History of transport - relationship between land use and transportation - transportation modes and characteristics - walking, cycling, transit (bus/rail), and private vehicles - transportation problems (congestion, safety, emissions, etc.) - role of transport in urban development - urban mobility challenges and solutions

Module: 2	Transportation Data collection and Survey Techniques	10 hours

Transportation survey - definition of study area and traffic zones - External cordon line - Sample size - Home interview survey and cordon line surveys - inventory of existing transport facilities, land use and economic activities

Module: 3	Transportation Systems Planning and Economics	12 hours

Systems approach to transportation planning - Trip Generation - Factors governing trip generation - multiple regression analysis - category analysis - Trip Distribution - Growth factor methods - Gravity model - opportunities model - Modal Split Analysis - Factors influencing mode choice - Modal split models - Traffic Assignment - Shortest path algorithm - Assignment techniques - Long term vs short term solutions - Economic evaluation techniques - Benefit cost ratio, NPV method, IRR method

Module: 4	**Public Transit and Non-Motorized Transport NMT**	**8 hours**

Introduction to public transportation systems - planning and scheduling - Measuring performance of transit systems - Intermediate Public Transportation - Transit Oriented Development (TOD) - NMT planning (pedestrian and cycling infrastructure) - Level of Service (LOS) for NMT - street design - pedestrian flow characteristics.

Module: 5	**Sustainable Urban Mobility and Future Trends**	**5 hours**

Sustainable Urban Mobility Planning (SUMPs) - Smart Mobility - Intelligent Transportation Systems (ITS) - Autonomous vehicles - Mobility-as-a-Service (MaaS) - shared mobility and electric mobility - Data Analytics - Using IoT, sensors and apps for smart mobility

Module: 6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)

1. C. S. Papacostas, P.D. Prevedouros, "Transportation Engineering and Planning", Pearson Education , 3rd Edition, 2020

Reference Books

1. Pradip Kumar Sarkar, Vinay Maitri, G. J. Joshi, "Transportation Planning: Principles, Practices and Policies ", PHI Learning Private limited, 3rd Edition, 2022.
2. Al-Khateeb, Ghazi G, "Highway Planning Survey and Design", CRC Press, 1st Edition, 2021.

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study

Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	2	1	-
CO4	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	2	-	-

BACLE307	ENVIRONMENTAL SUSTAINABILITY AND SMART CITIES	L	T	P	C
		3	0	0	3
Pre-requisite	BACHY101-Environmental Sciences	Syllabus Version			
		1			

Course Objectives

1. To understand the smart city concepts for sustainable development.
2. To develop the digital transformation technologies in the urban infrastructures for sustainable living.
3. To analyse the social, economic and environmental governance towards sustainable development goals.

Course Outcomes

1. Identify the components and characteristics of smart cities for sustainable development.
2. Make use of advanced technologies for digital transformation in smart cities
3. Apply the smart processes on urban infrastructure and energy systems.
4. Analyse environmental, social and economic framework towards sustainable development.
5. Apply governing principles, polices and sustainable development goals for smart cities.

Module: 1	The Smart City Paradigm	9 hours

Smart Cities Evolution, Features and Components of smart cities, Characteristics of Smart Cities, Paradigm Shift in Process Logic, Leveraging recent technologies in enhancing urban living, Challenges faced in developing smart cities, Concepts of sustainable development and cities. Case studies for smart Cities: National and International.

Module: 2	Digital Transformation for Smart Cities	9 hours

Convergence of Digital Twin, Internet of Things (IoT), Block chain and Machine learning in Smart Cities, Digital Fusion of Big Data, Cloud Computing, Edge Computing, and Cyber Physical systems applied in Cities, Security in Digital Twin-, Robotics and autonomous systems, Quantum Computing technologies for smart cities.

Module: 3	Smart Urban Infrastructure and Energy Systems	9 hours

Smart Infrastructure: Smart grids, intelligent transportation systems (ITS), and smart buildings, Smart Water Management: IoT- based Leak detection systems, smart metering, water quality monitoring, water conservation and sustainable urban drainage systems (SUDS).Smart Waste Management: Sensor-based bins, optimized collection routes, waste-to-energy (WtE) technologies, and Closed loop processes in cities, Smart Mobility: Electric vehicles (EVs) and charging infrastructure, Mobility-as-a-Service (MaaS) platforms, integrated public transport, and promoting non-motorized transport. Smart

Health Care systems: To provide real-time patient monitoring, telemedicine, and data-driven public health intelligence. Remote Patient Monitoring (RPM), Smart Energy & Climate Action: Renewable energy integration, Smart microgrids & energy management systems, energy efficiency in buildings, and urban climate adaptation planning

Module: 4	Environmental Sustainability and Urbanization	9 hours

Three pillars of Sustainability for smart cities - Environment, Economic and Social Sustainability, Ecological indicators of smart urban metabolism, carbon foot print reduction strategies in smart cities, Green spaces in smart city development, improving air quality, water conservation, and community engagement, Integration of nature-based solutions, Urban rejuvenation, Challenges Delivering Environmental Value for Sustainable Urbanization, Stimulation of urban economies and Green growth, Life cycle Assessment (LCA) and Circular Economy approach towards Urban Systems,

Module: 5	Governance Policy and Sustainable Development Goals for Smart Cities	7 hours

Smart governance and its components, Smart governance model, Smart citizens, Smart Economy, e-governance systems, Challenges of smart governance, Smart policing, Policy Frameworks for Sustainable Smart Cities, Eco-innovations-environmental and digital policies, Policy and regulations challenges, Stakeholder Engagement, Public-private partnership ventures, and Sustainable Development Goals (SDGs) for Smart Cities- SDGs 7, 9, 11 and 16. Ethics in Focus: Discussion on data privacy, surveillance capitalism, and the ethical use of citizen data

Module: 6	Contemporary Issues	2 hours
	Total Lecture Hours	**45 hours**

Text Book(s)

1. Carlo Ratti & Matthew Claudel, "The City of Tomorrow: Sensors, Networks, Hackers, and the Future of Urban Life", Yale University Press, 1st Edition, 2016.
2. Marcin Paprzycki, Mohamad Essaaidi, Shahram Rahimi, Pradeep Kumar Singh. , "Sustainable Smart Cities Theoretical Foundations and Practical Considerations", Springer, 1st Edition, 2022.
3. Amit Kumar Tyagi, "Digital Twin and Blockchain for Smart Cities ", Wiley , 1st Edition, 2024.

Reference Books

1. Sushil Kumar Singh, "Building Tomorrow's Smart Cities With 6G Infrastructure Technology,", IGI Global Scientific Publishing, 1st Edition, 2024.
2. Editors: Khaleel Ahmad et al. Publisher, "Fostering Machine Learning and IoT for Blockchain Technology Smart Cities Applications", Springer, 2nd Edition, 2025.

3. Elsa Estevez, Hans Jochen Scholl, Theresa A. Pardo , "Smart Cities and Smart Governance Towards the 22nd Century Sustainable City", Springer International Publishing , 1st Edition, 2021
Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study

Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	3	-	-

BACLE403	INFRASTRUCTURE MANAGEMENT AND DISASTER RESILIENCE	L	T	P	C
		3	0	0	3
Pre-requisite	BAEEE101-Basic Engineering	Syllabus Version			
		1			

Course Objectives

1. Provide adequate knowledge about various infrastructure sectors and challenges faced in managing infrastructure projects
2. Obtain the knowledge for understanding various Strategies for successful management of projects
3. Provide adequate knowledge about applications of space technology in effective infrastructure management and disaster resilience.

Course Outcomes

1. Demonstrate the characteristics of different infrastructure sectors and the stages of their project lifecycle
2. Identify the real-world challenges in Infrastructure planning activity scheduling and management
3. Illustrate the strategies for successful Infrastructure Project implementation
4. Implement sustainable and resilient approach towards disaster resilient infrastructure
5. Implement risk assessment, resource allocation, and GIS-based geospatial techniques for effective infrastructure project planning and feasibility analysis

Module: 1	Overview of Infrastructure Sectors and Management	9 hours

Infrastructures-India's Power Sector-India's Water Supply and Sanitation Sector- India's Road, Rail, Air, and Port Transportation Sectors-India's Telecommunications Sector- Urban & Rural Infrastructure, Introduction to Special Economic Zones, Infrastructure Organizations and Layers, Stages of an Infrastructure Project Lifecycle, Overview of Infrastructure Project Finance.

Module: 2	Challenges in Infrastructural Planning and Management	8 hours

Major infrastructure project planning and evaluation, socio-economic analysis, Good governance for infrastructure planning activity scheduling and management, legal and contractual issues in infrastructure, Difficulties in infrastructure construction and maintenance.

Module: 3	Strategies for Successful Infrastructure Project Management	9 hours

Framework for Infrastructure Projects Risk Management, Planning Phase of Infrastructure Projects to mitigate risks, Governments' role in Infrastructure Implementation and Management, Data-centered infrastructure management framework, Designing Sustainable Contracts, Fair Process and Negotiation, Negotiating with multiple Stakeholders on Infrastructure Projects.		
Module: 4	**Sustainability and Technology Towards Disaster Resilient Infrastructure**	**9 hours**
Definition and need of disaster resilience, Disaster management cycle, post-disaster phase-Recovery, Post-disaster rehabilitation; structural auditing and building regulations, Funding mechanism in effective recovery, Environmental Impact Assessment, and Smart Materials/Technologies, Structural and Non-structural Methods for building resilient Infrastructure,		
Module: 5	**Role of Emerging Technologies in infrastructure project management**	**8 hours**
Predictive models to optimize project delays-risk assessment and resource allocation, Overview of Geospatial tools, Application of Geographic Information Systems (GIS)- Project Planning and Feasibility Analysis-Environmental impact assessments and Risk management.		
Module: 6	**Contemporary Issues**	**2 hours**
Total Lecture Hours		**45 hours**

Text Book(s)

1. S. A. Goodman and M. Hastak, "**Infrastructure planning handbook: Planning, engineering, and economics, New York**", McGraw Hill, 1st Edition, **2006.**
2. J. Parkin and D. Sharma, "Infrastructure **planning,**" Thomas Telford, 1st Edition, **1995.**

Reference Books

1. Hudson, Haas, Uddin , " **Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation**", McGraw Hill, 1st Edition, **1997.**

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study

Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-2026

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	2	-	-	3	-
CO2	3	-	-	-	-	-	-	-	2	2	-	-	3	-
CO3	3	-	-	-	-	-	-	-	2	2	-	-	3	-
CO4	3	-	-	-	-	-	-	-	2	2	-	-	3	-
CO5	3	-	-	-	-	-	-	-	2	2	-	-	3	-

BACLE404	CLIMATE CHANGE AND URBAN RESILIENCE	L	T	P	C
		3	0	0	3
Pre-requisite	BAEEE101-Basic Engineering	Syllabus Version			
		1			

Course Objectives

1. To understand the fundamental science of climate change and its specific impacts on urban environments and infrastructure systems.
2. To evaluate strategies for urban adaptation and mitigation that enhance community resilience and sustainability.
3. To integrate ethical considerations, policy frameworks, and management principles into the design of resilient urban solutions.

Course Outcomes

1. Analyze the drivers of climate change and their localized impacts on urban micro-climates and public health.
2. Select sustainable engineering solutions for urban drainage and heat island mitigation considering net-zero carbon goals.
3. Identify the role of ethics, social equity, and international laws in climate-resilient urban planning.
4. Apply project management and economic decision-making principles to implement large-scale urban adaptation projects.
5. Analyze case studies on global urban resilience initiatives to derive data-driven conclusions for future challenges.

Module:1	Fundamentals of Climate Change & Urbanization	8 hours

Introduction to the science of Greenhouse Gas (GHG) effects; Analysis of global warming trends and IPCC scenarios - The Urban Heat Island (UHI) effect: physical causes, atmospheric consequences, and localized impacts on energy demand - Interaction between urbanization patterns, land-use change, and local climate shifts - Introduction to Sustainability indicators for modern cities: carbon foot printing and ecological resilience.

Module:2	Urban Vulnerability & Risk Assessment	9 hours

Identification of climate-induced hazards: sea-level rise, coastal flooding, extreme precipitation, and heatwaves - Techniques for vulnerability mapping of critical urban infrastructure - Ethics in risk distribution: analysing the Social Vulnerability Index and protecting marginalized communities - Frameworks for assessing the economic and environmental impact of climate disasters.

Module:3	Mitigation & Adaptation Strategies	9 hours
Implementation of Nature-based solutions (NbS) and Green-Blue Infrastructure - Water sensitive urban design (WSUD) for flood management and groundwater recharge - Strategies for achieving net-zero carbon buildings and sustainable transit-oriented development - Engineering solutions for urban heat mitigation: cool roofs, urban forestry, and permeable pavements.		
Module:4	**Governance, Policy & Ethics**	**8 hours**
International frameworks: The Paris Agreement, Sendai Framework, and UN Sustainable Development Goals (SDGs)- National and local Urban Climate Action Plans (CAPs) and legislative frameworks - Ethics in resource allocation: Climate Justice and the role of the engineer in upholding social equity - Legal frameworks governing urban development and disaster response.		
Module:5	**Project Management for Resilience**	**8 hours**
Management of large-scale urban resilience projects: procurement, stakeholder engagement, and multidisciplinary coordination. Economic decision-making: Cost-Benefit Analysis (CBA) of adaptation vs. inaction. Financing resilience: Introduction to Green Bonds, carbon credits, and international climate funds. Whole-life cost analysis and management of resilient infrastructure assets.		
Module:6	**Contemporary Issues**	**2 hours**
Role of emerging technologies: AI, IoT, and Digital Twins in real-time climate monitoring and disaster early warning systems - Case Studies of global resilience success: The Sponge City"concept in China, Rotterdam's water plazas, and flood management initiatives in Indian Smart Cities.		
	Total Lecture Hours	**44 hours**

Text Book(s)

1. Lamb, Z., & Vale, L., "The Equitably Resilient City: Solidarities and Struggles in the Face of Climate Crisis", MIT Press, 1st Edition, 2025.
2. Rosenzweig, C., Solecki, W., Romero-Lankao, P., Mehrotra, S., Dhakal, S., & Ibrahim, S. A., "Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network", Cambridge University Press, 1st Edition, 2018.
3. Register, R., "Ecocity Berkeley: Building Cities for a Healthy Future", North Atlantic Books, 1st Edition, 2006.

Reference Books

1. Van der Berg, A., & Verschuuren, J., "Urban Climate Resilience: The Role of Law", Edward Elgar Publishing, 1st Edition, 2022
2. Pelling, M., "Adaptation to Climate Change: From Resilience to Transformation", Routledge, 1st Edition, 2010
3. Newman, P., & Matan, A., "Green Urbanism in Asia", World Scientific Publishing, 1st Edition, 2018
4. Intergovernmental Panel on Climate Change (IPCC), "Sixth Assessment Report (AR6) â€“ Working Group II: Impacts, Adaptation, and Vulnerability", IPCC (Intergovernmental Panel on Climate Change), 1st Edition, 2022

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study

Recommended by Board of Studies :	25-02-2026	
Approved by Academic Council : No. 81	**Date**	12-03-26

CO-PO Mapping:

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CO2	3	2	-	-	-	2	-	-	-	-	2	2	-	2
CO3	3	-	-	-	-	2	-	-	-	-	2	2	-	-
CO4	3	-	-	-	-	2	-	-	-	-	2	2	-	2
CO5	3	2	-	-	-	2	-	-	-	-	-	2	-	-

BACLE405	GEO-INFORMATICS AND REMOTE SENSING APPLICATIONS	L	T	P	C
		3	0	0	3
Pre-requisite	BAEEE101-Basic Engineering	Syllabus Version			
		1			

Course Objectives

1. Understand the principles, components, and technologies of Geo-Informatics, Remote Sensing, GNSS, and GIS for civil engineering applications
2. Utilize geospatial tools and analytical techniques to address real-world problems in infrastructure planning, environmental management, and sustainable development
3. Apply geospatial datasets through case studies incorporating ethics, sustainability, and project management perspectives.

Course Outcomes

1. Apply the principles of remote sensing and geospatial data acquisition to identify suitable sensors for specific engineering needs
2. Perform georeferencing and spatial data modelling using GIS tools to interpret complex datasets
3. Implement image processing and spatial analysis techniques to solve problems in urban and water resource management
4. Analyse geospatial datasets to assess environmental impact and disaster risk
5. Identify geospatial project workflows incorporating ethical standards and project management principles

Module:1	Fundamentals of Geo Informatics and Remote Sensing	7 hours

Introduction to Geo-Informatics: Components and scope - Electromagnetic spectrum and radiation principles - Platforms and sensors (optical, thermal, microwave) - Satellite systems (Indian and global missions) - Image characteristics: Spatial, spectral, temporal, radiometric resolution - Data acquisition and preprocessing.

Module:2	GIS Principles and Spatial Data Management	9 hours

GIS components and architecture - Spatial data models: Vector and Raster - Georeferencing and coordinate systems - Database management systems (DBMS) in GIS Spatial data ethics, standards, and data security - Open-source and commercial GIS platforms.

Module:3	Image Processing and Spatial Analysis	9 hours

Image enhancement and classification techniques - Supervised and unsupervised classification - Digital Elevation Models (DEM) - Overlay analysis, buffering, network analysis - Accuracy

assessment and validation - Introduction to AI and machine learning in geospatial analytics - AI-based land cover classification		
Module:4	**Applications in Civil Engineering and Sustainability**	**9 hours**
Urban and regional planning - Water resources and watershed management - Transportation and highway alignment - Environmental Impact Assessment (EIA) - Climate change - Integration with BIM and Smart Cities		
Module:5	**Disaster Management Ethics and Project Management**	**9 hours**
Disaster monitoring (flood, drought, landslide, earthquake) - Early warning systems and risk mapping - Ethical issues in geospatial data usage - Policy framework and legal aspects - Project management in geospatial projects - Emerging trends: UAV, LiDAR, Cloud GIS, Web GIS.		
Module:6	**Contemporary Issues**	**2 hours**
	Total Lecture Hours	**45 hours**

Text Book(s)

1. Lillesand T. M, Kiefer R. W. & Chipman, J.W, , "Remote Sensing and Image Interpretation", John Wiley and Sons USA, 7th Edition, 2012.
2. Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind, "Geographic Information Science and Systems", John Wiley and Sons, 4th Edition, 2012.

Reference Books

1. Jensen, J.R., " Introductory Digital Image Processing: A Remote Sensing Perspective," Pearson, 4th Edition, 2015.
2. Chang, Kang-Tsung", Introduction to Geographic Information Systems", McGraw Hill, 9th Edition, 2023.
3. Peter A. Burrough, Rachael McDonnell, Rachael A. McDonnell, Christopher D. Lloyd, "Principles of Geographic Information Systems", Oxford University Press, 1st Edition, 2015.

Mode of Evaluation: Continuous Assessment Test, Quiz, Final Assessment Test, Course Project, Case Study

Recommended by Board of Studies :	25-02-2026	
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CO2	3	2	-	-	2	-	-	2	2	-	-	3	2	-
CO3	3	2	-	-	2	-	-	2	2	-	-	3	2	-
CO4	3	2	-	-	2	-	-	2	2	-	-	3	2	-
CO5	3	-	-	-	-	-	2	-	-	2	-	3	-	-