Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Code: CE (BS) 301

Course Type: Theory

Course Designation: Compulsory

Program Specific Outcome (PSO):

	PSO1	PSO2	PSO3	PSO4
CO1	**L**	**M**	**L**	**L**
CO2	**L**	**M**	**L**	**L**
CO3	**L**	M	**L**	**L**
CO4	**L**	**M**	**L**	**L**
CO5	**L**	**M**	**L**	**L**
CO6	**L**	**M**	**L**	**L**

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
BSC CE301.1	Describe how biological observations of 18th Century that lead to major discoveries.	Define, Understand, Explain, Describe, Discuss	Understand (L1)
BSC CE301.2	Find that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological.	Apply, calculate, estimate, find, solve, examine	Apply (L2)
BSC CE301.3	Classify the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring.	Analyze, Classify, Illustrate, categorize	Analyze (L3)
BSC CE301.4	Examine that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine and biological processes at the reductionistic level.	Select, model, examine, design, show.	Synthesize (L4)
BSC CE301.5	Justify enzymes and distinguish between different mechanisms of enzyme action and Apply thermodynamic principles to biological systems.	Assess, test, justify, compare,	Evaluate (L5)
BSC CE301.6	Identify DNA as a genetic material in the molecular basis of information transfer and microorganisms.	Design, formulate, develop, derive, modify, build, identify	Create (L6)

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3							2				1
CO2			2				3					2
CO3		3		1		1						
CO4						2						2
CO5	3				2	2	2					1
CO6	3	1		2	2		2					
Average	2.8	2	2	1.5	2	1.6	2.3	2				1.5

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University Syllabus:

Module 1 : **INTRODUCTION**

Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. [2L]

Module 2 **Classification**

Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitataacquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Purpose: To convey that classification per se is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. [3L]

Module 3 **Genetics**

Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" [4L]

Module 4 **Biomolecules**

Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine [4L]

Module 5 **Enzymes**

Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyzereactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Purpose: To convey that without catalysis life would not have existed on earth [4L]

Module 6 **Information Transfer**

Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structurefrom single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Purpose: The molecular basis of coding and decoding genetic information is universal [4L]

Module 7 **Macromolecular analysis**

Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Purpose: How to analyses biological processes at the reductionistic level [5L]

Module 8 **Metabolism**

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and

synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

Purpose: The fundamental principles of energy transactions are the same in physical and biological world. [4L]

Module 9 **Microbiology**

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics. [3L]

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: MATHEMATICS III **Course Code: CE(BS) 301**

Semester of Study: 3rd

Course Type: Theory

Course Designation: Compulsory

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Program Outcome (PO):

Engineering Graduates will be able to:

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5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(BS) 302.1	Learn the tools of Laplace Transform, Fourier Transform and Z-Transform to analyse engineering problems.	Learn	L1
CE(BS) 302.2	Learn the ideas of functions, relation and algebraic structure and their applications in engineering environment.	Analyse	L4
CE(BS) 302.3	Understand the concept of Logic, partially ordered set and apply the Counting technique in the problems of engineering fields.	Understand	L2
CE(BS) 302.4	Learn Basics of Graph Theory which are useful to solve engineering problems.	Apply	P3

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	1	-	-	-	-	-	-	2
CO2	3	3	1	1	-	-	-	-	-	-	-	2
CO3	3	3	2	1	-	-	-	-	-	-	-	2
CO4	3	3	2	2	1	-	-	-	-	-	-	2
Average	3	3	1.2	1	0.5							2

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University Syllabus:

Module 1 Transform Calculus-1

Polynomials – Orthogonal Polynomials – Lagrange's, Chebysev Polynomials; Trigonometric Polynomials; Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method.

Module 2 Transform Calculus-2

Fourier transforms, Z-transform and Wavelet transforms: properties, methods, inverses and their applications.

Module 3 Sets, relations and functions

Basic operations on sets, Cartesian products, disjoint union (sum), and power sets. Different types of relations, their compositions and inverses. Different types of functions, their compositions and inverses.

Module 4 Propositional Logic

Syntax and semantics, proof systems, satisfiability, validity, soundness, completeness, Deduction theorem, etc. Decision problems of propositional logic. Introduction to first order logic and first order theory.

Module 5 Partially ordered sets

Complete partial ordering, chain, lattice, complete, distributive, modular and complemented lattices. Boolean and pseudo Boolean lattices.

Module 6 Algebraic Structures

Algebraic structures with one binary operation – semigroup, monoid and group. Cosets, Lagrange's theorem, normal subgroup, homomorphic subgroup. Congruence relation and quotient structures. Error correcting code. Algebraic structures with two binary operations- ring, integral domain, and field. Boolean algebra and boolean ring (Definitions and simple examples only).

Module 7 Introduction to Counting

Basic counting techniques – inclusion and exclusion, pigeon-hole principle, permutation, combination, summations. Introduction to recurrence relation and generating functions.

Module 8 Introduction to Graphs

Graphs and their basic properties – degree, path, cycle, subgraph, isomorphism, Eulerian and Hamiltonian walk, trees.

Course Name: Engineering Mechanics Course Code: CE(ES)301

Semester of Study: 3rd (Semester III)

Course Type: Theory

Course Designation: Compulsory

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Program Outcome (PO):

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(ES)301.1	CO1: Illustrate system of forces and its resultant and free body diagram of forces.	Illustrate	Understand
CE(ES)301.2	CO2: List the types and laws of friction and analyse truss by method of joints and method of sections.	List	Analyse
CE(ES)301.3	CO3: Locate the centroid of simple figures and composite sections.	Locate	Analyse
CE(ES)301.4	CO4: Identify the principles of Virtual Work and Energy method and solve problems	Identify	Analyse
CE(ES)301.5	CO5: Demonstrate particle dynamics and kinematics of rigid bodies.	Demonstrate	Apply
CE(ES)301.6	CO6: Recognise mechanical Vibration and solve problems related to vibration and pendulum.	Solve	Analyse

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	-	-	-	2
CO2	3	3	3	3	-	-	-	-	-	-	-	2
CO3	3	3	3	3	-	-	-	-	1	-	-	2
CO4	3	3	3	3	-	-	-	-	-	-	-	-
CO5	3	3	3	3	-	-	-	-	1	-	-	1
CO6	3	3	3	3	-	-	-	-	-	-	-	2
Average	3	3	2.83	2.83	0	0	0	0	0.3	0	0	1.5

University Syllabus:

Module 1	Introduction to Engineering Mechanics: Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy.
Module 2	Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.
Module 3	Basic Structural Analysis: Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines.
Module 4	Centroid and Centre of Gravity: Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia-Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.
Module 5	Virtual Work and Energy Method: Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational),energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.
Module 6	Review of particle dynamics: Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2ndlaw (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).
Module 7	Introduction to Kinetics of Rigid Bodies: Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.
Module 8	Mechanical Vibrations: Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Energy Science and Engineering **Course Code: CE(ES)302**

Semester of Study: 3rd (Semester III)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(ES)302.1	To discuss the ideas of scientific principles, energy systems and various non-renewable and renewable resources for energy.	Discuss	Understand
CE(ES)302.2	To describe different energy generation systems and their environmental impacts.	Describe	Understand
CE(ES)302.3	To develop the idea about the role of civil engineering in energy sources.	Develop	Create
CE(ES)302.4	To use the concepts about green building LEED ratings, energy audit of facilities and optimization of energy consumption.	Use	Apply
CE(ES)302.5	To relate the global policy initiatives and meet the emerging challenges with sustainable technological solutions in the field of energy and environment.	Relate	Analyse
CE(ES)302.6	To relate the ideas of energy, environment and economic system.	Relate	Analyse

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Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	2	3	0	1	1	0	2
CO2	3	3	3	2	3	2	3	0	1	2	1	2
CO3	3	1	1	3	2	3	2	0	2	0	1	3
CO4	3	3	3	2	3	2	3	0	2	3	2	3
CO5	3	2	3	3	3	2	3	3	2	3	3	2
CO6	3	3	3	3	2	2	3	3	2	2	2	2
Average	3	2.5	2.5	2.66	2.5	2.16	2.83	1	1.66	1.83	1.5	2.33

University Syllabus:

Module 1	Introduction to Energy Science: Scientific Principles and historical interpretation to Place energy use in the Context of pressing societal, environmental, and climate issues; Introduction to energy systems and Resources; Introduction to Energy, Sustainability & the Environment. Tutorials: Compile a World map showing Energy Reserves by source, Total Energy consumption, Per capita energy consumption, and Carbon Footprint
Module 2	Energy Sources: Overview of energy systems, sources, transformations, efficiency, and storage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal, and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydropower projects, superconductor-based energy storages, high-efficiency batteries) Tutorials: Compile a Word Map showing Alternative Energy source usage; Compile a Process diagram for a Pumped Storage project; Collect details of a typical North Sea oil platform. Compile a map of India showing exiting potential and utilized potential for hydropower. List the pros and cons of Thermal, hydro, nuclear and solar power projects.
Module 3	Energy & Environment: Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How future energy use can be influenced by economic, environmental, trade, and research policy Tutorials: Study the functioning of an Electro Static Precipitator in a thermal power plant; study the uses of course and fine Fly Ash from thermal power plants. Compile the safety provisions in design and construction of a reactor containment building
Module 4	Civil Engineering Projects Connected with the Energy Sources: Coal mining technologies, Oil exploration offshore platforms, Underground and under-sea oil pipelines, solar chimney projects, wave energy caissons, coastal installations for tidal power, windmill towers; hydropower stations above-ground and underground along with associated dams, tunnels, penstocks, etc.; Nuclear reactor containment buildings and associated buildings, design and construction constraints and testing procedures for reactor containment buildings; Spent Nuclear fuel storage and disposal systems Tutorials: Compile a process diagram for a typical underground hydropower project; Collect details of a model solar chimney project; collect details of a wave energy project at Vizhinjam; Collect details of the Kalpasar (Tidal energy) project

Module 5	Engineering for Energy conservation: Concept of Green Building and Green Architecture; Green building concepts (Green building encompasses everything from the choice of building materials to where a building is located, how it is designed and operated); LEED ratings; Identification of energy-related enterprises that represent the breadth of the industry and prioritize these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and Optimization of energy consumption. Tutorials: Draw a typical geometrical orientation of a house in your area to avoid sun's radiation in the bedroom in the evening; Identify typical examples of Indian buildings having various LEED ratings; List various building materials with their embodied energy content. Do an Energy Audit of your departmental Building in the college.

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Humanities 1.(Effective Technical Communication)

Course Code: CE (HS 301)

Semester of Study: THIRD

Course Type: Theory

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Program Outcome (PO):

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Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering

PSO2: Graduates will have the ability to describe, analyse, and solve problems using

mathematics and systematic problem-solving technique for core subjects of Civil

Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil

Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and

management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE HS 301.1.	Understand the dynamics of Verbal and Non Verbal aspects of technical communication	Annalyse	L 4
CE HS301.2.	Practice multi-step writing process to plan, draft, and revise reports, correspondence, and presentations	Apply	L 1

CE HS 301.3	**.** Illustrate and examine the knowledge of ethical aspects of engineering	Understand	L 2
CE HS 301.4.	Demonstrate and explain social and professional etiquettes	Apply	L3
CE HS301.5..	Plan self-development and practice self-assessment to function on multi-disciplinary teams	Evaluate	L 5
CE HS 301.6.	Organize and write business correspondence properly and correctly, using appropriate formats, grammar, vocabulary, and syntax, and demonstrate effective writing and editing skills.	Create	L 6

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										*		
CO2	*									*		
CO3								*				
CO4				*								
CO5												*
CO6			*									
Average												

University Syllabus:

CE(HS)301 Humanities-I

(Effective Technical Communication)

Module 1 Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information anddocument design, Strategies for organization, Information design and writing for print and for on line media.

Module 2 Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing,

Localization.

Module 3 Self Development and Assessment- Self assessment, Awareness, Perception and attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity

Module 4 Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation,

Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes,

business letters, memos, progress reports, minutes of meetings, event report.

Module 5 Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer,

work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex **problem**

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Introduction to Civil Engineering Course Code: CE(HS)302

Semester of Study: 3rd (Semester III)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(HS)302.1	Describe the basic of civil engineering.	Describe	Understand
CE(HS)302.2	Summarize the History of Civil engineering, National Planning for Construction and Infrastructure Development, Fundamentals of Architecture & Town Planning, Fundamentals of Building Materials.	Summarize	Comprehension
CE(HS)302.3	Discuss the Basics of Construction Management & Contracts Management, Environmental Engineering & Sustainability, basics of Geotechnical Engineering.	Discuss	Comprehension
CE(HS)302.4	Explain fundamentals of Hydraulics, Hydrology &Water Resources Engineering, Ocean Engineering, Power Plant Structures, surveying techniques, & Geomatics, Traffic &Transportation Engineering, Repairs & Rehabilitation of Structures, Computational Methods, IT, IoT in Civil Engineering.	Explain	Comprehension
CE(HS)302.5	Analyze the cases of large civil engineering projects by industry professionals, covering comprehensive planning to commission.	Analyze	Analysis
CE(HS)302.6	Summarize Basics of Professionalism.	Summarize	Comprehension

Maulana Abul Kalam Azad University of Technology, West Bengal

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CE(HS)302.1	3	1	2	1	-	-	-	-	-	-	-	2
CE(HS)302.2	3	1	2	1	-	-	-	-	-	-	-	2
CE(HS)302.3	3	1	2	1	-	-	-	-	-	-	-	2
CE(HS)302.4	3	1	2	1	2	-	-	-	-	-	-	2
CE(HS)302.5	3	1	2	1	-	-	-	-	-	-	-	2
CE(HS)302.6	-	-	-	-	-	-	-	-	-	-	-	2
Average	2.5	0.83	1.67	0.83	0.33	0	0	0	0	0	0	2

University Syllabus:

Module 1	**Basic Understanding**: What is Civil Engineering/ Infrastructure? Basics of Engineering and Civil Engineering; Broad disciplines of Civil Engineering; Importance of Civil Engineering,Possible scopes for a career **Tutorials** Develop a matrix of various disciplines and possibleroles for engineers in each
Module 2	**History of Civil engineering**: Early constructions and developments over time; Ancient monuments & Modern marvels; Development of various materials of construction and methodsof construction; Works of Eminent civil engineers **Tutorials** Identify 10 ancient monuments and ten modern marvels and list the uniqueness of each
Module 3	**Overview of National Planning for Construction and Infrastructure Development**; Positionof construction industry vis-à-vis other industries, five year plan outlays for construction; currentbudgets for infrastructure works **Tutorials** Develop a Strategic Plan for Civil Engineering worksfor next ten years based on past investments andidentify one typical on-going mega project in eacharea
Module 4	**Fundamentals of Architecture & Town Planning**: Aesthetics in Civil Engineering, Examples of great architecture, fundamentals of architectural design & town planning; BuildingSystems (HVAC, Acoustics, Lighting, etc.); LEED ratings; Development of Smart cities **Tutorials** Identify ten best civil engineering projects with highaesthetic appeal with one possible factorfor each; Listdown the possible systems required for a typical SmartCity
Module 5	**Fundamentals of Building Materials**: Stones, bricks, mortars, Plain, Reinforced &Prestressed Concrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites; Plastics in Construction; 3D printing; Recycling of Construction & Demolition wastes **Tutorials** Identify three top new materials and their potential in construction; Visit a Concrete Lab and make a report
Module 6	**Basics of Construction Management & Contracts Management**: Temporary Structures inConstruction; Construction Methods for various types of Structures; Major Construction equipment; Automation & Robotics in Construction; Modern Project management Systems; Advent of Lean Construction; Importance of Contracts Management **Tutorials** Identify 5 typical construction methods and list their advantages/ positive features

Module 7	**Environmental Engineering & Sustainability**: Water treatment systems; Effluent treatmentsystems; Solid waste management; Sustainability in Construction **Tutorials** Sustainability principles, Sustainable builtenvironment, water treatment systems, and goodpracticesof wastewater management. examples of Solid andhazardous waste management, Air pollution andcontrol
Module 8	**Geotechnical Engineering**: Basics of soil mechanics, rock mechanics and geology; varioustypes of foundations; basics of rock mechanics & tunnelling **Tutorials** List top five tunnel projects in India and their features;collect and study geotechnical investigation report ofany one Metro Rail (underground) project; Visit aconstruction site and make a site visit report
Module 9	**Hydraulics, Hydrology &Water Resources Engineering**: Fundamentals of fluid flow, basics ofwater supply systems; Underground Structures; Underground Structures Multi-purpose reservoirprojects **Tutorials** Identify three river interlinking projects and theirfeatures; visit a Hydraulics Lab and make areport
Module 10	**Ocean Engineering**: Basics of Wave and Current Systems; Sediment transport systems; Ports&Harbours and other marine structures **Tutorials** Identify 5 typical ports in India and list the structuresavailable in them; Visit a related/similarfacility, ifpossible in nearby place and make a report
Module 11	Power Plant Structures: Chimneys, Natural & Induced Draught Colling towers, coal handling systems, ash handling systems; nuclear containment structures; hydro power projects Tutorials Collect the typical layout for a large thermal powerplant and a large hydro power plant and identify all thestructures and systems falling in them.
Module 12	Structural Engineering: Types of buildings; tall structures; various types of bridges; Water retaining structures; Other structural systems; Experimental Stress Analysis; Wind tunnel studies; Tutorials Identify 5 unique features for typical buildings,bridges, tall structures and large span structures; VisitStructures Testing Lab/facility and make a report
Module 13	Surveying & Geomatics: Traditional surveying techniques, Total Stations, Development of Digital Terrain Models; GPS, LIDAR; Tutorials Collect visual representations prepared by a TotalStation and LIDAR and compare; Study typicalGoogle street map and Google Earth Map and studyhow each can facilitate the other
Module 14	Traffic &Transportation Engineering: Investments in transport infrastructure development inIndia for different modes of transport; Developments and challenges in integrated transport development in India: road, rail, port and harbour and airport sector; PPP in transport sector; Intelligent Transport Systems; Urban Public and Freight Transportation; Road Safety underheterogeneous traffic; Sustainable and resilient pavement materials, design, construction andmanagement; Case studies and examples. Tutorials Investments in transport infrastructure; Developmentsand challenges; Intelligent Transport Systems; SmartCities, Urban Transport; Road Safety; Sustainable andresilient highway design principles; Plan a sustainabletransport system for a city; Identify keyfeatures/components in the planning and design of agreen field highway/airport/port/railway and the cost –economics.

Module 15	Repairs & Rehabilitation of Structures: Basics of corrosion phenomena and other structural distress mechanisms; some simple systems of rehabilitation of structures; Non- Destructivetesting systems; Use of carbon fibre wrapping and carbon composites in repairs. Tutorials Collect the history of a major rehabilitation project andlist the interesting features
Module 16	Computational Methods, IT, IoT in Civil Engineering: Typical software used in Civil Engineering- Finite Element Method, Computational Fluid Dynamics; Computational Geotechnical Methods; highway design (MX), Building Information Modelling; Highlighting typical available software systems (SAP, STAAD, ABAQUS, MATLAB, ETAB, NASTRAN, NISA, MIKE 21, MODFLOW, REVIT, TEKLA, AUTOCAD,…GEOSTUDIO, EDUSHAKE, MSP, PRIMAVERA, ArcGIS, VisSIM, …) Tutorials Visit an AutoCad lab and prepare a report; Identify teninteresting software systems used in Civil Engg andtheir key features
Module 17	Industrial lectures: Case studies of large civil engineering projects by industry professionals, covering comprehensive planning to commissioning; Tutorials For each case study list the interesting features
Module 18	Basics of Professionalism: Professional Ethics, Entrepreneurial possibilities in Civil Engineering, Possibilities for creative & innovative working, Technical writing Skills enhancement; Facilities Management; Quality & HSE Systems in Construction
Tutorials	List 5 cases of violation of professional ethics and listpreventive measures; Identify 5 interesting projectsand their positive features; Write 400 word reports on one ancient monument and a modern marvel of civilengineering

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Basic Electronics **Course Code: CE (ES)391**

Semester of Study: 3rd Semester

Course Type: Laboratory

Course Designation: Compulsory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

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PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

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Course Outcomes:

Course Outcome	Details/Statement	Action Verb	Knowledge Level
CE(ES)391.1	Analyze behaviour of passive electrical components such as resistors, capacitors and inductors and understand carrier transport phenomenon in semiconductors	Analyze	K6
CE(ES)391.2	Illustrate the principle of operation of measuring insruments such as volt meters, ammeters power supplies, CRO etc used to measure electrical parameters according to the range selected..	Determine	K5
CE(ES)391.3	Illustrate the characteristics and working principles of semiconductor diodes and determine their parameters.	Determine	K5
CE(ES)391.4	Bias the transistor such as BJT, JFET and MOSFET in the desired operating region using any of the available biasing techniques.	Apply	K3

CE(ES)391.5	Analyze the characteristics of Integrated circuits and its use in several applications in electronics circuits particularly the IC Op - Amp and 555 timer, IC voltage regulators etc.	Analyze	K4
CE(ES)391.6	Design combinational and sequential circuits for a given functions using logic gates.	Design	K2

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	3	1	1	1	1	1	2	1	1
CO2	1	3	3	3	1	1	1	1	1	1	1	1
CO3	1	2	3	3	1	1	1	1	1	1	1	1
CO4	1	3	3	3	1	1	1	1	1	1	1	1
CO5	1	3	3	3	1	1	1	1	1	1	1	1
CO6	1	3	3	3	2	2	1	1	1	1	2	2
Average	1	2.83	3	3	1.2	1.16	1	1	1	1.16	1.16	1.16

University Syllabus:

Module 1

Laboratory Sessions covering, Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Switches (SPDT, DPDT and DIP), Bread Boards and Printed Circuit Boards (PCBs); Identification, Specifications, Testing of Active Devices – Diodes, BJTs, JFETs, MOSFETs, Power Transistors, SCRs and LEDs;

Module 2

Study and Operation of Digital Multi Meter, Function / Signal Generator, Regulated Power Supply (RPS), Cathode Ray Oscilloscopes; Amplitude, Phase and Frequency of Sinusoidal Signals using Lissajous Patterns on CRO; (CRO);

Module 3

Experimental Verification of PN Junction Diode Characteristics in A) Forward Bias B) Reverse Bias, Zener Diode Characteristics and Zener Diode as Voltage Regulator, Input and Output Characteristics of BJT in Common Emitter (CE) Configuration, Drain and Transfer Characteristics of JFET in Common Source (CS) Configuration;

Module 4

Study of Half Wave and Full Wave Rectification, Regulation with Filters, Gain and Bandwidth of BJT Common Emitter (CE) Amplifier, Gain and Bandwidth of JFET Common Source(CS) Amplifier, Gain and Bandwidth of BJT Current Series and Voltage Series Feedback Amplifiers, Oscillation Frequency of BJT based RC Phase Shift, Hartley and Colpitts Oscillators;

Module 5

Op-Amp Applications – Adder, Subtractor, Voltage Follower and Comparator; Op-Amp Applications – Differentiator and Integrator, Square Wave and Triangular Wave Generation, Applications of 555 Timer – Astable and Monostable Multivibrators;

Module 6

Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs); Truth Tables and Functionality of Flip-Flops – SR, JK and D-Flip-Flop ICs; Serial-In-Serial-Out and Serial-In-Parallel-Out Shift operations using 4- bit/8-bit Shift Register ICs; Functionality of Up-Down / Decade Counter ICs

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Computer Aided Civil Engineering Drawing **Course Code:CE(ES)392**

Semester of Study: 3rd (Semester III)

Course Type: Practical

Course Designation: Compulsory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(ES)392.1	Discuss the basic concepts of drawing.	Discuss	Understand
CE(ES)392.2	Differentiate the various signs and symbols used in AUTOCAD.	Differentiate	Analyse
CE(ES)392.3	Sketch the site plan, floor plan, elevation and section drawing of small residential buildings.	Sketch	Apply
CE(ES)392.4	Illustrate isometric, perspective view of building and fundamentals of Building Information Modelling.	Illustrate	Apply
CE(ES)392.5	Describe the types of masonry bonds.	Describe	Understand
CE(ES)392.6	Construct an Industrial building and roof truss.	Construct	Create

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	3	-	-	-	-	-	-	2
CO3	3	3	3	1	1	-	-	-	2	1	-	2
CO4	3	3	1	2	1	-	-	-	2	1	-	2
CO5	3	2	1	-	-	-	-	-	-	-	-	2
CO6	3	3	3	3	1	-	-	-	2	1	-	2
Average	3	2.5	1.5	1	1	0	0	0	1	0.5	0	2

University Syllabus:

Module 1	INTRODUCTION Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, co-ordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards
Module 2	SYMBOLS AND SIGN CONVENTIONS Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards
Module 3	MASONRY **BONDS** English Bond and Flemish Bond – Corner wall and Cross walls -One brick wall and one and half brick wall
Module 4	BUILDING DRAWING Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity
Module 5	PICTORIAL VIEW Principles of isometrics and perspective drawing. Perspective view of building. Fundamentals of Building Information Modelling (BIM)
Drawings	
1	Buildings with load bearing walls including details of doors and windows
2	Taking standard drawings of a typical two storeyed building including all MEP, joinery, rebars, finishing and other details and writing out a description of the Facility in about 500-700 words
3	RCC framed structures
4	Reinforcement drawings for typical slabs, beams, columns and spread footings
5	Industrial buildings - North light roof structures – Trusses
6	Perspective view of one and two storey buildings

Maulana Abul Kalam Azad University of Technology, West Bengal

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Life Science Laboratory ; Code: CE(ES)393

Semester of Study: 3rd (Semester III)

Course Type: Practical

Course Designation: Compulsury

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

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PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(ES)393.1	Describe about Ecosystems- Components, types, flow of matter and energy in an ecosystem Biotic & food chain, food web, ecological pyramids;	Describe	Understand
CE(ES)393.2	Explain about Plant Physiology: like Transpiration; Mineral nutrition	Explain	Understand
CE(ES)393.3	Recognize the Structures of DNA and RNA; Concept of Gene, Gene regulation	Recognize	Understand
CE(ES)393.4	Identify the Basic concepts: of Tot potency and Cell manipulation; Plant &Animal tissue culture- Methods and uses in agriculture, medicine and health; Recombinant DNA Technology- Techniques and applications	Identify	Understand
CE(ES)393.5	Calculate Value Index of a	Calculate	Analyse

	species in a plant community and its importance		
CE(ES)393.6	Comparison of stomata index in different plants	Comparison	Evaluate

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	2	2	2	2	-	-	1	-	1
CO2	3	-	-	1	2	-	-	-	-	1	-	1
CO3	3	1	1	1	3	-	-	-	-	1	-	3
CO4	3	1	1	1	3	-	-	-	-	1	-	3
CO5	3	-	1	1	2	-	-	-	-	1	-	3
CO6	3	-	1	1	2	-	-	-	-	1	-	3
Average	2.83	0.33	0.67	1.17	2.33	0.33	0.33	0	0	1	0	2.33

University Syllabus:

Module 1A	**Plant Physiology** Transpiration; Mineral nutrition
Module 1B	**Ecology** Ecosystems- Components, types, flow of matter and energy in an ecosystem; Community ecology- Characteristics, frequency, life forms, and biological spectrum; Ecosystem structure-Biotic and a-biotic factors, food chain, food web, ecological pyramids;
Module 2A	**Population Dynamics** Population ecology- Population characteristics, ecotypes; Population genetics- Concept of genepool and genetic diversity in populations, polymorphism and heterogeneity;
Module 2B	**Environmental Management** Principles: Perspectives, concerns and management strategies; Policies and legal aspects- Environment Protection Acts and modification, International Treaties; Environmental Impact Assessment- Case studies (International Airport, thermal power plant);
Module 3A	**Molecular Genetics** Structures of DNA and RNA; Concept of Gene, Gene regulation, e.g., Operon concept
Module 3B	**Biotechnology** Basic concepts: Tot potency and Cell manipulation; Plant &Animal tissue culture- Methods and uses in agriculture, medicine and health; Recombinant DNA Technology- Techniques andapplications
Module 4	**Biostatistics** Introduction to Biostatistics:-Terms used, types of data; Measures of Central Tendencies- Mean, Median, Mode, Normal and Skewed distributions; Analysis of Data- Hypothesis testing andANNOVA (single factor)
Module 5	**Laboratory & Fieldwork Sessions**

	Comparison of stomata index in different plants; Study of mineral crystals in plants; Determination of diversity indices in plant communities; To construct ecological pyramids of population sizes in an ecosystem; Determination of Importance Value Index of a species in a plant community; Seminar (with PPTs) on EIA of a Mega-Project (e.g., Airport, Thermal/Nuclear Power Plant/ Oil spill scenario); Preparation and extraction of genomic DNA and determination of yield by UV absorbance; Isolation of Plasmid DNA and its separation by Gel Electrophoresis; Data analysis using Bio-statistical tools;

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Introduction to Fluid Mechanics Course Code: CE(ES)401

Semester of Study: 4th (Semester IV)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(ES)401.1	Define basic terms, values and laws in the areas of fluids properties.	Define	Remember
CE(ES)401.2	Use the basic equations of fluid statics to solve problems on submerged planes and manometers.	Use	Apply
CE(ES)401.3	Identify the concept and application of fluid kinematics and fluid dynamics	Identify	Understand
CE(ES)401.4	Relate dimensional analysis principle for problems in fluid mechanics	Relate	Analyse
CE(ES)401.5	Use fundamental theories of fluid flow for the analysis of flow through the pipeline system.	Use	Apply
CE(ES)401.6	Design components of hydraulic machines, turbines, and pumps; and study their characteristics	Design	Create

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CE(ES)401.1	2	1	-	-	-	-	-	-	-	-	-	-
CE(ES)401.2	3	3	3	1	-	-	-	-	-	1	-	1
CE(ES)401.3	2	3	3	2	-	-	-	-	-	-	-	1
CE(ES)401.4	3	3	3	3	-	1	-	-	-	-	-	2
CE(ES)401.5	2	3	3	3	-	1	-	-	-	1	-	1
CE(ES)401.6	3	3	3	3	-	1	2	-	-	1	-	2
Average	2.5	2.7	3	2.4	0	1	2	0	0	1	0	1.4

University Syllabus:

Module 1	**Properties of fluids:** Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension.
Module 2	**Fluid statics:** Pressure at a point, basic equation for pressure field, pressure variation in a fluid at rest- incompressible fluid, compressible fluid, absolute pressure, gauge pressure; pressure measurements by manometers – general, inclined, inverted, micro-manometer; pressure and forces on submerged planes and curved surfaces, centre of pressure, buoyancy and floatation, Stability of submerged and floating bodies, metacentric height.
Module 3	**Fluid Kinematics:** The velocity field, Eulerian and Lagrangian flow descriptions, concepts of: - one-, two- and three-dimensional flows, steady and unsteady flows, streamlines, streaklines, pathlines; The acceleration field; Control volume and system representation, Continuity Equation, Momentum Equation, Moment-ofmomentum equation, applications to pipe bends.
Module 4	**Fluid Dynamics:** Application of Newton's Law along a streamline, Bernoulli Equation, Kinetic energy head, potential energy head and pressure energy head, total energy head, Pitot tube, Examples of use of Bernoulli Equation, measurement of flows - venturimeter, energy line and hydraulic grade line.
Module 5	**Dimensional Analysis:** Buckingham Pi Theorem, determination of Pi terms, correlation of experimental data, examples.
Module 6	**Flow through Pipes:** Laminar flow, Reynolds number, critical velocity, turbulent flow, shear stress at pipe wall, velocity distribution, loss of head for laminar flow, Darcy-Weisbach Formula, friction factor, contraction and expansion head losses. Concept of boundary layer and its growth.
Module 7	**Pipeline Systems:** Pipes in series, pipes in parallel, equivalent pipes, branching pipes, pipe networks.
Module 8	**Hydraulic Machines:** Basics of hydraulic machines, specific speed of pumps and turbines.

Maulana Abul Kalam Azad University of Technology, West Bengal

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Introduction to Solid Mechanics **Course Code: CE(ES)402**

Semester of Study: 4th (Semester IV)

Course Type: Theory

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Program Outcomes (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(ES)402.1	To identify different degrees of freedoms for support conditions, equilibrium conditions and elastic properties of axially loaded bars through stress-strain and force-displacement curves.	Identify	Comprehension
CE(ES)402.2	To calculate the bending moment diagram, shear force diagram, bending and shear stresses and deflection of beams for uniformly distributed, concentrated, linearly varying and external concentrated moment.	Calculate	Analysis
CE(ES)402.3	To identify strain energy due to bending moment, axial force, shear force and the concepts of principal stresses, principal planes, and Mohr's circle.	Identify	Comprehension
CE(ES)402.4	To calculate the member forces in plane trusses; hoop and meridonial stresses in thin cylinders and spherical shells.	Calculate	Analysis
CE(ES)402.5	To identify torsional moment and twist on a circular shaft and calculate the shear stress.	Identify	Comprehension
CE(ES)402.6	To calculate the buckling load of columns using Euler's theory for different support constraints.	Calculate	Analysis

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	0	0	0	0	0	0	0	0	1
CO2	3	2	1	0	0	0	0	0	0	0	0	1
CO3	3	2	1	0	0	0	0	0	0	0	0	1
CO4	3	2	1	0	0	0	0	0	0	0	0	1
CO5	3	2	1	0	0	0	0	0	0	0	0	1
CO6	3	2	1	0	0	0	0	0	0	0	0	1
Average	3	2	1	0	0	0	0	0	0	0	0	1

University Syllabus:

Module 1	Review of Basic Concepts of Stress and Strain: Normal stress, Shear stress, Bearing stress, Normal strain, Shearing strain; Hooke's law; Poisson's ratio; Stress-strain diagram of ductile and brittle materials; Elastic limit; Ultimate stress; Yielding; Modulus of elasticity; Factor of safety, Beam Statics: Support reactions, concepts of redundancy, axial force, shear force and bending moment diagrams for concentrated, uniformly distributed, linearly varying load, concentrated moments in simply supported beams, cantilever and overhanging beams.
Module 2	Symmetric Beam Bending: Basic kinematic assumption, moment of inertia, elastic flexure formulae and its application, Bending and shear stress for regular sections, shear centre.
Module 3	Deflection of statically determinate beams: Fundamental concepts: Elastic curve, moment Curvature relationship, governing differential equation, boundary conditions: Direct integration solution.
Module 4	Analysis of determinate plane trusses: Concepts of redundancy, Analysis by method of joints, method of sections.
Module 5	Two Dimensional Stress Problems: Principal stresses, maximum shear stresses, Mohr's circle of stresses, construction of Mohr's circle.
Module 6	Introduction to thin cylindrical & spherical shells: Hoop stress and meridional - stress and volumetric changes.
Module 7	Torsion: Pure torsion, torsion of circular solid shaft and hollow shafts, torsional equation, torsional rigidity, closed coil helical springs.
Module 8	Columns: Fundamentals, criteria for stability in equilibrium, column buckling theory, Euler's load for columns with different end conditions, limitations of Euler's theory – problems, eccentric load and secant formulae.

Course Name: Civil Engineering- Societal & Global Impact CE(HS)401

Semester of Study: 4th (Semester IV)

Course Type: Theory

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Program Outcome (PO):

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

On completion of the course, the students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(HS)401 .1	Discuss the change in trends of civil engineering from the past to present and future in Indian as well as global scenario.	Discuss	Understand
CE(HS)401 .2	The impact, which Civil Engineering projects have on the Society and identifying the ancient and modern marvels of civil engineering to plan for a better world.	Identify	Understand
CE(HS)401 .3	Recognise the different infrastructural requirements of civil engineering related to megacities, smart cities, energy generation and communication.	Recognise	Understand
CE(HS)401 .4	Classification of environmental engineering including waste managements, flood control, pollution control to build a sustainable society.	Classification	Understand
CE(HS)401 .5	Identify the built environment and factors influencing the quality of life ensuring sustainability.	Identify	Understand
CE(HS)401 .6	Understand the EIA procedures and apply advanced engineering techniques to contribute to GDP and generate employment.	Apply	Apply

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	2	2	-	-	-	-	1
CO2	3	3	3	2	-	2	2	-	-	-	-	1
CO3	3	1	-	-	1	-	-	-	-	-	-	-
CO4	3	2	2	2	-	2	3	2	1	-	2	2
CO5	2	2	3	2	-	3	3	1	-	1	2	2
CO6	3	3	3	3	1	3	3	2	2	2	2	3
Average	2.83	2.17	1.83	1.5	0.33	2	2.16	0.83	0.5	0.50	1.00	1.50

University Syllabus:

Module 1	Introduction to Course and Overview; Understanding the past to look into the future: Preindustrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis
Module 2	Understanding the importance of Civil Engineering in shaping and impacting the world; The ancient and modern Marvels and Wonders in the field of Civil Engineering; Future Vision for Civil Engineering
Module 3	Infrastructure - Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground, under water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic, Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy); Water provisioning; Telecommunication needs (towers, above-ground and underground cabling); Awareness of various Codes & Standards governing Infrastructure development; Innovations and methodologies for ensuring Sustainability;
Module 4	Environment-Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena and Pollution Mitigation measures, Stationarity and non-stationarity; Environmental Metrics & Monitoring; Other Sustainability measures; Innovations and methodologies for ensuring Sustainability.
Module 5	Built environment–Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability
Module 6	Civil Engineering Projects – Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspects of Civil Engineering Projects; New Project Management paradigms & Systems (Ex. Lean Construction), contribution of Civil Engineering to GDP, Contribution to employment(projects, facilities management), Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Soil Mechanics - I **Course Code: CE(PC)401**

Semester of Study: 4th (Semester IV)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)401.1	Classify soil as per grain size distribution curve and understand the index properties of soil.	Classify	Understand
CE(PC)401.2	Implement the concept of total stress, effective stress and pore water pressure for solving geotechnical problems.	Implement	Apply
CE(PC)401.3	Assess the permeability of different types of soil and solve flow problems.	Assess	Evaluation
CE(PC)401.4	Estimate the seepage loss, factor of safety against piping failure using flow net related to any hydraulic structure.	Estimate	Evaluation
CE(PC)401.5	Explain vertical stress on a horizontal plane within a soil mass subjected to different	Explain	Comprehension

	types of loading on the ground surface and also the maximum stressed zone or isobar below a loaded area.		
CE(PC)401.6	Use the concept of shear strength to analyse different geotechnical problems and determine the shear strength parameters from lab and field tests.	Use	Application

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	-	1	1	-	-	-	-	1
CO2	3	3	3	3	-	-	-	-	-	-	-	1
CO3	3	3	3	2	-	1	-	-	-	-	-	-
CO4	3	3	3	3	-	2	1	-	-	-	-	2
CO5	3	3	3	3	-	2	1	-	-	-	-	-
CO6	3	3	3	3	-	2	-	-	-	-	-	2
Average	3	3	3	2.83	0	1.5	0.5	0	0	0	0	1

University Syllabus:

Module 1	**Soil Formation** Introduction, Origin of Soil, Formation and Types of soil, Formative classification, Typical Indian Soil, Some Special Types of Soils, Structure and Composition, Clay Mineralogy. **Soil as a Three Phase System** Basic Definitions, Weight - Volume Relationship, Measurement of Physical Properties of Soil: Insitu Density, Moisture Content, Specific Gravity, Relative density, Functional Relationships. **Index Properties of Soil** Introduction, Particle Size Distribution, Mechanical Analysis - Sieve Analysis, Sedimentation Analysis – Hydrometer and Pipette Methods. Consistency of Soil– Atterberg Limits, Different Indices, Discussion on Limits and Indices. **Classification of Soil** Classification by Structure, Particle Size Classification, Textural System, PRA System (AASHTO Classification), Unified Classification System, as per IS Code Recommendation, Field Identification of Soil, Classification by Casagrande's Plasticity Chart.
Module 2	**Soil Hydraulics** Modes of Occurrence of Water in Soil – Free Water, Held Water, Structural Water, Capillary Water, Gravitational Water, Adsorbed Water, Pore Water, Pore Water Pressure, Effective Pressure, Total Pressure, Effective Pressure under Different Conditions and in Different Cases of Flow through Soils, Critical Hydraulic Gradient, Quick Sand Condition.
Module 3	**Permeability** Introduction, Darcy's Law, Coefficient of Permeability, Discharge Velocity, Seepage Velocity, Factors Affecting Permeability. Determination of Coefficient of Permeability – Constant Head and Falling Head Methods, Permeability of Stratified Soil Deposits, Field Determination of Permeability – Unconfined and Confined Aquifers.

Module 4	**Seepage Analysis** Introduction, Seepage, Seepage Pressure, Two-Dimensional Flow, Laplace's Equations, Continuity equation, Flow Nets, Flow through Earthen Dam, Estimation of Seepage, Construction, Properties and Use of Flow Nets, Piping and Heaving, Uplift due to Seepage, Design of Fillers.
Module 5	**Stress distribution in soils** Introduction, Geostatic Stress, Boussinesq's Equation, Determination of Stress due to Point Load, Vertical Stress Distribution on a Horizontal Plane, Isobar and Pressure Bulb, Vertical Stress Distribution on a Vertical Plane, Vertical Stress under Uniformly Loaded Circular Area, Vertical Stress Beneath a Corner of a Rectangular Area, Equivalent Point Load Method, 2:1 Method, Newmark's Influence Chart, Vertical Stress Beneath Line and Strip Loads. Westergaard Analysis, Comparison of Boussinesq and Westergaard Theories, Contact Pressure.
Module 6	**Shearing strength of soils** Shear Strength of Soil Introduction, Basic Concept of Shear Resistance and Shear Strength of Soil, Mohr Circle of Stress, Sign Conventions, Mohr – Coulomb Theory, Relationship between Principal Stresses and Cohesion. Determination of Shear Parameters of Soil Stress Controlled and Strain Controlled Tests, Laboratory Determination of Soil Shear Parameters- Direct Shear Test, Triaxial Test, Classification of Shear Tests Based on Drainage Conditions, Unconfined Compression Test, Vane Shear Test as per Relevant IS Codes. Stress- Strain Relationship of Clays and Sands, Concept of Critical Void Ratio. Skempton's Pore Pressure Parameters. Sensitivity and Thixotropy of clay. Concept of Stress path.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Environmental Engineering-I **Course Code: CE(PC)402**

Semester of Study: 4th (Semester IV)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)402.1	Define the basic concepts and terminologies of water supply engineering and solid waste management.	Define	Remember
CE(PC)402.2	Describe different surface and groundwater sources; and composition and characteristics of municipal solid waste.	Describe	Understand
CE(PC)402.3	Implement the methods of quantifying water requirement and MSW generation.	Implement	Apply
CE(PC)402.4	Solve different mathematical problems regarding different components of water supply systems, distribution networks and MSW management systems.	Solve	Apply
CE(PC)402.5	Compare between different water samples based on their physical, chemical and biological characteristics.	Compare	Analyse
CE(PC)402.6	Design different unit processes and operations involved in wastewater treatment.	Design	Create

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	2	-	-	-	-	1
CO2	3	2	-	1	-	-	3	-	-	-	-	1
CO3	3	3	-	-	-	2	1	-	-	-	-	3
CO4	3	3	-	2	-	1	1	-	-	-	-	-
CO5	3	3	-	3	-	2	3	-	-	-	-	-
CO6	3	-	3	1	-	2	3	-	-	-	-	1
Average	3	2.33	0.83	1.5	0	1.33	2.17	0	0	0	0	1

University Syllabus:

Module 1	**Water Requirement Estimation :** Water Demand: Different types of water demand; Per capita demand; Variations in demand; Factors affecting water demand; Future Demand Forecasting: Design period; Population forecasting methods
Module 2	**Sources of Water :** Surface Water Sources; Ground Water Sources
Module 3	**Water Quality :** Water Quality Characteristics: Physical, Chemical, and Biological parameters Drinking Water Standards: BIS; WHO; USEPA Water Quality Indices: Basic concept and examples
Module 4	**Water Treatment :** Typical flow chart for surface and groundwater treatments Unit Operation and Processes: Aeration, Plain Sedimentation, Sedimentation with Coagulation and Flocculation, Water Softening, Filtration, Disinfection
Module 5	**Water Conveyance and Distribution :** Hydraulic design of pressure pipes; Analysis of distribution network; Storage and distribution reservoirs; Capacity of reservoirs.
Module 6	**Characteristics of Municipal Solid Waste (MSW) :** Composition and characteristics of MSW
Module 7	**Handling of MSW :** Generation, collection and transportation of MSW
Module 8	**Engineered Systems for MSW Management :** Methods of reuse/ recycle, energy recovery, treatment and disposal of MSW

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Surveying & Geomatics **Course Code: CE(PC)403**

Semester of Study: 4th (Semester IV)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)403.1	To explain and state the scope of surveying and geomatics in civil engineering	Explain	Understand
CE(PC)403.2	To demonstrate the basic principles of surveying and geomatics engineering	Demonstrate	Apply
CE(PC)403.3	To solve the problems using different methods of surveying and geomatics to measure the features of interest	Solve	Apply
CE(PC)403.4	To examine the traditional and advanced methods of surveying	examine	Analyze
CE(PC)403.5	To relate the different techniques of surveying and geomatics in solving real world problems.	Relate	Analyze

CE(PC)403.6	To develop and construct solutions for real-world problems related to surveying and geomatics.	Develop	Create

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	1	0	0	3	2	2	3
CO2	3	2	3	2	3	3	1	0	2	2	3	3
CO3	3	3	2	3	3	3	0	0	3	2	3	2
CO4	3	3	3	3	3	3	0	0	1	1	2	2
CO5	3	3	2	2	3	1	0	0	3	2	3	2
CO6	3	3	3	2	3	2	0	0	2	2	3	2
Average	3	2.83	2.5	2.33	3	2.16	0.16	0	2.33	1.83	2.66	2.33

University Syllabus:

Module 1	Principles of Surveying Introduction, Principles and classification of surveying; Concept of scales; Survey stations and lines – ranging and bearing; Chain surveying – Concept, Instruments, numerical problems on errors due to incorrect chain; Plane table surveying – Advantages, disadvantages, parts, methods; Elements of simple and compound curves.
Module 2	Levelling: Levelling – Principles, Precautions and Difficulties; Differential levelling, Concepts and numerical problems; Contouring.
Module 3	Triangulation and Trilateration: Theodolite survey – Instruments, measurements of horizontal and vertical angles; Triangulation – Network, signals, numerical examples; Baseline measurement – site selection, measuring equipment, numerical problems o banseline corrections; Trigonometric levelling – Axis signal correction.
Module 4	Advanced Surveying: Principle of Electronic Distance Measurement (EDM); Types of EDM instruments; Distomats; Total Station – Parts, advantages, applications, field procedure and errors; Global Positioning System (GPS) – Concept, applications, segments, location determination, errors; Principle of Differential GPS; Terrestrial laser scanner.
Module 5	Photogrammetric Surveying: Concept; Classification of photogrammetric surveying – terrestrial, aerial and satellite; scale of a vertical photograph; relief displacement and object height determination; Stereoscopic vision – depth perception, parallactic angle, stereoscopes; Object height determination using parallax; Parallax bar; Flight planning – Concept and numerical problems; Photo mosaic; Orthophotography; Stereoscopic plotting instruments.
Module 6	Remote Sensing: Energy sources and radiation principles; Concept of Electromagnetic Spectrum; Energy interactions in the atmosphere and earth surface features; Data acquisition and interpretation; Platforms and sensors – Geostationary and sun-synchronous orbits, push broom and whiskbroom scanning system, characteristics of IRS, Landsat and Sentinel sensors; Visual image Interpretation.
Module 7	Digital Image Processing: Concept; Image rectification and restoration; Image enhancement; Image classification; Accuracy assessment and post-classification smoothing.
Module 8	Applications of Geomatics in Civil Engineering: 3D mapping; Earthquake and landslides; Runoff modeling; Groundwater targeting; Flood risk assessment; Urban planning; Highway and transportation.

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: CONCRETE TECHNOLOGY Code: CE(PC)404

Semester of Study: 4th (Semester IV)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)404.1	Explain the composition, manufacturing process, chemical compounds and types of cement, along with influence of aggregate and water in concrete making.	Explain	Understand
CE(PC)404.2	Examine the properties of materials required for concrete making and the properties of concrete at fresh and hardened state as per IS code and its strength characteristics.	Examine	Analysis
CE(PC)404.3	Select the admixture as per requirement for concreting, its role and properties.	Select	Understand
CE(PC)404.4	Design the concrete mix as per latest IS code methods	Design	Synthesis
CE(PC)404.5	Apply the basic knowledge of non-destructive testing in field operations.	Apply	Application
CE(PC)404.6	Analyze various special types of concrete and their applications.	Analyze	Analysis

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(Applicable from the academic session 2023-2024)

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CE(PC)404.1	3	3	2	3	2	2	1	1	-	-	-	3
CE(PC)404.2	3	3	2	3	2	2	1	1	-	-	-	3
CE(PC)404.3	3	3	2	3	2	2	1	1	-	-	-	2
CE(PC)404.4	3	3	2	3	2	2	1	-	-	-	-	2
CE(PC)404.5	3	3	2	3	2	2	1	-	-	-	-	2
CE(PC)404.6	3	3	2	3	2	2	1	-	-	-	-	2
Average	3	3	2	3	2	2	1	0.5	0	0	0	2.33

University Syllabus:

Module 1	**Cement:** Manufacturing of cement, Oxides composition of cement and the calculation of compounds, Heat of hydration, Types of cement-OPC, RPC. Low heat cement, PPC, PSC, Sulphate resisting cement, High Alumina cement, Expansive cement, White cement; Test on cement- fineness, consistency, initial setting time & final setting time, soundness test, strength test, specific gravity of cement, storage of cement.
Module 2	**Aggregates**: Classification, Grading, alkali-aggregate reaction, deleterious substances in aggregates, physical properties, testing of aggregates- fineness modulus, bulking, specific gravity, sieve analysis, flakiness & elongation index. Quality of Water for mixing and curing - use of sea water for mixing concrete.
Module 3	**Properties of fresh concrete**: Workability, factors affecting workability, segregation and bleeding, tests on workability- slump test, compacting factor test, vee-bee test, flow table test.
Module 4	**Properties of Hardened concrete**: Tensile & compressive strength, flexural strength, stress-strain characteristics, modulus of elasticity, poisson's ratio, Creep, shrinkage, permeability of concrete, micro cracking of concrete.
Module 5	**Strength of concrete**: curing methods, water-cement ratio. gel-space ratio, maturity of concrete.
Module 6	**Admixtures**: types, uses, superplasticizers, plasticizers, Bonding admixtures.
Module 7	**Mix Design –** Objective, factors influencing mix proportion - Mix design by I.S. 10262-2019. (with & without admixture)
Module 8	**Non-destructive test**: Rebound hammer and Ultra-sonic pulse velocity testing methods. Quality control - Sampling and testing, Acceptance criteria.
Module 9	**Special Concrete –** Ferrocement - Fibre reinforced concrete - Polymer concrete - Sulphur Concrete - Self compacting concrete. Ready mix concrete, Batching plant.

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Fluid Mechanics Laboratory Course Code: CE(ES)491

Semester of Study: 4th (Semester IV)

Course Type: Practical

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(ES)491.1	To prepare the Coefficient of discharge, calibration of the notch and orifice meter.	prepare	Application
CE(ES)491.2	Evaluate the performance of pump and turbine.	Evaluate	Evaluation
CE(ES)491.3	Calculate the various hydraulic coefficients.	Calculate	Analysis
CE(ES)491.4	Examine the minor losses through pipes.	Examine	Analysis
CE(ES)491.5	Inspect the water surface profile due to formation of hydraulic jump.	Inspect	Analysis
CE(ES)491.6	Inspect the water surface profile for flow over Broad crested weir.	Inspect	Analysis

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	1	-	-	2	1	-	1
CO2	3	2	-	-	-	1	-	-	2	1	-	1
CO3	3	2	-	-	-	1	-	-	2	1	-	1
CO4	3	2	-	-	-	1	-	-	2	1	-	1
CO5	3	2	-	-	-	1	-	-	2	1	-	1
CO6	3	2	-	-	-	1	-	-	2	1	-	1
Average	3	2	0	0	0	1	0	0	2	1	0	1

University Syllabus:

Experiment 1	Calibration of Notches.
Experiment 2	Calibration of Orifice meter.
Experiment 3	Determination of Hydraulic Coefficient of an Orifice.
Experiment 4	Performance Test on Centrifugal Pump.
Experiment 5	Performance Test on Reciprocating Pump.
Experiment 6	Determination of Minor Losses in Pipes due to Sudden Enlargement and Sudden Contraction.
Experiment 7	Performance Test on Pelton Wheel Turbine.
Experiment 8	Measurement of water surface profile for flow over Broad crested weir.
Experiment 9	Measurement of water surface profile for a hydraulic jump.

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Solid Mechanics Laboratory Course Code: CE(ES)492

Semester of Study: 4th (Semester IV)

Course Type: Practical

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Program Outcome (PO):

Engineering Graduates will be able to:

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(ES)492.1	Demonstrate the method and findings of tension and compression tests on ductile, brittle materials and explain the method of bending tests on mild steel beam and concrete beam.	Demonstrate and Explain	Apply
CE(ES)492.2	Demonstrate the method and findings of Torsion test on mild steel circular bar, concrete beam.	Demonstrate	Apply
CE(ES)492.3	Interpret the concept of hardness and explain the procedure and findings of Brinnel and Rockwell tests.	Interpret and Explain	Apply
CE(ES)492.4	Demonstrate the concept, procedure and calculation of spring constant and execute its use in Civil Engineering.	Demonstrate and Execute	Apply
CE(ES)492.5	Demonstrate the method and findings of Izod and Charpy impact tests.	Demonstrate	Apply
CE(ES)492.6	Explain the concepts of fatigue test.	Explain	Understand

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CE(ES)492.1	3	3	1	2	1	-	-	-	2	1	-	1

CE(ES)492.2	3	3	1	2	1	-	-	-	2	1	-	1
CE(ES)492.3	3	3	1	2	1	-	-	-	2	1	-	1
CE(ES)492.4	3	3	1	2	1	-	-	-	2	1	-	1
CE(ES)492.5	3	3	1	2	1	-	-	-	2	1	-	1
CE(ES)492.6	3	1	0	1	1	-	-	-	1	1	-	1
Average	3	2.7	0.8	1.8	1	0	0	0	1.8	1	0	1

University Syllabus:

Experiment 1	Tension test on Structural Materials: Mild Steel and Tor steel (HYSD bars)
Experiment 2	Compression Test on Structural Materials: Timber, bricks and concrete cubes
Experiment 3	Bending Test on Mild Steel
Experiment 4	Torsion Test on Mild Steel Circular Bar
Experiment 5	Hardness Tests on Ferrous and Non-Ferrous Metals: Brinnel and Rockwell Tests
Experiment 6	Test on closely coiled helical spring
Experiment 7	Impact Test: Izod and Charpy
Experiment 8	Demonstration of Fatigue Test

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Engineering Geology Laboratory Course Code: CE(ES)493

Semester of Study: 4th (Semester IV)

Course Type: Laboratory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(ES)493.1	Define and state the role of engineering geology in civil engineering.	Define	Remember
CE(ES)493.2	Identify the origin of rocks and geologic structures.	Identify	Understand
CE(ES)493.3	Use different tools to identify rocks and minerals in hand specimens and under the microscope.	Use	Apply
CE(ES)493.4	Relate the geological structures by drawing the cross sections from the geological maps.	Relate	Analyse
CE(ES)493.5	Interpret the results obtained from different geological experiments.	Interpret	Apply
CE(ES)493.6	Investigate the natural hazards/disasters that are caused by geological reasons.	Discuss	Understand

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	3	1	-	-
CO3	3	2	-	-	1	1	-	-	3	1	-	1
CO4	3	2	1	-	1	1	-	-	3	1	2	1
CO5	3	2	-	-	-	1	-	-	3	1	-	1
CO6	3	2	-	-	-	-	-	-	-	-	-	-
Average	2.83	2	.16	0	.33	0.5	0	0	2	.66	.33	0.5

University Syllabus:

Experiment 1	Identification of minerals in hand specimen.
Experiment 2	Identification of igneous rocks in hand specimen.
Experiment 3	Identification of sedimentary rocks in hand specimen.
Experiment 4	Identification of metamorphic rocks in hand specimen.
Experiment 5	Study of crystals with the help of crystal models.
Experiment 6	Study of geologic structures with the help of models.
Experiment 7	Interpretation of geological maps: horizontal, vertical, uniclinal, folded and faulted structures.
Experiment 8	Microscopic study of rocks and minerals.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Surveying & Geomatics Laboratory; Code: CE(PC) 493

Semester of Study: 4th (Semester IV)

Course Type: Sessional

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC) 493.1	Interpret the interdependency and advancement of different surveying methods	Interpret	Evaluation
CE(PC) 493.2	Explain the working principles of different surveying and geomatics instruments and experiments	Explain	Understand
CE(PC) 493.3	Execute the different methods of surveying and geomatics to measure the features of interest	Execute	Apply
CE(PC) 493.4	Examine the results obtained from the surveying and geomatics experiments	Examine	Analysis
CE(PC) 493.5	Asses the different techniques of surveying and geomatics in measuring and assessing the features of interest	Asses	Evaluation
CE(PC) 493.6	Design and construct solutions for real world problems related to surveying and geomatics.	Design	Synthesis

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	3	-	2	-	3	1	1	1
CO2	3	3	3	3	1	-	1	-	1	2	1	2
CO3	3	3	1	2	3	-	3	-	2	1	1	-
CO4	3	3	2	1	2	-	2	-	1	-	1	1
CO5	3	3	3	2	1	-	3	-	1	1	2	1
CO6	3	3	2	2	3	-	2	-	2	-	1	2
Average	3	3	2.17	1.83	2.17	0	2.17	0	1.67	0.83	1.16	1.16

University Syllabus:

Prerequisite	Surveying & Geomatics [CE(PC)403]
Experiment 1	Traverse survey by Prismatic Compass: Procedure; Computation and checks on closed traverse; Preparation of field book; Plotting the traverse; Sources of errors.
Experiment 2	Theodolite Survey: Closed traverse by transit theodolite, Preparation of field book
Experiment 3	Differential Levelling using Dumpy level: Collimation and Rise and Fall methods, Field book preparation
Experiment 4	Total Station Survey: Traversing and Levelling
Experiment 5	Visual Image Interpretation
Experiment 6	Satellite Image Pre-processing
Experiment 7	Digital Image Classification and Accuracy Assessment
Experiment 8	Stereoscopic fusion of aerial photographs using mirror stereoscope

Course Name: Concrete Technology Laboratory Course Code: CE(PC)494
Semester of Study: 4th (Semester - IV)
Course Type: Practical

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, andin multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)494.1	Demonstrate the method and findings of tension and compression tests on concrete.	Demonstrate	APPLY
CE(PC)494.2	Describe the concepts of different test on hardened concrete and different properties of cement.	Describe	UNDERSTAND
CE(PC)494.3	Calculate the specific gravity of concrete ingredients.	Calculate	ANALYSIS
CE(PC)494.4	Calculate the mix proportion of high grade of concrete.	Calculate	ANALYSIS
CE(PC)494.5	Measure the workability of concrete mix.	Measure	EVALUATION
CE(PC)494.6	Investigate the quality of concrete.	Investigate	CREATE

Course Articulation Matrix (CAM):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	0	1	1	1	0	0	1	1	0	1
CO2	2	1	0	1	1	1	0	0	1	1	0	1
CO3	2	3	1	1	2	1	0	0	2	1	0	1
CO4	2	3	2	1	2	1	0	0	2	1	0	1
CO5	3	3	1	1	2	2	0	1	2	2	0	1
CO6	3	3	2	3	3	3	1	1	3	2	1	1
Average	2.5	2.33	1	1.83	1.83	1.5	0.2	0.33	1.83	1.33	0.2	1

University Syllabus:

Test on Fine aggregates	Bulking, Specific gravity, Bulk Density, Percentage voids, Fineness Modulus. Grading curve.
Test on Coarse aggregates	Specific gravity, Bulk Density, Percentage voids, Fineness Modulus. Grading curve.
Test on Cement	Normal consistency, fineness, Initial setting and final setting time of cement. Specific gravity, soundness and Compressive strength of Cement.
Test on Fresh Concrete	Concrete mix design, Various workability tests – slump, compacting factor, Vee-bee test.
Test on Hardened Concrete	Spilt-tensile strength test, Flexure test, NDT Tests (Rebound hammer and Ultra-sonic pulse velocity), Poission ratio.

Maulana Abul Kalam Azad University of Technology, West Bengal

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Design of RC Structures **Course Code: CE(PC)501**

Semester of Study: 5th (Semester V)

Course Type: Theory

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Program Outcomes (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)501.1	To identify material properties and design methodologies for reinforced concrete structures.	Identify	Comprehension
CE(PC)501.2	Assess different type of loads and prepare layout for reinforced concrete structures.	Assess	Evaluation
CE(PC)501.3	To apply the applicable industrial design codes relevant to the design of reinforced concrete members.	Apply	Application
CE(PC)501.4	To analyse and design various structural elements of reinforced concrete building like beam, slab, column, footing, and staircase	Analyze	Analysis
CE(PC)501.5	Assessment of serviceability criteria for reinforced concrete beam and slab	Assess	Evaluation
CE(PC)501.6	Prepare structural drawings and detailing and produce design calculations and drawing in appropriate professional format	Design	Synthesis

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	0	0	1	1	0	0	1	0	1
CO2	3	2	3	0	0	1	1	0	0	1	0	1
CO3	3	2	3	0	0	1	1	0	0	1	0	1
CO4	3	2	3	0	0	1	1	0	0	1	0	1
CO5	3	2	3	0	0	1	1	0	0	1	0	1
CO6	3	2	3	0	0	1	1	0	0	1	0	1
Average	3	2	3	0	0	1	1	0	0	1	0	1

University Syllabus:

Module 1	Introduction: Principles of design of reinforced concrete members- working stress and Limit State method of design
Module 2	Working stress method of design: Basic concepts and IS code provisions (IS:456 2000) for design against bending moment and shear forces - Balanced, under-reinforced and over-reinforced beam/slab sections; design of singly and doubly reinforced sections.
Module 3	Limit state method of design: Basic concepts and IS code provisions (IS: 456 2000) for design against bending moment and shear forces; concepts of bond stress and development length; Use of design aids for reinforced concrete (SP: 16).
Module 4	Beam Design by LSM: Analysis, design and detailing of singly reinforced rectangular, T, L, and doubly reinforced beam sections by limit state method.
Module 5	Slab Design by LSM: Design and detailing of one-way and two-way slab panels as per IS code provisions
Module 6	Continuous slab and beam design by LSM: Design and detailing of continuous beams and slabs as per IS code provisions
Module 7	Design of Staircases by LSM: Types; Design and detailing of reinforced concrete dog legged staircase
Module 8	Design of Columns by LSM: Design and detailing of reinforced concrete short columns of rectangular and circular cross sections under axial load. Design of short columns subjected to axial load with moments (uniaxial and biaxial bending)– usingSP16.
Module 9	Design of Foundation by LSM: Design and detailing of reinforced concrete isolated square and rectangular isolated and combined footing for columns as per IS code provisions by limit state method Design and detailing of Pile foundation as per IS code provisions.

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(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Engineering Hydrology **Course Code: CE(PC)502**

Semester of Study: 5th (Semester V)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)502.1	Explain the source, occurrence, movement and distribution of water which is a prime resource for development of a nation.	Explain	Understand
CE(PC)502.2	Interpret to Estimate and process the precipitation data.	Interpret	Apply
CE(PC)502.3	Analyze the functioning of reservoirs and estimation of storage capacities.	Analyze	Analyse
CE(PC)502.4	Calculate to estimate the passage of floods through rivers and reservoirs.	Calculate	Analyse
CE(PC)502.5	Design the flood volumes and flood hazards for various structures	Design	Create
CE(PC)502.6	Estimate the measurement of flow in rivers.	Estimate	Evaluation

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	0	0	0	1	2	2	0	0	0	0	0
CO2	3	1	1	0	1	0	1	0	0	0	0	2
CO3	3	3	2	1	0	0	2	0	0	0	0	1
CO4	3	3	3	3	0	0	1	0	0	0	0	0
CO5	3	3	3	2	0	1	2	0	0	0	0	3
CO6	3	3	2	3	0	0	1	0	0	0	0	2
Average	3	2.1	1.83	1.5	0.7	1	1.5	0	0	0	0	1.3

University Syllabus:

Module 1	Hydrology: Hydrologic Cycle, Global Water Budget, India's Water Budget.
Module 2	Catchment: Definition & Descriptions, Various Types of Catchments, Factors Characterizing a Catchment, Delineation of Catchment Boundary.
Module 3	Measurement of Precipitation: Precipitation, Description and Functioning of Various Types of Rain gauges, Rain gauge Network- Codal Provisions, Optimum Number of Raingauge Stations.
Module 4	Processing of Rainfall Data: Normal Rainfall, Estimation of Missing Rainfall Data, Test for Consistency of Record; Mass Curve of Rainfall, Hyetograph, Point Rainfall; Mean Precipitation over an Area– Arithmetic Mean, Thiessen Polygon and Isohyetal Method.
Module 5	Losses from Precipitation: Evaporation – Evaporation Process, Factors affecting Evaporation, Measurement of Evaporation– Description and Functioning of Pan Evaporimeter, Pan Co-efficient Evapo-transpiration: AET, PET, Measurement of ET, Estimation of ET–Blaney Criddle Formulae; Infiltration– Process, Factors Affecting Infiltration, Infiltration Rate and Infiltration Capacity, Measurement of Infiltration, Infiltration Equations, Infiltration Indices.
Module 6	Streamflow Measurement: Importance, Direct and Indirect Methods, Measurement of Stage– Various Gauges and Recorders, Measurement of Velocity–Current Meters, their Functioning and Calibration; Velocity Distribution, Floats; Streamflow Computation– Area-Velocity Method, Moving Boat Method, Dilution Technique, Electromagnetic Method, Ultrasonic Method; Indirect Methods– Flow Measuring Structures, Slope Area Method; Stage Discharge Relation, Permanent Control, Stage for Zero Discharge, Shifting Control– Backwater Effect, Unsteady Flow Effect, Extension of the Rating Curve.
Module 7	Runoff: Description of the Process, Components of Runoff, Factors Affecting Runoff, Characteristics of Streams, Rainfall Runoff Relationships. Hydrographs: Types, Base Flow Separation, Effective Rainfall.
Module 8	Unit Hydrograph– Definition, Assumptions, Applications– Derivation of Unit Hydrograph, Distribution Graph, Unit Hydrograph of Different Durations–Method of Superposition and S-Curve.
Module 9	Floods: Concept of flood as a natural hazard; Estimation of flood discharge in a river – rational method, empirical formulae, unit hydrograph method; flood frequency studies – return period.
Module 10	Flood Routing: Concept of flood routing in channels and through a reservoir, basic routing equations; reservoir routing – Modified Pul's method; channel routing – Muskingum method.

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Structural Analysis – I **Course Code: CE(PC)503**

Semester of Study: 5th (Semester V)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)503.1	Distinguish between stable and unstable and statically determinate and indeterminate structures.	Distinguish	Analyse
CE(PC)503.2	Solve equations of equilibrium to structures and compute the reactions.	Solve	Apply
CE(PC)503.3	Interpret the internal forces in cable and arch type structures.	Interpret	Apply
CE(PC)503.4	Develop and draw the influence lines for reactions, shears and bending moments in beams due to moving loads.	Develop	Create
CE(PC)503.5	Use approximate methods to solve statically indeterminate structures	Solve	Apply
CE(PC)503.6	Sketch the deflections of truss structures and beams.	Sketch	Apply

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	1	1	0	0	0	0	2
CO2	3	3	3	-	-	1	1	0	0	0	0	2
CO3	3	3	3	-	-	1	1	0	0	0	0	2
CO4	3	3	3	-	-	1	1	0	0	0	0	2
CO5	3	3	3	-	-	1	1	0	0	0	0	2
CO6	3	3	3	-	-	1	1	0	0	0	0	2
Average	3	3	3	0	0	1	1	0	0	0	0	2

University Syllabus:

Module 1	Basics of Structural Analysis: Concept of static and kinematic indeterminacy, Determination of degree of indeterminacy for different types of structures. Theorem of minimum potential energy, law of conservation energy, principle of virtual work, the first and second theorems of Castigilano, Betti's law, Clark Maxwell's theorem of reciprocal deflection.
Module 2	Analysis of Determinate Structures: Portal Frames, Three hinged arches, Cables.
Module 3	Deflection of Determinate Structures: Energy methods. Unit Load method for beams, Deflection of trusses and Simple Portal Frames.
Module 4	Influence Line Diagram: Statically determinate beams and trusses under series of concentrated and uniformly distributed rolling loads, criteria for maximum and absolute maximum moments and shear.
Module 5	Analysis of Statically Indeterminate Beams: Theorem of three moments, Energy methods, Force method (Method of consistent deformation) [For analysis of propped cantilever, fixed beams and continuous beams (maximum two degree of indeterminacy) for simple loading case], Analysis of two hinged arch.
Module 6	Influence Line Diagram for Indeterminate Structures: Muller – Breslau principle.

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Soil Mechanics-II **Course Code: CE(PC)504**

Semester of Study: 5th (Semester V)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)504.1	Assess the compaction and consolidation characteristics of soil for solving geotechnical problems.	Assess	Evaluation
CE(PC)504.2	Calculate earth pressure on rigid retaining walls on the basis of classical earth pressure theories	Calculate	Analysis
CE(PC)504.3	Interpret the concept of different methods in design, construction of the pavement.	Interpret	Apply
CE(PC)504.4	Solve the bearing capacity of shallow foundation by applying established theory.	solve	Application
CE(PC)504.5	Estimate settlement in soils by different methods.	Estimate	Evaluation
CE(PC)504.6	Design safety of dams and embankments on the basis of	Design	Synthesis

	various methods of slope stability analysis.		

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	1	1	-	-	-	-	-
CO2	3	3	3	3	-	2	1	-	-	-	-	-
CO3	3	3	3	2	-	2	-	-	-	-	-	-
CO4	3	3	3	2	-	2	-	-	-	-	-	-
CO5	3	3	3	3	-	3	1	-	-	-	-	1
CO6	33	3	3	2	-	2	-	-	-	-	-	1
Average	3	3	3	2.33	0	2	0.5	0	0	0	0	0.33

University Syllabus:

Module 1	**Consolidation of Soil** Terzaghi's theory of one-dimensional consolidation, Compressibility characteristics of soils, Compression index, Coefficient of compressibility and volume change, Coefficient of consolidation, Degree and rate of consolidation, Time factor, Settlement computation, Consolidometer and laboratory one dimensional consolidation test as per latest IS Code, Determination of consolidation parameters.
Module 2	**Compaction of Soil** Principles of compaction, Standard and modified proctor compaction test, Field compaction methods, Field compaction control, Factors affecting compaction, Effect of compaction on soil properties.
Module 3	**Earth Pressure Theories** Plastic equilibrium of soil, Earth pressure at rest, Active and passive earth pressures, Rankine's and Coulomb's earth pressure theories, Different types of backfill, Wedge method of analysis. Analytical and graphical methods for determination of earth pressure against various earth retaining structures. **Stability of retaining walls:** Cantilever retaining wall.
Module 4	**Bearing capacity of shallow foundations** Bearing capacity, Definition, Factors affecting bearing capacity, Modes of failures, Methods of determining bearing capacity of soils. Terzaghi's bearing capacity theory, Effect of depth of embedment, Eccentricity of load, Foundation shape on bearing capacity, Effect of 11 water table and eccentric loads. Isolated footings with combined action of loads and moments, Bearing capacity as per IS: 6403.
Module 5	**Settlement** Allowable bearing pressure and settlement analysis (as per IS: 8009), Immediate and consolidation settlements, Rigidity and depth factor corrections, Settlement values as per IS: 1904 recommendations.
Module 6	**Stability of slopes** Types of failure, Analysis of finite and infinite slopes, Swedish and friction circle method, Ordinary method of slices, Factor of safety, Taylor's stability number, Bishop's simplified method of stability analysis.

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Environmental Engineering-II **Course Code: CE(PC)505**

Semester of Study: 5th (Semester V)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)505.1	Recognize the basic concepts and terminologies of waste water engineering and hazardous waste management.	Recognize	Comprehension
CE(PC)505.2	Describe different home plumbing systems for water supply and wastewater disposal	Describe	Comprehension
CE(PC)505.3	Implement the methods of quantifying sanitary sewage and storm sewage.	Implement	Apply
CE(PC)505.4	Solve different mathematical problems regarding different components of sewerage system.	Solve	Application
CE(PC)505.5	Compare between different wastewater samples based on their physical, chemical and biological characteristics	Compare	Analyse
CE(PC)505.6	Design different unit processes and operations involved in wastewater treatment	Design	Create

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	2	-	-	-	-	1
CO2	3	3	3	-	-	1	3	-	-	-	-	-
CO3	3	3	2	-	-	1	3	-	-	-	-	3
CO4	3	3	3	2	-	1	2	-	-	-	-	1
CO5	3	2	-	1	-	1	3	-	-	-	-	-
CO6	3	2	3	-	1	1	3	-	-	-	-	1
Average	3	2.67	2.17	0.83	0.17	1	2.67	0	0	0	0	1

University Syllabus:

Module 1	Sewage and Drainage: Sewage or Sanitary Sewage, Drainage or Storm Sewage, Sullage, Black Water, Grey Water Sewerage Systems: Separate system, Combined System, Partially Separate System; applicability, advantages and disadvantages
Module 2	Sewage and Drainage Quantity : Quantity estimation for sanitary sewage; Quantity estimation for storm sewage.
Module 3	Conveyance of Sewage : Sewers: Shapes; Design parameters; Operation and maintenance of sewers; Sewer appurtenances Hydraulic Design of Sewers: Partial flow diagrams and Nomograms
Module 4	Wastewater Characteristics : Physical, chemical and biological characteristics of municipal and domestic sewage; Effluent discharge standards
Module 5	Wastewater Treatment : Primary, secondary and tertiary treatment of wastewater; aerobic an anaerobic treatment options Primary and Secondary Treatment of Domestic Wastewater: Typical Flow Chart of STP; Screen and Bar Racks; Grit Chamber; Primary and Secondary Tank; Activated Sludge Process; Trickling Filter
Module 6	Sludge Handling and Disposal : Sludge Thickening; Sludge Digestion; Sludge Drying Bed.
Module 7	Building Plumbing : Introduction to various types of home plumbing systems for water supply and waste water disposal; high rise building plumbing; Pressure reducing valves; Break pressure tanks; Storage tanks; Building drainage for high rise buildings; various kinds of fixtures and fittings used
Module 8	Hazardous waste : Types and nature of hazardous waste as per the HW Schedules of regulating authorities

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(Applicable from the academic session 2023-2024)

Course Name: Transportation Engineering **Course Code: CE(PC)506**

Semester of Study: 5th (Semester V)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)506.1	Summarize the knowledge of planning, design and the fundamental properties of highway materials in highway engineering.	Summarize	Comprehension
CE(PC)506.2	Apply the knowledge of geometric design and draw appropriate conclusion.	Apply	Apply
CE(PC)506.3	Interpret the concept of different methods in design, construction of the pavement.	Interpret	Apply
CE(PC)506.4	Interpret traffic parameters by applying the knowledge in traffic planning and intersection design.	Interpret	Apply
CE(PC)506.5	Define the various pavement materials, types of pavement and their typical cross-sections; Design parameters	Define and Design	Synthesis

	and design the Flexible Pavement rigid Pavement: with Design of rigid Pavement thickness.		
CE(PC)506.6	Illustrate the scope of adoption of sustainable construction techniques by using recyclable hazardous materials.	Illustrate	Application

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	1	1	-	-	-	-	1
CO2	3	2	2	-	-	1	1	-	-	-	-	1
CO3	3	2	2	-	-	1	1	-	-	-	-	1
CO4	3	2	2	-	-	1	1	-	-	-	-	1
Average	3	2	2	0	0	1	1	0	0	0	0	1

University Syllabus:

Module 1	Scope of Highway Engineering; Jayakar Committee Report: Recommendations – CRF, IRC, CRRI; Scope of Motor Vehicle Act; Recommendations of Nagpur Road conference; Road Classification as per third 20 years road development plan (1981-2001); Basic types of Road Patterns and its scope of application
Module 2	Factors controlling alignment; engineering surveys for highway alignment and location.
Module 3	Cross-sectional elements of highway; Design Parameters (as per IRC) – Vehicle Dimensions, Carriageway width, Design speed, Frictional coefficients (Lateral andLongitudinal) etc; Design Principles of Horizontal Alignment: Camber, SightDistance (PIEV theory, SSD, OSD, ISD); Horizontal Curves – [Radius, Superelevation, Extra widening, Set back distance, Transition curve]; Design Principles of Vertical Alignment: Gradients; Grade Compensation; Vertical Curves – SummitCurve, Valley curve.
Module 4	Traffic studies: Fundamental parameters of Traffic Flow (speed, flow, density, capacity) and their basic relations; Basics of Spot Speed Studies- Speed and Delaystudy- O & D study; Intersections and Channelization: At Grade and Grade Separated intersections;Conflict points; Salient features of Rotary; Traffic Signs; Signal Design – Basic concepts of IRC design method, 2 phase signal design by Webster method.
Module 5	Pavement materials: Bitumen, Aggregate, Subgrade soil; Types of Pavement:Flexible and Rigid pavements and their typical cross-sections; Design parameters: Wheel Load, ESWL, Tyre Pressure, CBR, Resilient Modulus& Poisson's Ratio of various layers, Subgrade Modulus etc. Design of Flexible Pavement using IRC 37:2018 Design of Rigid Pavement: Wheel Stresses, Frictional Stresses and WarpingStresses; Expansion, Contraction and Construction Joints; Design of rigid Pavement thickness, Dowel Bar and Tie Bar. Distresses in Pavements
Module 6	Sustainability: Scope of adoption of sustainable construction techniques by using recyclable hazardous materials- fly ash, plastics, recyclable construction materials.

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: RC Design Sessional Course Code: CE(PC)591

Semester of Study: 5th (Semester V)

Course Type: Practical

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)591.1	Identify material properties and design methodologies for reinforced concrete structures.	Identify	Understand
CE(PC)591.2	Examine different type of loads and organise layout for reinforced concrete structures.	Examine and Organise	Analyse
CE(PC)591.3	Identify and use the applicable industrial design codes relevant to the design of reinforced concrete members.	Identify and Use	Apply
CE(PC)591.4	Design various structural elements of reinforced concrete building like beam, slab, column, footing, and staircase.	Design	Create
CE(PC)591.5	Examine serviceability criteria for reinforced concrete beam and slab.	Examine	Analyse
CE(PC)591.6	Develop structural drawings and detailing in appropriate professional format.	Develop	Create

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CE(PC)591.1	2	1	-	1	-	1	-	-	-	-	-	-
CE(PC)591.2	2	2	1	2	-	-	-	-	-	1	-	-
CE(PC)591.3	3	3	3	2	-	1	-	1	-	-	-	3
CE(PC)591.4	3	3	3	2	-	1	-	1	-	1	-	1
CE(PC)591.5	3	3	3	1	-	1	-	1	-	-	-	1
CE(PC)591.6	3	3	2	-	1	1	-	-	-	2	-	2
Average	2.7	2.5	2	1.3	0.2	0.8	0	0.5	0	0.7	0	1.2

University Syllabus:

Design of a small RCC framed building using Limit State method of design including preparation of necessary working drawing and report in accordance with CE(PC)501.

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Soil Mechanics Laboratory Course Code: CE(PC)594

Semester of Study: 5th (Semester V)

Course Type: Practical

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Program Outcome (PO):

Engineering Graduates will be able to:

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)594.1	Classify the types of soil and determine its natural moisture content alongwith specific gravity.	Classify	Comprehension
CE(PC)594.2	Estimate in-situ density of soil by core cutter and sand replacement method.	Estimate	Evaluation
CE(PC)594.3	Develope grain size distribution curve and Atterberg limits for soil.	Develope	Create
CE(PC)594.4	Demonstrate laboratory tests to determine permeability and compaction characteristics of soil.	Demonstrate	Application
CE(PC)594.5	Calculate the shear strength parameters of soil by using UCS, Vane Shear, Direct Shear & Triaxial Test.	Calculate	Analysis
CE(PC)594.6	Calculate the California Bearing Ratio (CBR) of soil.	Calculate	Analysis

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(Applicable from the academic session 2023-2024)

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CE(PC)594.1	3	3	1	2	2	-	1	-	3	2	-	1
CE(PC)594.2	3	3	1	3	-	-	1	-	3	2	-	1
CE(PC)594.3	3	3	1	3	2	-	1	-	3	2	-	1
CE(PC)594.4	3	3	1	3	-	-	1	-	3	2	-	1
CE(PC)594.5	3	3	1	3	2	-	1	-	3	2	-	1
CE(PC)594.6	3	3	2	3	2	-	1	-	3	2	-	1
Average	3.00	3.00	1.17	2.83	1.33	-	1.00	-	3.00	2.00	-	1.00

University Syllabus:

Experiment 1	Field identification of different types of soil as per Indian Standards [collection of field samples and identifications without laboratory testing].
Experiment 2	Determination of natural moisture content.
Experiment 3	Determination of specific gravity of cohesionless and cohesive soils.
Experiment 4	Determination of in-situ density by core cutter method and sand replacement method.
Experiment 5	Determination of grain size distribution by sieve and hydrometer analysis.
Experiment 6	Determination of Atterberg limits (liquid limit, plastic limit and shrinkage limit).
Experiment 7	Determination of co-efficient of permeability by constant and variable head permeability tests.
Experiment 8	Determination of compaction characteristics of soil by standard proctor compaction test.
Experiment 9	Determination of unconfined compressive strength of soil by unconfined compression test.
Experiment 10	Determination of shear strength parameters of soil by direct shear test.
Experiment 11	Determination of undrained shear strength of soil by vane shear test.
Experiment 12	Determination of shear strength parameters of soil by unconsolidated undrained triaxial test.
Experiment 13	Determination of California Bearing Ratio (CBR) of soil.
Experiment 14	Determination of relative density of soil.
Experiment 15	Standard Penetration Test.

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Environmental Engineering Laboratory **Course Code: CE(PC)595**

Semester of Study: 5th (Semester V)

Course Type: Practical

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)595. 1	Test the various physical characteristics for a given sample of water and waste water.	Test	Analyse
CE(PC)595. 2	Recognize the various chemical characteristics for a given sample of water and waste water.	Recognize	Understand
CE(PC)595. 3	Examine the bacteriological characteristics for a given sample of water and waste water.	Examine	Analysis
CE(PC)595.4	Assess the suitability of a few treatment options for a given sample of water and waste water.	Assess	Evaluation
CE(PC)595. 5	Compare the determined quality parameters with standards to decide on the suitability of use for the tested water and disposal of tasted wastewater.	Compare	Analyse
CE(PC)595. 6	Use the most appropriate technique to purify and control water contamination.	Use	Application

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	3	-	2	3	-	2	2	-	1
CO2	3	2	-	2	-	2	3	-	2	2	-	1
CO3	3	3	-	2	-	2	3	-	2	2	-	1
CO4	3	3	-	2	-	2	2	-	2	2	-	1
CO5	3	2	-	2	-	1	2	-	2	2	-	1
CO6	3	2	3	1	-	2	3	-	2	2	-	1
Average	3	2.5	0.5	2	0	1.83	2.67	0	2	2	0	1

University Syllabus:

Experiment 1	Determination of turbidity for a given sample of water
Experiment 2	Determination of Electrical Conductivity for a given sample of water
Experiment 3	Determination of Total Solids, Suspended Solids, Dissolved Solids and Volatile Solids in a given sample of water
Experiment 4	Determination of pH for a given sample of water
Experiment 5	Determination of carbonate, bi-carbonate and hydroxide alkalinity for a given sample of water
Experiment 6	Determination of acidity for a given sample of water
Experiment 7	Determination of hardness for a given sample of water
Experiment 8	Determination of concentration of Iron in a given sample of water
Experiment 9	Determination of concentration of Chlorides in a given sample of water
Experiment 10	Determination of the Optimum Alum Dose for a given sample of water through Jar Test
Experiment 11	Determination of the Chlorine Demand and Break-Point Chlorination for a given sample of water
Experiment 12	Determination of amount of Dissolved Oxygen (DO) in a given sample of water
Experiment 13	Determination of the Biochemical Oxygen Demand (BOD) for a given sample of wastewater
Experiment 14	Determination of the Chemical Oxygen Demand (COD) for a given sample of wastewater
Experiment 15	Determination of Colliform Bacteria: presumptive test, Confirmative test and Determination of MPN

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Transportation Engineering Laboratory Course Code: CE(PC)596

Semester of Study: 5th (Semester V)

Course Type: Laboratory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)596.1	Classify and examine of aggregates through different tests.	Classify and Examine	Analysis
CE(PC)596.2	Examine the Specific Gravity test, Penetration test, and Static or Kinematic viscosity test on Bitumen.	Examine	Analysis
CE(PC)596.3	Examine Softening point test, Flash and Fire Point test and Ductility test on Bitumen.	Examine	Analysis
CE(PC)596.4	Calculate the CBR value of sub-grade (Soaked and Unsoaked).	Calculate	Analysis
CE(PC)596.5	To design the bituminous mix with Marshall stability test.	Design	Synthesis

CE(PC)596.6	Demonstrate on striping value, Loss on heating, Benkelman beam and Bump integrator test.	Demonstrate	Application

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	1	-	-	3	1	-	1
CO2	3	1	-	-	-	1	-	-	3	1	-	1
CO3	3	1	-	-	-	1	-	-	3	1	-	1
CO4	3	2	-	-	-	1	-	-	3	2	-	1
CO5	3	2	-	-	-	1	-	-	3	2	-	1
CO6	3	1	-	-	-	1	-	-	1	1	-	1
Average	3	1.33	0	0	0	1	0	0	2.66	1.33	0	1

University Syllabus:

CE(PC)596	**Transportation Engineering Laboratory**	2P	1 Credits
Introduction	Introduction on pavement construction materials		
Experiment	Shape test of aggregate.		
Experiment	Crushing strength test of aggregate.		
Experiment	Impact test of aggregate.		
Experiment	Los Angeles Abrasion test of aggregate.		
Experiment	Specific gravity and Water Absorption test of aggregate.		
Experiment	Specific Gravity test.		
Experiment	Penetration Test.		
Experiment	Static or Kinematic viscosity.		
Experiment	Softening point test.		
Experiment	Flash and Fire point test.		
Experiment	Ductility Test.		
Experiment	CBR value of sub-grade (Soaked and unsoaked).		
Experiment	Marshall Stability test.		
Demonstration	Demonstration on Stripping value and Loss on heating tests of bitumen, Benkelman beam and bump integrator test.		

Course Name: Computer Applications in Civil Engineering **Course Code: CE(PC)597**
Semester of Study: 5th (Semester - V)
Course Type: Practical

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, andin multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)597.1	Use the computer as a problem-solving tool.	Use	APPLY
CE(PC)597.2	Identify and formulate Civil Engineering problems solvable by computers.	Identify	UNDERSTAND
CE(PC)597.3	Solve Civil Engineering problems by illustrating linear algebra and matrix operations and their applications.	Solve	APPLY
CE(PC)597.4	Solve sets of linear equations and determine roots and nonlinear equations.	Solve	APPLY
CE(PC)597.5	Construct, interpret and solve simple optimization problems.	Construct	CREATE
CE(PC)597.6	Develop programs for Civil Engineering analysis and design problems and with the help of various software, analysis and design are done for industries.	Develop	CREATE

Course Articulation Matrix (CAM):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	0	2	2	2	1	2	1	0	2
CO2	3	3	2	0	2	2	2	1	2	2	0	2
CO3	3	3	3	1	3	2	2	1	2	3	0	2
CO4	3	3	3	1	3	2	2	1	2	3	0	2
CO5	3	3	2	1	2	2	2	1	2	3	0	2
CO6	3	3	3	3	3	2	2	1	3	3	3	2
Average	3	2.83	2.5	1	2.5	3	2	1	2.17	2.5	0.5	2

University Syllabus:

Module 1	**Introduction:** Concept of problem-solving using computer, use of programming language and software for problem solving; Identification of various design and analysis problems in different fields of Civil Engineering to be solved using computers; Procedure, formulae and data related to the analysis and design of such problems.
Module 2	**Use of spreadsheets:** Learning spreadsheets like MS Excel, matrix analysis, use of Goal Seek and Solver, Optimization Tools; Plotting. Applications to problems involving tabular data, CE estimation, surveying, and design problems.
Module 3	**Programming Languages:** Learning at least one language: Fortran 2003/2008/2018, C++11/C++14, Python 3, VBA 7.0; Computing platforms like Matlab/Scilab/MathCAD; Solving analysis and design problems in areas like surveying, hydraulics, structural analysis, RCC design, soil mechanics and foundation, transportation, water resources, etc.
Module 4	**Use of Software:** Familiarity with widely used Civil Engineering software like STAAD Pro, HEC- RAS, HEC-HMS, SWMM, Mx Roads, etc.; Solving at least two such analysis/design problems.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: SOFT SKILLS AND INTERPERSONAL COMMUNICATION 1.
Course Code: CE (OE) 601 A

Semester of Study: SIXTH

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: : Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE OE 601A.1	Analyse the dynamics of business communication and communicate accordingly**.**	Analyse/Apply	L4/ 3
CE OE 601A.2	Write business letters and reports	Apply	L 3
CE OE 601A.3	Learn to articulate opinions and views with clarity	Remember	L 1
CE OE 601A.4	. Appreciate the use of language to create beautiful expressions	Creat	L 6

CE OE 601A.5	Analyse and appreciate literature.	Understand and evaluate	L 2 /5
CE OE 601A.6	Communicate in an official and formal environment.	understand	L 2

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										*		
CO2										*		
CO3												*
CO4									*			
CO5						*						
CO6										*		
Average												

University Syllabus:

Module 1 : Communication Skill Definition, nature & attributes of Communication Process of Communication Models or Theories of Communication Types of Communication Levels or Channels of Communication Barriers to Communication

Module 2 : Business Communication- Scope & Importance Writing Formal Business Letters Writing Reports Organizational Communication: Agenda & minutes of a meeting, notice, memo, circular Project Proposal Technical Report Writing Organizing e-mail messages E-mail etiquette Tips for e-mail effectiveness

Module 3 : Language through Literature Modes of literary & non-literary expression Introduction to Fiction, (An Astrologer's Day by R.K. Narayan and Monkey's Paw by W.W. Jacobs), Drama (The Two Executioners by Fernando Arrabal) or (Lithuania by Rupert Brooke) & Poetry (Night of the Scorpion by Nissim Ezekiel and Palanquin Bearers by Sarojini Naidu)

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Construction Engineering & Management Code: CE(PC)601

Semester of Study: 6th (Semester VI)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)601.1	Prepare well planned building which balances all aspects of building such as space conditioning, ventilation, privacy etc. maintain building bye-laws regulations with respect to building side spaces and fire protections.	Prepare	Application
CE(PC)601.2	Inspect the project planning and control activities in the construction projects by using the techniques of PERT and CPM.	Inspect	Analysis
CE(PC)601.3	Apply the concept of wall panels , slabs, columns during erection of prefabricated buildings evaluate and choose appropriate shoring and scaffolding techniques for construction projects, understand the construction sequence of silos, chimneys and sky scrapers.	Apply	Application
CE(PC)601.4	Choose construction equipments for earthwork, material handling and miscellaneous purposes.	Choose	Application
CE(PC)601.5	Interpret the elements and types of contracts, Contract formation, Potential contractual problems,	Interpret	Evaluation

	Comparison of actions and laws, Powers and duties of arbitrator and types of laws, justify the legal requirements to solve contractual problems for managing construction contracts, achieve awareness on arbitrations, powers and duty of an arbitrator.		
CE(PC)601.6	List the idea of hierarchy, work responsibility of the administrator.	List	Knowledge

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CE(PC)601.1	3	3	3	-	-	-	-	-	-	-	-	1
CE(PC)601.2	3	3	3	-	1	-	-	-	-	-	2	1
CE(PC)601.3	3	3	3	-	1	-	-	-	-	-	-	1
CE(PC)601.4	3	3	3	-	3	-	-	-	-	-	-	1
CE(PC)601.5	2	-	2	-	1	-	-	-	-	-	1	1
CE(PC)601.6	1	-	-	-	-	1	-	1	-	-	3	1
Average	2.5	2	2.3	0	1	0.17	0	0.17	0	0	1	1

University Syllabus:

Module 1	**Planning:** General consideration, Definition of aspect, prospect, roominess, grouping, circulation, Privacy.
Module 2	**Regulation and Bye laws** Bye Laws in respect of side space, Back and front space, Covered areas, height of building etc., Lavatory blocks , ventilation, Requirements for stairs, lifts in publicassembly building, offices
Module 3	**Fire Protection** Fire fighting arrangements in public assembly buildings, planning , offices, **auditorium**
Module 4	**Planning &Scheduling of constructions Projects** Planning by CPM Preparation of network, Determination of slacks or floats. Critical activities. Critical path. Project duration. Planning by PERT Expected mean time, probability of completion of project, Estimation of critical path, problems
Module 5	**Construction Methods basics** Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges.
Module 6	**Construction plants & Equipment**

	Plants & equipment for earth moving, road constructions, excavators, dozers, scrapers, spreaders, rollers, their uses. **Plants &Equipment for concrete construction** Batching plants, Ready Mix Concrete, concrete mixers, Vibrators etc., quality control.
Module 7	Contracts Management basics Importance of contracts; Types of Contracts, parties to a contract; Common contractclauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution methods.
Module 8	**Management** Professional practice, Definition, Rights and responsibilities of owner, engineer, Contractors, types of contract
Module 9	**Departmental Procedures** Administration, Technical and financial sanction, operation of PWD, Tenders and itsnotification, EMD and SD, Acceptance of tenders, Arbitration.

Maulana Abul Kalam Azad University of Technology, West Bengal

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Engineering Economics, Estimation & Costing **Course Code: CE(PC)602**

Semester of Study: 6th (Semester VI)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)602.1	Have an idea of Economics in general, Economics of India particularly for public sector agencies and private sector businesses.	Learn	Remember
CE(PC)602.2	Be able to differentiate present worth, future worth and annual worth analyses on one of more economic alternatives.	Differentiate	Analyse
CE(PC)602.3	Be able to sketch benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.	Sketch	Apply
CE(PC)602.4	Be able to explain the technical specifications for various works to be performed for a project and how they impact the cost of a structure.	Explain	Understand
CE(PC)602.5	Be able to weigh the worth of a structure by evaluating quantities of constituents,	Weigh	Evaluate

	derive their cost rates and build up the overall cost of the structure.		
CE(PC)602.6	Be able to explain how competitive bidding works and how to submit a competitive bid proposal.	Explain	Understand

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	-	-	1	1	1	1	1	3	2
CO2	2	2	1	-	-	1	1	-	-	-	3	2
CO3	2	2	1	-	-	1	1	-	-	-	3	2
CO4	3	3	3	-	-	1	1	-	-	-	2	2
CO5	3	3	3	-	-	1	1	-	-	-	1	2
CO6	3	3	3	-	-	1	1	2	2	2	3	2
Average	2.5	2.5	2	0	0	1	1	0.5	0.5	0.5	2.5	2

University Syllabus:

Module 1	Basic Principles and Methodology of Economics. Demand/Supply – elasticity – Government Policies and Application. Theory of the Firm and Market Structure. Basic Macroeconomic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes.
Module 2	Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control – Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method.
Module 3	Estimation / Measurements for various items: Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying.
Module 4	Specifications: Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures.
Module 5	Rate analysis: Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity.
Module 6	Tender: Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management.
Module 7	Valuation: Values and cost, gross income, outgoing, net income, scrap value, salvage value, market value, Book Value, sinking fund, capitalised value, Y. P., depreciation, obsolescence, deferred income, freehold and leasehold property, mortgage, rent fixation, valuation table.
Module 8	Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Water Resources Engineering **Course Code: CE(PC)603**

Semester of Study: 6th (Semester VI)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)603.1	Explain the fundamentals of flow in open channels.	Explain	Understand
CE(PC)506.2	Describe the concepts of irrigation	Describe	Understand
CE(PC)506.3	Estimate the quantity of water required by different crops in different seasons, and accordingly the irrigation water requirement.	Estimate	Evaluate
CE(PC)506.4	Design canals and other irrigation structures required for irrigation and other water-management projects.	Design	Create
CE(PC)506.5	Design drains required for land drainage, soil conservation, flood control.	Design	Create
CE(PC)603.6	Define about groundwater resources, aquifers and wells.	Define	Remember

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	0	0	0	0	0	0	0	2
CO2	3	0	1	0	0	3	1	0	0	0	0	0
CO3	3	3	3	3	1	1	1	0	0	0	0	3
CO4	3	3	3	3	0	1	0	0	0	0	0	1
CO5	3	2	2	0	0	1	1	0	0	0	0	0
CO6	3	1	0	0	0	1	1	0	0	0	0	0
Average	3	2	1.8	1.2	0.3	1.2	0.7	0	0	0	0	2

University Syllabus:

Module 1	**Open Channel Flow:** Channel Characteristics and parameters, Energy-depth relationship, Specific Energy concept, Critical Flow, Hydraulic Jump, Uniform flow, Efficient sections, Slope profiles, Gradually varied flow, Water surface profiles.
Module 2	**Irrigation:** Definition, Necessity, Scope, Benefits of Irrigation; Types, techniques and sources of irrigation; Development of irrigation in India.
Module 3	**Soil-water plant relationship:** Types of crops, cropping seasons, water requirement of crops, base period, kor period, Duty, Delta, Commanded area, Net Irrigation Requirement, Field Irrigation requirement, Gross Irrigation Requirement, Intensity of Irrigation, Consumptive use of water, Estimation of Evapotranspiration, Blaney-Criddle method, Modified Penman's method, Irrigation Efficiencies, Frequency of irrigation.
Module 4	**Canal irrigation:** Classification of irrigation canals, canals in alluvium; Design of unlined canals: Kennedy's method, Lacye's method; Lined canals: advantages, materials used, typical sections, design of lined canals, economics of canal lining; Canal sections- filling, cutting, partial cutting and partial filling.
Module 5	**Land Drainage:** Water logging issues in irrigation, provisions of drains, design and maintenance of open drains, closed drains, discharge and spacing of closed drains.
Module 6	**Groundwater:** Occurrence of groundwater- Aquifers, Various types of aquifers, Aquifer Parameters: Specific Yield, Specific Retention, Storage Coefficient, Transmissivity.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Design of Steel Structures **Course Code: CE(PC)604**

Semester of Study: 6th (Semester VI)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)604.1	Identify the material properties of structural steel.	Identify	Understand
CE(PC)604.2	Design different bolted and welded connections for axial and eccentric loads.	Design	Create
CE(PC)604.3	Design the tension, compression & column bases member under axial and combined loading.	Design	Create
CE(PC)604.4	Differentiate between laterally supported and unsupported flexure members and Design the flexure members using Indian codes of practice.	Differentiate and Design	Create
CE(PC)604.5	Examine shear force and bending moment on plate girders, and finally design it following Indian standard design guidelines.	Examine and Design	Create
CE(PC)604.6	Identify different components of gantry girders, examine lateral and vertical	Identify, Examine and	Create

	loads acting on the gantry girders and design them.	Design	

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CE(PC)604.1	2	1	-	-	-	1	1	-	-	-	-	-
CE(PC)604.2	3	3	2	1	-	1	-	1	-	1	-	1
CE(PC)604.3	3	3	2	1	-	1	-	1	-	1	-	1
CE(PC)604.4	3	3	2	1	-	1	-	1	-	1	-	1
CE(PC)604.5	3	3	2	1	-	1	-	1	-	1	-	1
CE(PC)604.6	3	3	2	1	-	1	-	1	-	1	-	-
Average	2.8	2.7	1.7	0.8	0	1	0.2	0.8	0	0.8	0	0.7

University Syllabus:

Module 1	Materials and Specification: Rolled steel sections, mechanical properties of steel and their specifications for structural use. Codes of practices. Design of Steel structures using tubular, rectangular and square section
Module 2	Structural connections: Riveted, welded and bolted including High strength friction grip bolted joints. — types of riveted & bolted joints, assumptions, failure of joints, efficiency of joints, design of bolted, riveted & welded joints for axial load. Eccentric connection:- Riveted & bolted joints subjected to torsion & shear, tension & shear, design of riveted, bolted & welded connection.
Module 3	Design of Tension members: Design of tension members, I.S. code provisions. Permissible stresses, Design rules, Examples.
Module 4	Design of Compression members: Effective lengths about major & minor principal axes, I.S. code provisions. Permissible stresses, Design rules, Design of one component, two components and built up compression members under axial load. Examples. Built up columns under eccentric loading: Design of lacing and batten plates, Different types of Column Bases- Slab Base , Gusseted Base, Connection details
Module 5	Design of Beams: Permissible stresses in bending, compression and tension. Design of rolled steel sections, plated beams. simple Beam end connections, beam -Column connections. I.S. code provisions
Module 6	Design of Plate girders: Design of webs & flanges, Concepts of curtailment of flanges — Riveted & welded web stiffeners, web flange splices - Riveted, welded & bolted.
Module 7	Design of Gantry Girder: Design gantry girder considering lateral buckling — I.S. code provisions.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Foundation Engineering **Course Code: CE(PE)601B**

Semester of Study: 6th (Semester VI)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PE)601B.1	Classify the shallow and deep foundation Determine the load carrying capacity of pile foundation.	Classify	Comprehension
CE(PE)601B.2	Calculate the efficiency and settlement of pile group.	Calculate	Analysis
CE(PE)601B.3	Express different subsoil exploration methods and interpret field and laboratory test data to obtain design parameters for geotechnical analysis.	Express & interpret	Application
CE(PE)601B.4	Categorize bearing capacity of shallow foundation from field test data.	Categorize	Analysis
CE(PE)601B.5	Analyze and design sheet pile structure on the basis of earth pressure theories.	Analyze	Analysis
CE(PE)601B.6	Identify and apply various types of ground improvement methods for solving complex geotechnical problems.	Identify & Apply	Application

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CE(PE)601B.1	3	3	2	-	-	-	-	-	-	-	-	2
CE(PE)601B.2	3	3	2	-	-	-	-	-	-	-	-	2
CE(PE)601B.3	3	3	2	-	-	-	-	-	-	-	-	2
CE(PE)601B.4	3	3	2	-	-	-	-	-	-	-	-	2
CE(PE)601B.5	3	3	2	-	-	-	-	-	-	-	-	2
CE(PE)601B.6	3	3	2	-	-	-	-	-	-	-	-	2
Average	3	3	2	0	0	0	0	0	0	0	0	2

University Syllabus:

Module 1	Classification, selection- shallow and deep foundations.
Module 2	Pile foundation: Types of piles, material, Suitability and uses, Method of installation of piles - classification of piles based on material, Installation Techniques – Selection and uses, Determination of types and lengths of piles, Load transfer mechanism, Determination of load carrying capacities of piles by static and dynamic formulae as per IS codes, Pile spacing and group action, Group efficiency, Negative skin friction, Pile load test, Settlement of pile group, Lateral load capacity of pile by IS: 2911 and Reese & Matlock methods, Uplift capacity of pile - introduction.
Module 3	**Site Investigation & Soil Exploration** Planning of sub-surface exploration, Methods of boring, sampling, Different types of samples, Spacing, Depth and number of exploratory borings, Bore log, Preparation of sub-soil investigation report. **In-situ tests** Standard penetration test, Static cone penetration test, Dynamic cone penetration test, Field vane shear test, Plate load test. **Indirect methods of soil exploration** Geophysical method: seismic refraction and electrical resistivity methods.
Module 4	**Shallow Foundations** Bearing Capacity from SPT, SCPT and Plate load Test data. of loads and moments, Bearing capacity as per IS: 6403.
Module 5	Type of sheet pilling, Design of sheet pile, Cantilever sheet piling, Anchored sheet piling, Free earth and fixed earth support methods, Analysis with anchored bulk heads.
Module 6	**Introduction to Ground Improvement Techniques** Introduction, Economic considerations, Consolidation by preloading and sand drains, Stone columns, Compaction by vibro-floatation, Grouting techniques and principles, Applications of geo-synthetics, Ground anchors and soil nailing.

Course Name: Structural Analysis – II CE(PE)602B

Semester of Study: 6th (Semester VI)

Course Type: Theory

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Program Outcome (PO):

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE (PE)602B.1	Apply the Slope Deflection and Moment Distribution Method to analyze indeterminate structures.	Apply	Apply
CE (PE)602B.2	Develop and analyze the concept of suspension bridge and stiffness girders	Analyse	Analyse
CE (PE)602B.3	Apply and analyze the concepts of curved beam analysis in hooks, rings and bow girders. Develop the concept bending in unsymmetrical beams.	Develop	Analyse
CE (PE)602B.4	Develop the fundamental concepts of plastic analysis using kinematic method and apply them in frames and continuous beam analysis.	Apply	Apply
CE (PE)602B.5	Develop and analyze the portal frames using Portal and Cantilever method.	Analyse	Analyse
CE (PE)602B.6	Develop and analyze the indeterminate structures (continuous beams and frames) using flexibility and stiffness matrix method.	Analyse	Analyse

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	-	-	-	-	-	-	-	1
CO2	3	3	3	3	-	-	-	-	-	-	-	-
CO3	3	3	3	3	-	-	-	-	-	-	-	1
CO4	3	3	3	3	-	-	-	-	-	-	-	2
CO5	3	3	3	3	-	-	-	-	-	-	-	-
CO6	3	3	3	3	-	-	-	-	-	-	-	1
Average	3	3	3	3	0	0	0	0	0	0	0	0.83

University Syllabus:

Module 1	Analysis of statically Indeterminate Structures: Moment distribution method-solution of continuous beam, effect of settlement and rotation of support, frames with or without side sway. Slope deflection method: method and application in continuous beams and frames. Suspension Bridge and stiffening girders.
Module 2	Curved Beam analysis: Hooks, rings and Bow girders. Unsymmetrical bending.
Module 3	Plastic analysis of structures: beams and portal frames.
Module 4	Approximate method of analysis of structures: Portal and Cantilever methods. 4L Module 5
Module 5	Matrix methods of structural analysis – Stiffness and flexibility approaches for analysis of beam.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Water resources Engineering Laboratory Course Code: CE(PC)693

Semester of Study: 6th (Semester VI)

Course Type: Laboratory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)693.1	Prepare a diagram of the catchment area for any water body manually or using DEM.	Prepare	Synthesis
CE(PC)693.2	Calculate the average rainfall over a catchment.	Calculate	Analysis
CE(PC) 693.3	Measure the rainfall data using different types of rain-gauges.	Measure	Evaluation
CE(PC) 693.4	Measure the rate of infiltration of water through the soil.	Measure	Evaluation
CE(PC) 693.5	Measure the evaporation using evaporimeter.	Measure	Evaluation
CE(PC) 693.6	Measure the sunshine hours in a particular day.	Measure	Evaluation

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	0	3	0	1	0	1	2	1	0
CO2	3	3	2	1	0	2	2	0	2	2	1	1
CO3	3	2	0	1	3	0	2	0	3	2	1	1
CO4	3	2	0	0	3	0	2	0	3	2	1	1
CO5	3	2	0	0	3	0	2	0	3	2	1	1
CO6	3	1	0	1	3	1	2	0	3	2	1	0
Average	3	1.83	0.5	0.5	1.5	0.5	1.83	0	2.5	2	1	0.67

University Syllabus:

CE(PC)693	**Water Resources Engineering Laboratory**
Experiment 1	Catchment area delineation (Manually and using DEM).
Experiment 2	Calculation of average rainfall over a catchment area with arithmetic mean method, Thiessen polygon method and Isohyetal Method.
Experiment 3	Use of different type of Rain-Gauges.
Experiment 4	Measurement of infiltration rate using double ring infiltrometer.
Experiment 5	Measurement of evaporation using evaporimeter.
Experiment 6	Measurement of bright sunshine hours using sunshine recorder.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Steel Structure Design Sessional Code:CE(PC)694

Semester of Study: 6th (Semester VI)

Course Type: Sessional

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)694.1	Identify the material properties of structural steel. Moreover, the students will identify different bolted and welded connections, analyse and design them for axial and eccentric loads.	Identify	Understand
CE(PC)694.2	Design different steel sections subjected to axial compression and tension following Indian codes of practices.	Design	Synthesis
CE(PC)694.3	Identify the differences between laterally supported and unsupported flexure members. Designing of the flexure members using Indian codes of practice.	Identify	Understand
CE(PC)694.4	Analyse and design rolled and built up compression members along with base connection subjected to axial compression, bending and tension.	Analyse	Analysis
CE(PC)694.5	Calculate shear force and bending moment on rolled and built up girders, dimension the section and finally design it following Indian standard design guidelines.	Calculate	Analysis
CE(PC)694.6	Identify different components of gantry system, calculate lateral and vertical loads acting on the system, dimension the components and design them. Design different components of an industrial building.	Identify	Understand

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	-	2	2	-	2	2	-	1
CO2	2	2	1	2	-	1	1	-	3	1	-	3
CO3	2	3	2	1	-	3	1	-	1	1	-	1
CO4	2	3	3	2	-	2	2	-	2	3	-	2
CO5	2	2	1	1	-	1	2	-	2	1	-	3
CO6	3	2	1	2	-	3	1	-	1	3	-	3
Average	2.17	2.33	1.5	1.67	0	2	1.84	0	1.84	1.83	0	2.17

University Syllabus:

Prerequisite	DesignofSteel Structures (CE(PC)604
	Design of a factory shed including preparation of necessary working drawings and report in accordance with CE(PC)604

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Quantity Survey Estimation & Valuation

Course Code: CE(PC)695

Semester of Study: 6th

Course Type: Sessional

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PC)695. 1	Explain about Quantity Surveying, different types of estimates, items of work and their units.	Explain	Understand
CE(PC)695. 2	Analyze the schedule of rates	Analyze	Analysis
CE(PC)695. 3	Prepare the specification of materials & works.	Prepare	Application
CE(PC)695. 4	Prepare bar bending schedule for RCC structure	Prepare	Application
CE(PC)695. 5	Interpret the fundamental concept of valuation	Interpret	Evaluation
CE(PC)695. 6	Estimate the detailed quantity of material consumption and abstracts for constructions for single storied building, road, Underground reservoir, Surface drain, Septic tank	Estimate	Evaluation

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	2	1	-	-	1	2	-
CO2	3	2	-	-	1	2	-	2	-	1	2	1
CO3	3	1	2	-	-	2	-	1	-	1	2	1
CO4	3	3	2	1	2	2	-	1	2	1	2	1
CO5	3	1	-	-	3	2	2	3	2	2	3	1
CO6	3	-	2	-	2	2	1	3	3	2	3	3
Average	3	1.17	1	0.17	1.34	2	0.67	1.67	1.17	1.34	2.34	1.17

University Syllabus:

1. Quantity Surveying: Types of estimates, approximate estimates, items of work, unit of measurement, unit rate of payment.
2. Quantity estimate of a single storied building
3. Bar bending schedule.
4. Details of measurement and calculation of quantities with cost, bill of quantities, abstract of quantities.
5. Estimate of quantities of road, Underground reservoir, Surface drain, Septic tank.
6. Analysis and schedule of rates: Earthwork, brick flat soling, DPC, PCC and RCC, brick work, plastering, flooring and finishing,
7. Specification of materials: Brick, cement, fine and coarse aggregates
8. Specification of works: Plain cement concrete, reinforced cement concrete, first class brickwork, cement plastering, pointing, white washing, colour washing, distempering, lime punning, painting and varnishing
9. Valuation: Values and cost, gross income, outgoing, net income, scrap value, salvage value, market value, Book Value, sinking fund, capitalised value, Y. P., depreciation, obsolescence, deferred income, freehold and leasehold property, mortgage, rent fixation, valuation table

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Metro System and Engineering **Course Code: CE(OE)701A**

Semester of Study: 7th (Semester VII)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(OE)701A.1	Describe the overview of metro system.	Describe	Understand
CE(OE)701A.2	Design the construction methods related to civil engineering structures of metro system.	Design	Create
CE(OE)701A.3	Design the survey, planning and managements related to civil engineering structures of metro system.	Design	Create
CE(OE)701A.4	Explian about required electronics and communication system for Metro system.	Explain	Understand
CE(OE)701A.5	Identify different parts of the mechanical structure for metro system and engineering.	Identify	Understand

CE(OE)701A.6	Apply knowledge on the Electrical system required for metro system and engineering.	Apply	Apply

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	0	0	1	0	1	1	0	0	0	0	0
CO2	3	3	3	3	0	1	1	0	0	0	0	0
CO3	3	2	2	1	0	1	1	0	0	0	1	0
CO4	3	2	2	1	0	1	1	0	0	0	0	0
CO5	3	2	2	1	0	1	1	0	0	0	0	0
CO6	3	2	2	1	0	1	1	0	0	0	0	0
Average	3	1.9	2	1.3	0	1	1	0	0	0	0.3	0

University Syllabus:

Module 1	Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financial.
Module 2	**CIVIL ENGINEERING:** Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management.
Module 3	**ELECTRONICS AND COMMUNICATION ENGINEERING:** Signalling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors.
Module 4	**MECHANICAL & TV + AC** Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators
Module 5	**ELECTRICAL:** OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Hydraulic Structures **Course Code: CE(PE)701C**

Semester of Study: 7th (Semester VII)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

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PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PE)701C.1	Identify the characteristics of various types of dams and their selection procedure.	Identify	Understand
CE(PE)701C.2	Operate the reconnaissance survey and, geophysical investigations necessary for selection of suitable dam site.	Operate	Apply
CE(PE)701C.3	Examine forces acting on gravity dams and develop stability analysis.	Examine and Develop	Create
CE(PE)701C.4	Examine the seepage loss through embankment dams and construct necessary remedial measures.	Examine and construct	Create
CE(PE)701C.5	Describe various diversion head works and their components, including creep in foundation.	Describe	Understand
CE(PE)701C.6	Examine the discharge through the overflow section and design the appropriate energy dissipation structures.	Examine and design	Create

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CE(PE)701C.1	3	2	-	-	-	1	1	-	-	-	-	-
CE(PE)701C.2	3	2	-	-	-	1	1	-	-	-	-	-
CE(PE)701C.3	3	3	2	1	-	2	-	1	-	1	-	1
CE(PE)701C.4	3	3	2	1	-	2	-	1	-	1	-	1
CE(PE)701C.5	3	3	1	-	-	2	-	-	-	-	-	-
CE(PE)701C.6	3	3	2	1	-	2	-	1	-	-	-	1

Average	3	2.7	1.2	0.5	0	1.7	0.3	0.5	0	0.3	0	0.5

University Syllabus:

Module 1	Storage Structures: Dams, Types of Dams — Embankment dams, gravity dams, various components and their functions
Module 2	Selection of Dam Site: Site investigations, initial study, reconnaissance survey, geophysical investigations, preliminary selection, evaluation of selected site -various types of foundation testing, field testing and borrow pit investigations, detailed investigations; assessment of foundation characteristics and suitability; selection of type of dam.
Module 3	Gravity Dam: Definition, Features of some important gravity dams, Forces acting on a gravity dam, estimation of forces due to: self-weight, water pressure on upstream and downstream face, Uplift pressure, wave pressure, silt pressure, wind pressure, earthquake forces, hydrodynamic forces; Stability analysis - load combinations, codal provisions, modes of failures - overturning, sliding, tension and compression failures, factors of safeties, principal stresses; Elementary profile of a gravity dam - forces acting, minimum base width - no tension, no sliding basis, principal stresses.
	Embankment Dams: Definitions, Features of some important embankment dams- Types of embankment dams and their sectional features; Design criteria; Freeboard - necessity, estimation procedure; Seepage analysis - Laplace's flow equations, drainage blanket and rock toe, phreatic line, graphical procedure of drawing phreatic line, estimation of seepage loss; Stability analysis of embankment dams — slip circle method; Seepage Control - cut-offs, slurry trench, sheet piling, grouting, slope protection.
	Diversion headworks: Necessity and uses, different types, layout and different components; weirs on permeable foundation, Creep theories, Khosla's method; Different types of modules, Canal escapes, Silt control devices.
Module 4	Spillways and Energy Dissipation Structures: Necessity, types, selection, spillway gates; High overflow ogee spillway - profile, discharge computation, flow equations, factors affecting coefficient of discharge, codal provisions. stilling basins (USSR and BIS) types.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Prestressed Concrete **Course Code: CE(PE)702A**

Semester of Study: 7th (Semester VII)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

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PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PE)702A.1	Learn the introduction of prestressed concrete member and its deflection properties.	Learn	Understand
CE(PE)702A.2	Develop the design criteria of prestressed concrete section for flexure and shear properties.	Develop	Create
CE(PE)702A.3	Design the anchorage zone stress for post-tensioned members.	Design	Create
CE(PE)702A.4	Use the methods for Analysis of Statically Indeterminate Structures.	Use	Apply
CE(PE)702A.5	Explain the composite construction of Prestress and In-situ concrete.	Explain	Understand
CE(PE)702A.6	Design the Prestressed concrete poles and sleepers and introduction of partial prestressing.	Design	Create

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	1	1	0	0	1	0	2
CO2	3	3	3	-	-	1	1	0	0	1	0	2
CO3	3	3	3	-	-	1	1	0	0	1	0	2
CO4	3	3	3	-	-	0	0	0	0	1	0	2
CO5	3	3	3	-	-	0	0	0	0	1	0	2
CO6	3	3	3	-	-	0	0	0	0	1	0	2
Average	3	3	3	0	0	0.5	0.5	0	0	1	0	2

University Syllabus:

Module 1	Introduction of Prestressed concrete: Materials, prestressing system, analysis of prestress and bending stress, losses Shear and torsional resistance: design of shear reinforcement, design of reinforcement for torsion shear and bending. Deflections of prestressed concrete members: Importance, factors, short term and long term deflection.
Module 2	Shear and Torsional Resistance: Design of Shear Reinforcement, Design of Reinforcement for Torsion, Shear and Bending. Limit State Design Criteria: Inadequacy of Elastic and Ultimate Load Method, Criteria for Limit States, Strength and Serviceability. Design of Prestressed Concrete Section: for Flexure & methods by Lin and Magnel.
Module 3	Anchorage Zone stresses in post tensioned members: Stress distribution in end block, anchorage zone reinforcement.
Module 4	Statically Indeterminate Structures: Advantages of Continuous Member, Effect of Prestressing, Methods of Achieving Continuity and Method of Analysis of Secondary Moments.
Module 5	Composite Construction of Prestressed and In-situ Concrete: Types, Analysis of Stresses.
Module 6	Prestressed Concrete Poles and Sleepers: Design of Sections for Compression and Bending. Introduction to Partial Prestressing.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Air and Noise Pollution and Control **Course Code: CE(PE)703A**

Semester of Study: 7th (Semester VII)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PE)703.1	To explain the basic concepts and terminologies regarding air pollution and noise pollution	Explain	Understand
CE(PE)703.2	To demonstrate the physics of air pollution and noise pollution	Demonstrate	Apply
CE(PE)703.3	To use the methods to solve the air pollution and noise pollution measurements	Solve	Apply
CE(PE)703.4	To examine different concepts of air and noise pollution for solving mathematical problems	Examine	Analyse
CE(PE)703.5	To investigate air and noise quality with allowable standards and limits	Investigate	Create

CE(PE)703.6	To select and design proper techniques for air pollution, noise pollution, and control	Select	Evaluate

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	0	2	3	1	0	0	0	2
CO2	3	2	1	2	2	2	3	1	0	1	0	2
CO3	3	3	3	3	3	2	3	2	1	1	1	2
CO4	3	3	3	3	3	3	3	2	2	3	1	2
CO5	3	3	3	3	3	2	3	0	2	2	1	2
CO6	3	3	3	3	3	3	3	2	2	3	2	2
Average	3	2.83	2.5	2.66	2.33	2.33	1	1.33	1.16	1.66	0.83	2

University Syllabus:

Module 1	Air Pollutants: Sources; Classification; Effects on Human, Vegetation, Material Effects of Air pollution on Atmosphere: Photochemical Smog, Ozone Layer Depletion, Acid Rain, Greenhouse Effect and Global Warming
Module 2	Air Pollution Meteorology: Lapse Rate; Atmospheric Stability; Inversion; Plume Pattern
Module 3	Dispersion of Air Pollutants: Point Source Gaussian Plume Model, Stability Classes, Stability Charts, Design of Stack Height
Module 4	Air Quality: Methods of Measurement: Gaseous pollutants, Particulate pollutants, Air Quality Standards and Indices: Ambient Air Quality Standard, NAAQS, Emission Standard, Air Quality Indices.
Module 5	Air Pollution Control: Control of Gaseous Pollutants: Adsorption, Absorption, Condensation Control of Particulate Pollutants: Settling chambers, Cyclone separators, Wet collectors, Fabric filters, Electrostatic precipitators Control of Pollution from Automobiles
Module 6	Physics of Noise: Basics of Acoustics; Sound Pressure, Power and Intensity and their Interrelations
Module 7	Measurement of Noise: Noise Level; Interrelation between Noise, Pressure, Power and Intensity Levels; Noise Meter; Noise Networks; Frequency Band Analysis; Decibel Addition Measurement of Community Noise: L_N, L_{eq}, L_{dn},, L_{NP}
Module 8	Source and Effect of Noise: Psychoacoustics and noise criteria; effects of noise on health; annoyance rating schemes
Module 9	Noise Pollution Control: Noise Standards and Limits; Methods of Noise Pollution Control

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Advanced Structural Analysis **Course Code: CE(PE)704B**

Semester of Study: 7th (Semester VII)

Course Type: Theory

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Program Outcomes (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PE)704B.1	To use matrix methods of structural analysis for plane trusses, beams, continuous frames.	Use	Application
CE(PE)704B.2	To solve simple problems by the finite difference method.	Solve	Application
CE(PE)704B.3	To identify various relaxation techniques used in structural analysis.	Identify	Comprehension
CE(PE)704B.4	To demonstrate three dimensional stress and strain analysis, stress invariants, equilibrium and compatibility equations.	Demonstrate	Application
CE(PE)704B.5	To identify plane stress, plane strain problems.	Identify	Comprehension
CE(PE)704B.6	To solve simple plate and shell problems.	Solve	Application

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	0	0	0	0	1	0	1
CO2	3	2	1	1	0	0	0	0	0	1	0	1
CO3	3	2	1	1	1	0	0	0	0	1	0	1
CO4	3	2	1	1	0	0	0	0	0	1	0	1
CO5	3	2	1	1	0	0	0	0	0	1	0	1
CO6	3	2	1	1	0	0	0	0	0	1	0	1
Average	3	2	1	1	0.33	0	0	0	0	1	0	1

University Syllabus:

Module 1	Matrix Methods of Structural Analysis: Application of matrix methods to plane truss, beams, continuous frames
Module 2	Finite difference and relaxation technique- application to simple problems.
Module 3	Theory of plate bending: Navier's Sol utions. Levy's solution. Plate buckling problem. Membrane theory of domes and cylindrical shells.
Module 4	Theory of Elasticity: Three dimensional stress and strain analysis, stress strain transformation, stress invariants, equilibrium and compatibility equations. Two dimensional problems in Cartesian and polar coordinates. Plane stress, plane stain problems, St. Venant's principle.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Pavement Design **Course Code: CE(PE)705B**

Semester of Study: 7th (Semester VII)

Course Type: Theory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PE)705.1	Differentiate between different types of pavements, both structurally and functionally.	Differentiate	Analyse
CE(PE)705.2	Execute Axle Load Survey and Estimate Design Traffic.	Execute	Apply
CE(PE)705.3	Classify different stresses, strains and deflections in flexible and rigid pavements.	Classify	Understand
CE(PE)705.4	Design different components of bituminous pavement.	Design	Create
CE(PE)705.5	Identify the specifications and design criteria of low-volume rigid pavement.	Identify	Understand
CE(PE)705.6	Recognize the principles of Pavement Maintenance and identify various pavement distresses	Recognize, Identify	Understand

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CE(PE)705.1	2	2	-	-	-	-	-	-	-	-	-	-
CE(PE)705.2	3	3	3	3	1	-	-	-	-	1	-	2
CE(PE)705.3	3	3	-	-	-	-	-	-	-	-	-	1
CE(PE)705.4	3	3	3	3	-	-	-	-	-	1	-	2
CE(PE)705.5	3	3	3	3	-	-	2	-	-	1	-	1
CE(PE)705.6	3	3	-	-	-	-	-	-	-	-	-	-
Average	2.83	2.83	1.5	1.5	.16	0	0.3	0	0	0.5	0	1

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

University Syllabus:

Module 1	**Pavement Design** Flexible Pavement Design: Stresses and Deflections in homogeneous masses.; Burmister's two layer theory; Three layer and multi-layer theories; wheel load stresses, various factors in traffic wheel loads; ESWL of multiple wheels; McLeod method of design; AASTHO method of flexible pavement design. Low Volume Rigid Pavement: Criteria of Load, Scope and Specifications as per different Govt policies in India, Design Criteria.
Module 2	**Pavement Construction and Management** Flexible Pavement Construction: Earthwork (Method of Alignment-wise marking using chainage), compaction of embankments, construction methods and field control checks for various types of flexible pavement materials in sub-base, base, binder and surface course layers; Construction procedure of Low Volume Rigid Pavement.
Module 3	**Pavement Evaluation - Pavement Distress** Functional condition evaluation of pavements- Roughness, Skid Resistance, Serviceability Index; Structural evaluation of pavements –Benkelman beam and Falling Weight Deflectometer; Pavement strengthening; Design of bituminous and concrete overlays as per IRC

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Industrial Internship Code: CE(IN)791

Semester of Study: 7th (Semester VII)

Course Type: Practical/Sessional

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(IN)791.1	Apply fundamental principles of engineering to find solutions based on a systems approach which integrate theory with practice.	Apply	Application
CE(IN)791.2	Demonstrate skills to work in a team and understand to work with people from diverse backgrounds.	Demonstrate	Application
CE(IN)791.3	Develop the skills required in a profession to become updated with the latest technical advancements and adapt to the changes of the industry.	Develop	Synthesis
CE(IN)791.4	Develop communication and interpersonal skills as per the Industry standards.	Develop	Synthesis
CE(IN)791.5	Evaluate leadership skills by accomplishing the tasks assigned by the industry.	Evaluate	Evaluation
CE(IN)791.6	Analyze the challenges and future of potential career in an organization in particular and the sector in general.	Analyze	Analysis

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CE(IN)791.1	3	3	2	2	3	-	-	-	1	-	3	3
CE(IN)791.2	-	-	1	1	2	2	-	2	3	1	3	3
CE(IN)791.3	2	2	3	2	3	-	-	2	-	-	2	3
CE(IN)791.4	-	-	-	-	1	-	-	-	-	3	2	3
CE(IN)791.5	1	1	1	-	1	-	-	3	2	-	3	3
CE(IN)791.6	-	2	3	1	2	2	1	2	1	-	2	3
Average	1	1.3	1.67	1	2	0.67	0.17	1.5	1.17	0.67	2.5	3

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Project I **Course Code: CE(PROJ)792**

Semester of Study: 7th (Semester VII)

Course Type: Sessional

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PROJ)792.1	To recognize the scope of the problem and conduct a Literature review	Identify	Understand
CE(PROJ)792.2	To use existing/new methods to apply the fundamental aspects of civil engineering and their relevance with respect to the societal benefit	Execute	Apply
CE(PROJ)792.3	To set up experimentation/design/development of models to analyze and compare the results	Formulate	Create
CE(PROJ)792.4	To identify the modern techniques to collect the data & solve the real-life problems	Develop	Create
CE(PROJ)792.5	To Identify the solutions and relate them with the literature with proper analysis of the problem	Discuss	Understand

CE(PROJ)792.6	To develop the ability of working in the groups and to develop skills related to comprehensive report writing.	Report	Understand

Course Articulation Matrix:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	3	3	2	2	2	1	3	0	2	2
CO2	3	3	3	3	2	2	2	0	3	0	3	2
CO3	3	3	3	2	3	2	2	2	3	1	3	2
CO4	3	3	3	2	3	3	3	2	3	2	3	2
CO5	3	3	3	3	3	2	2	2	3	3	3	2
CO6	3	2	3	2	3	2	0	3	3	3	3	3
Average	3	2.66	3	2.5	2.67	2.16	1.83	1.67	3	1.5	2.83	2.16

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Professional Practice, law & Ethics Course Code: CE(HS)801A

Semester of Study: 8th (Semester VIII)

Course Type: Theory

Course Category: Humanities and Social Sciences including Management courses

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(HS)801.1	Recognize the importance of Values and Ethics in their Personal lives and professional careers.	Recognize	Understand
CE(HS)801.2	Discuss the key principles, aspects and purpose of contract management	Discuss	Understand
CE(HS)801.3	Implement the process for tender, bid evaluation, contract documentation, and contract notices	Implement	Apply
CE(HS)801.4	Discuss Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system	Discuss	Understand
CE(HS)801.5	Identify the role of labour in civil engineering and methods of engaging labour	Identify	Understand
CE(HS)801.6	Identify the need for intellectual property, main forms of IP, Copyright, Trademarks, and the process of obtaining Patents.	Identify	Understand

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CE(HS)801.1	-	-	-	-	-	2	-	3	-	-	-	1
CE(HS)801.2	-	-	-	-	-	2	-	2	-	-	-	-
CE(HS)801.3	3	2	-	-	-	2	-	3	-	1	2	2
CE(HS)801.4	-	-	-	-	-	2	-	2	-	1	2	-
CE(HS)801.5	-	-	-	-	-	2	-	2	-	1	1	-
CE(HS)801.6	3	-	-	-	-	3	-	3	-	1	-	2
Average	1	0.33	0	0	0	2.16	0	2.5	0	0.66	0.83	0.83

University Syllabus:

Module 1	**Professional Practice:** Respective roles of various stakeholders: Government(constituting regulatory bodies and standardization organizations, prescribing norms to ensure safety of the citizens); Standardization Bodies (ex. BIS, IRC)(formulating standards of practice);professional bodies (ex. Institution of Engineers(India), Indian Roads Congress, IIA/COA, ECI, Local Bodies/ Planning Authorities) (certifying professionals and offering platforms for interaction);Clients/ owners (role governed by contracts); Developers (role governed by regulations such asRERA); Consultants (role governed by bodies such as CEAI); Contractors (role governed by contracts and regulatory Acts and Standards); Manufacturers/ Vendors/ Service agencies (rolegoverned by contracts and regulatory Acts and Standards) Professional Ethics – Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in the website of Institution of Engineers (India); Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistleblowing, protected disclosures.
Module 2	**General Principles of Contracts Management:** Indian Contract Act, 1972 and amendments covering General principles of contracting; Contract Formation & Law; Privacy of contract; Various types of contract and their features; Valid & Voidable Contracts; Prime and subcontracts; Joint Ventures & Consortium; Complex contract terminology; Tenders, Request For Proposals, Bids & Proposals; Bid Evaluation; Contract Conditions & Specifications; Critical /"Red Flag" conditions; Contract award & Notice To Proceed; Variations & Changes in Contracts; Differing site conditions; Cost escalation; Delays, Suspensions & Terminations; Time extensions &Force Majeure; Delay Analysis; Liquidated damages & Penalties; Insurance & Taxation; Performance and Excusable Nonperformance; Contract documentation; Contract Notices; Wrong practices in contracting (Bid shopping, Bid fixing, Cartels); Reverse auction; Case Studies; Build-Own-Operate & variations; Public- Private Partnerships; International Commercial Terms
Module 3	**Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system**: Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996; UNCITRAL model law –Arbitration and expert determination; Extent of judicial intervention; International commercial arbitration; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Award including Form and content, Grounds for setting aside an award, Enforcement, Appeal and Revision; Enforcement of foreign awards – New York and Geneva Convention Awards; Distinction between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; Lok Adalats.
Module 4	**Engagement of Labour and Labour & other construction-related Laws:** Role of Labour in Civil Engineering; Methods of engaging labour- on rolls, labour subcontract, piece rate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act,1946; Workmen's Compensation Act, 1923; Building & Other Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017, NBC 2017
Module 5	**Law relating to Intellectual property:** Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970 including Concept and historical perspective of patents law in India, Patentable inventions with special reference to biotechnology products, Patent protection for computer programs, Process of obtaining patent – application, examination, opposition and sealing of patents, Patent cooperation treaty and grounds for opposition, Rights and obligations of patentee, Duration of patents – law and policy considerations, Infringement and related remedies.

Maulana Abul Kalam Azad University of Technology, West Bengal

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Deep Foundation **Course Code: CE(OE)801C**

Semester of Study: 8th (Semester VIII)

Course Type: Theory

Course Designation: Elective

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(OE)801C.1	Explain the concept of bearing capacity for deep foundation.	Explain	Understand
CE(OE)801C.2	Differentiate in what circumstances pile is needed and how to estimate pile and pile group capacity under various soil conditions Characterize	Differentiate	Analysis
CE(OE)801C.3	Estimate the safe bearing capacity including settlement consideration for deep foundations.	Estimate	Evaluation
CE(OE)801C.4	Select a suitable deep foundation system for various site conditions and also analysis of that.	Select	Evaluate

CE(OE)801C.5	Identify different types and methods of construction for cassion foundation.	Identify	Understand
CE(OE)801C.6	Explain different types and suitable design method of well foundation to check their stability analysis.	Explain	Understand

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	-	-	-	-	-	-	-	-
CO2	3	3	3	3	-	2	1	-	-	-	-	-
CO3	3	3	3	3	-	2	-	-	-	-	-	-
CO4	3	3	3	3	-	1	-	-	-	-	-	-
	3	3	3	2	-	-	1	-	-	-	-	-
	3	3	3	3	-	1	1	-	-	-	-	-
Average	3	3	3	2.83	0	1	0.5	0	0	0	0	0

University Syllabus:

Module 1	**Piles:** Types - load carrying capacity of pile - static and dynamic formula - pile load test - penetration test - pile groups - Efficiency - Feld's rule –Converse Labarre formula, Settlement of piles and pile groups - Negative skin friction – under-reamed piles, pile cap.
Module 2	**Drilled Pier:** Introduction, uses, types, bearing capacity, settlement, construction procedures.
Module 3	**Cassion foundations:** Types & selections, forces & moments, depth determination.
Module 4	**Well foundations:** The Types, components, design of well foundations – grip, size, steining, curb, cutting edge, top & bottom plug, well cap; stability analysis of well foundation, construction, shift & tilts

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Environmental Impact Assessment and Life Cycle Analyses
Course Code: CE(OE)802D

Semester of Study: 8th (Semester VIII)

Course Type: Theory

Course Designation: Open Elective-IV

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(OE)802D.1	Recognize perspectives from ecological and social sciences to understand complex socio-ecological issues in developmental projects at multiple spatial scales.	Recognize	Understand
CE(OE)802D.2	Assess the impact of any activity (large or small scale) on the surrounding environment.	Assess	Evaluation
CE(OE)802D.3	Implement the process of environmental impact modelling and prediction as a design tool.	Implement	Apply
CE(OE)802D.4	Formulate mitigation strategies to protect the environment leading to sustainability.	Formulate	Create
CE(OE)802D.5	Measure the environmental performance of energy and production systems.	Measure	Evaluation
CE(OE)802D.6	Identify the intricacies of Life Cycle Analysis and basic knowledge for coherent existence.	Identify	Comprehension

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	-	1	2	-	-	-	-	1
CO2	3	3	3	-	-	1	3	-	-	-	-	-
CO3	3	3	2	-	-	1	3	-	-	-	-	3
CO4	3	3	3	-	-	1	3	-	-	-	-	1
CO5	3	2	-	-	-	1	3	-	-	-	-	-
CO6	3	2	3	-	-	1	3	-	-	-	-	1
Average	3	2.67	2.17	0	0	1	2.83	0	0	0	0	1

University Syllabus:

Module 1	**Introduction** Definition, Objective with legal aspect of Environmental Impact Assessment(EIA)
Module 2	**Methodology** for EIA with Base Line Studies, Screening , Scoping and Public Consultation
Module 3	**EIA Analysis** Data Collection & Environmental Impact Analysis, preparation of EIA report
Module 4	**EIA Mitigation and Audit**- Mitigation and Impact Management with various case studies, Environmental Audit
Module 5	**Introduction to Life Cycle Analysis (LCA):** History, Definition, Standards and structure of LCA Goal and Scope of LCA: System of a product with boundary, unit process and functional unit
Module 6	**Life Cycle Interpretation and Inventory:** Limitation of LCA, Identification of significant issues, Evaluation, Reporting, Critical Review. Inventory: Data Collection, Data Bases, Allocation, Validation
Module 7	**LCA Impact Assessment and Practice:** Categories, Classification, Normalization, LCA Management, Life Cycle thinking, Sustainability

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Pavement Materials and Design **Course Code: CE(PE)801D**

Semester of Study: 8th (Semester VIII)

Course Type: Theory

Course Designation: Compulsory

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

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10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PE)801D.1	To identify the engineering properties and characteristics of the different materials that concern the pavement engineer	Identify	Understand
CE(PE)801D.2	To use the modern testing techniques of soil, granular and bituminous materials for pavement analysis and design	Use	Apply
CE(PE)801D.3	To implement the use of different superlative aggregate tests and requirements	Implement	Apply
CE(PE)801D.4	To solve the design mix of rigid pavement	Solve	Apply
CE(PE)801D.5	To discuss the relationship between key materials and their properties along with the behaviour of pavement component systems.	Discuss	Understand

CE(PE)801D.6	To select the proper pavement techniques, the deflection of pavements, and methods of maintenance of pavements.	Select	Evaluate

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	2	2	0	2	2	2	2
CO2	3	2	3	3	2	2	1	0	3	3	2	2
CO3	3	2	3	3	2	2	1	0	3	3	2	2
CO4	3	3	3	3	3	2	3	0	2	2	2	3
CO5	3	3	3	3	3	2	3	0	2	2	3	2
CO6	3	3	3	3	3	2	3	0	2	3	3	2
Average	3	2.5	2.83	3	2.5	2	2.16	0	2.33	2.5	2.33	2.16

University Syllabus:

Module 1	Introduction: Basic road construction materials: Types of basic materials, Suitability of different materials depending on their availability and characteristics, Economic, Environmental, and Social issues of material usage, Life cycle analysis, and its use in design
Module 2	Soil: Classification; Index & Engineering properties of soil, Properties of sub-grade; Suitability of different type of soil for the construction of highway embankments and pavement layers; Field compaction and control. Introduction to Soil Stabilization: Physical and Chemical Modification: Stabilization with admixtures like cement, lime, calcium chloride, fly ash and bitumen. A critical look at the different laboratory and in-situ procedures for evaluating the mechanical properties of soils viz. CBR, Plate Load test, resilient modulus, DCPT
Module 3	Aggregate: Characterization: Origin, classification, properties. Tests and specifications on road aggregates for flexible and rigid pavements. Importance of aggregate gradation problems on Rothfutch's and Critical sieve methods and Shape factor in mix design
Module 4	Bitumen Binders: Different types, properties and uses, Tests on bitumen, Rheological and pavement performance-related properties, and Criteria for selection of different binders. Marshall Method of mix design, Additives & Modifiers in Bituminous mixes, problems on mix design
Module 5	Cement: Requirements, design of mix for CC pavement, use of additives, IRC specifications & Tests, joint filler and sealer materials.
Module 6	The modern trend of using Modified, Sustainable and Environment-friendly materials: Geo-Synthetics: Geo-synthetic clay liner – Construction details – Geo Synthetic Materials – Functions – Property characterization Modified bitumen: Crumb Rubber Modified bitumen, Natural rubber modified bitumen, polymer modified bitumen; Long term and short term aging and its effect on bitumen performance Plastic waste: Types of polymer, the applicability of polymer-based waste product in different layers of pavement

Maulana Abul Kalam Azad University of Technology, West Bengal

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Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Comprehensive Viva Voce **Course Code: CE(CV)881**

Semester of Study: 8th (Semester VIII)

Course Type: Sessional

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(CV)891.1	To memorize the basic and advanced knowledge in civil engineering	Memorize	Remember
CE(CV)892.2	To develop an idea about the environment of job market and their preparedness to defend the interview after graduation	Develop	Create
CE(CV)892.3	To implement their knowledge in civil engineering acquired in the last four years.	Implement	Apply
CE(CV)892.4	To relate usefulness to the society and assess the impact of civil engineering on the environment.	Relate	Analyze
CE(CV)892.5	To Recognize the properties, uses, advantages and disadvantages of different	Recognize	Understand

	materials/construction - techniques used in civil engineering		
CE(CV)892.6	To identify the usage of the different provisions given in the IS codes & schedules	Identify	Understand

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	0	2	0	0	0	0	0	0	3
CO2	3	1	3	1	1	2	1	0	2	0	0	3
CO3	3	2	2	2	0	1	0	0	1	0	0	3
CO4	3	2	2	3	0	2	2	1	0	0	0	3
CO5	3	2	2	2	1	1	2	2	0	0	0	3
CO6	3	2	2	2	0	1	0	0	0	0	0	3
Average	3	1.67	2.16	1.67	0.67	1.17	0.83	0.5	0.5	0	0	3

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering

(Applicable from the academic session 2023-2024)

Course Name: Project 2 **Course Code: CE(PROJ)882**

Semester of Study: 8th (Semester VIII)

Course Type: Sessional

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Program Outcome (PO):

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduates will have strong fundamental knowledge in core topics of each subject of the University curriculum of Civil Engineering.

PSO2: Graduates will have the ability to describe, analyse, and solve problems using mathematics and systematic problem-solving technique for core subjects of Civil Engineering.

PSO3: Graduates will be able to patronize higher studies and technological practice in Civil Engineering.

PSO4: Graduates will be able to keep pace with the modern construction techniques and management tools of Civil Engineering, either in industry or through entrepreneurship.

Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CE(PROJ)892.1	To recognize the scope of problem and conduct a Literature review	Identify	Understand
CE(PROJ)892.2	To use existing/new methods to apply the fundamental aspects of civil engineering and their relevance with respect to the societal benefit	Execute	Apply
CE(PROJ)892.3	To set up experimentation / design / development of models to analyze and compare the results	Formulate	Create
CE(PROJ)892.4	To identify the modern techniques to collect the data & solve the real-life problems	Develop	Create
CE(PROJ)892.5	To Identify the solutions and relate them with the literature with proper analysis of the problem	Discuss	Understand

CE(PROJ)892.6	To develop the ability of working in the groups and to develop skills related to comprehensive report writing	Report	Understand

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	2	2	1	3	0	2	2
CO2	3	3	3	3	2	2	2	0	3	0	3	2
CO3	3	3	3	2	3	2	2	2	3	1	3	2
CO4	3	3	3	2	3	3	3	2	3	2	3	2
CO5	3	3	3	3	3	2	2	2	3	3	3	2
CO6	3	2	3	2	3	2	0	3	3	3	3	3
Average	3	2.67	3	2.5	2.67	2.16	1.83	1.67	3	1.5	2.83	2.16

University Syllabus:

Module 1	Scope of Highway Engineering; Jayakar Committee Report: Recommendations – CRF, IRC, CRRI; Scope of Motor Vehicle Act; Recommendations of Nagpur Road conference; Road Classification as per third 20 years road development plan (1981-2001); Basic types of Road Patterns and its scope of application
Module 2	Factors controlling alignment; engineering surveys for highway alignment and location.
Module 3	Cross-sectional elements of highway; Design Parameters (as per IRC) – Vehicle Dimensions, Carriageway width, Design speed, Frictional coefficients (Lateral andLongitudinal) etc; Design Principles of Horizontal Alignment: Camber, SightDistance (PIEV theory, SSD, OSD, ISD); Horizontal Curves – [Radius, Superelevation, Extra widening, Set back distance, Transition curve]; Design Principles of Vertical Alignment: Gradients; Grade Compensation; Vertical Curves – SummitCurve, Valley curve.
Module 4	Traffic studies: Fundamental parameters of Traffic Flow (speed, flow, density, capacity) and their basic relations; Basics of Spot Speed Studies- Speed and Delaystudy- O & D study; Intersections and Channelization: At Grade and Grade Separated intersections; Conflict points; Salient features of Rotary; Traffic Signs; Signal Design – Basic concepts of IRC design method, 2 phase signal design by Webster method.
Module 5	Pavement materials: Bitumen, Aggregate, Subgrade soil; Types of Pavement:Flexible and Rigid pavements and their typical cross-sections; Design parameters: Wheel Load, ESWL, Tyre Pressure, CBR, Resilient Modulus& Poisson's Ratio of various layers, Subgrade Modulus etc. Design of Flexible Pavement using IRC 37:2018 Design of Rigid Pavement: Wheel Stresses, Frictional Stresses and WarpingStresses; Expansion, Contraction and Construction Joints; Design of rigid Pavement thickness, Dowel Bar and Tie Bar. Distresses in Pavements
Module 6	Sustainability: Scope of adoption of sustainable construction techniques by using recyclable hazardous materials- fly ash, plastics, recyclable construction materials.