HALDIA INSTITUTE OF TECHNOLOGY, HALDIA (W.B.)

(An Autonomous Institute under MAKAUT)

B. TECH. CURRICULUM STRUCTURE

CIVIL ENGINEERING

Effective from the academic session 2024-25

DEPARTMENT OF CIVIL ENGINEERING

Vision

To establish the department as frontiers by offering quality education in proper perspective to accomplish diversified necessities in the field of Civil Engineering education, research and profession.

Mission

The mission of the Department of Civil Engineering is to optimize an effective teaching learning process to prepare the students equipped with fundamental and effective knowledge base blended with contemporary skills with focus on its relevance to the industrial and real life scenarios so that one can emerge as a successful graduate and poised readily to serve the industry and having a strong foundation of higher studies and research with ethical and human values. The prima-facie mission of the Department is

- To develop qualified and proficient civil engineers having contemporary skills through outcome-based and self-learning strategies for the service of the sorority.
- To encourage innovative and real world problem oriented research capabilities in the young engineers.
- To infuse strong ethical values and good professional behaviour, so as to adapt and absorb contemporary changes in the field of engineering profession.

DEPARTMENT OF CIVIL ENGINEERING

Program Educational Objectives (PEOs)

PEO 1: To educate and make students ready with sound knowledge of mathematics, basic sciences and engineering along with contemporary skills in the areas of Civil Engineering.

PEO 2: To groom students for successful professional careers in Civil Engineering in public and private domain of activities and to prepare for higher studies in engineering and allied areas and to undertake research in different domain of Civil Engineering.

PEO 3: To make the students aware of the societal impact on engineering profession, ethical practices and the advantages of effective team work to function coherently in the inter-disciplinary areas.

Program Specific Outcomes (PSOs)

PSO 1: Able to clearly understand, analyze and comprehend the different courses of Civil Engineering and other interdisciplinary courses and to develop a holistic approach for execution.
PSO 2: Able to design optimally and offer solution to the real world problems related to Civil Engineering through the use of modern tools and techniques.
PSO 3: Capable of sustaining their existence by qualifying national level competitive examinations for higher studies and by successfully meeting the industrial requirements.

DEPARTMENT OF CIVIL ENGINEERING

PROGRAM OUTCOMES (POs)

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. 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.

PO5. 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.

PO6. 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.

PO7. 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.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. 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.

PO11. 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.

PO12. 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.

*** Definition of Credit**

1Hr. Lecture (L) per week	1 credit
1Hr. Tutorial (T) per week	1 credit
1Hr. Practical (P) per week	0.5 credits

*** Range of credits**

All B.Tech. programs include arrange of credits from 160 to 165.

*** Mandatory Additional Requirement (MAR) for earning B. Tech. Degree**

Every student, who is admitted to the 4 years B. Tech program from the academic year 2019-20 onwards, is required to earn *minimum 100* Activity Points, in addition to the required academic grades for getting B. Tech degree.

The MAR activities, (as per guideline of AICTE / affiliating University, MAKAUT) will provide necessary needs of modern industry and the society. Through this program, irrespective of one's technological field, each student develops the skill of active participation in the co-curricular and extra-curricular activities through SWAYAM based learning activities. Such activities enhance student's employability and global acceptances. Details are given in *Annexure-I*.

*** MOOCs for B.Tech Honours**

A student will be eligible to get B.Tech Degree *with Honours*, if he/she completes an *additional 20 credits*, through Massive Open Online Courses (MOOCs). The complete description of the MOOCs relevant for the first-year course is given in *Annexure-II.*

*** Guidelines regarding Mandatory Induction Program for the new students**

The aim of the Induction Program is to acclimatize the students to the environment of their engineering institution, give them a flavour of the exciting new world of education that they are entering, provide them with mentoring schemes, and make them aware of their neighborhood, society and people. This will allow them to evolve as well rounded individuals. Details are given in *Annexure- III*.

*** Group division:**

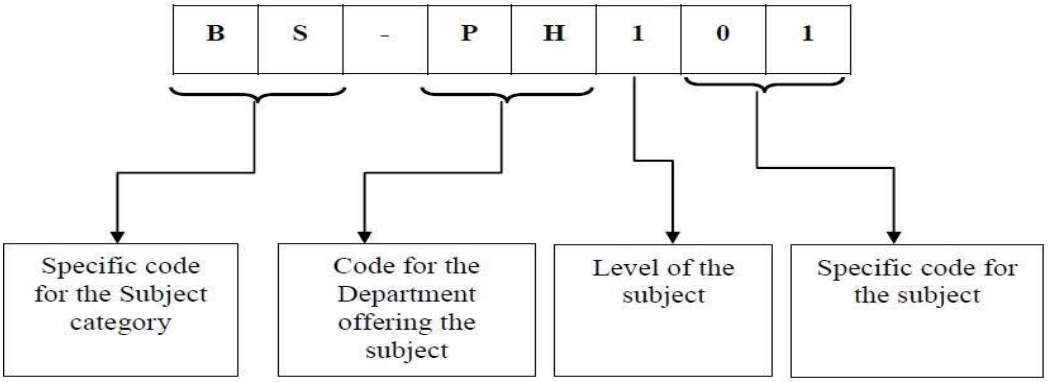
Group-A

All non-IT based Programs like –Mechanical Engineering(ME), Chemical Engineering(CHE), Civil Engineering (CE), Electrical Engineering (EE), Applied Electronics & Instrumentation Engineering (AEIE), Biotechnology(BT), Food Technology(FT), Agriculture Engineering(AE), and Electronics & Communication Engineering (ECE).

Group-B

All IT-based Programs like – Computer Science & Engineering (CSE), Computer Science & Engineering (Cyber Security), Computer Science & Engineering (Data Science), Computer Science & Engineering (Artificial Intelligence & Machine Learning), Information Technology.

Subject Numbering Scheme:



List of Codes for Subject Category	
Code	**Category Name**
BS	Basic Science Courses
ES	Engineering Science Courses
HS	Humanities and Social Sciences including Management courses
PC	Professional Core Courses
PE	Professional Elective Courses
OE	Open Elective Courses
MC	Mandatory Courses
PW	Project, Internship etc.

Table of Contents

Syllabus & Curriculum

SEMESTER - I

Sl. No.	Code	Course Title	Hours per week			Credits
			L	T	P	
	Theory					
1	BS-M 101	Mathematics-I	3	1	0	4
2	BS-PH 101	Physics-I	3	1	0	4
3	ES-EE 101	Basic Electrical & Electronics Engineering	3	1	0	4
4	ES-BT 101	Biology for Engineers	2	0	0	2
(14 Hours) Theory credits						**14**
Practical/ Sessional						
1	BS-PH 191	Physics-I Laboratory	0	0	3	1.5
2	ES-EE 191	Basic Electrical & Electronics Engineering	0	0	3	1.5
3	ES-ME 191	Workshop Practice	0	0	3	1.5
***(9 Hours) Practical credits**						**4.5**
(* Total hours - 20) Total credits						**18.5**

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SEMESTER - II

Sl. No.	Code	Course Title	Hours per week			Credits
			L	T	P	
	Theory					
1	BS-M 201	Mathematics-II	3	1	0	4
2	BS-CH 201	Chemistry-I	3	1	0	4
3	ES-CS 201	Programming for Problem Solving	3	1	0	4
4	HS-MC 201	Values, Ethics and Indian Knowledge System	2	0	0	2
5	HM-HU 201	English Language and Technical Communication	2	0	0	2
(16 Hours) Theory credits						**16**
Practical/ Sessional						
1	BS-CH 291	Chemistry-I Laboratory	0	0	3	1.5
2	ES-CS 291	Programming Laboratory	0	0	3	1.5
3	ES-ME291	Engineering Drawing	0	0	3	1.5
4	HM-HU 291	Language Laboratory	0	0	2	1
***(9 Hours) Practical credits**						**5.5**
(* Total hours - 20) Total credits						**21.5**

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SEMESTER - III

Sl. No.	Code	Course Title	Hours per week			Credits
			L	T	P	
Theory						
1	ES-CE 301	Engineering Mechanics	3	0	0	3
2	ES-CE 302	Building Materials and Construction	2	0	0	2
3	ES-CE 303	Fluid Mechanics	3	0	0	3
4	PC-CE 304	Surveying	3	0	0	3
5	BS-CE 305	Engineering Mathematics	3	0	0	3
6	HS-CE 306	Effective Technical Communication	2	0	0	2
(16 Hours) Theory credits						**16**
Practical/ Sessional						
1	ES-CE 391	Computer-Aided Engineering Drawing	0	0	3	1.5
2	PC-CE 392	Surveying Practice	0	0	3	1.5
3	PC-CE 393	Civil Engineering Material Laboratory-I	0	0	3	1.5
***(9 Hours) Practical credits**						**4.5**
(* Total hours - 25) Total credits						**20.5**

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SEMESTER - IV

Sl. No.	Code	Course Title	Hours per week			Credits
			L	T	P	
	Theory					
1	ES-CE 401	Solid Mechanics	3	0	0	3
2	PC-CE 402	Soil Mechanics-I	3	0	0	3
3	PC-CE 403	Environmental Engineering-I	3	0	0	3
4	PC-CE 404	Transportation Engineering-I	3	0	0	3
5	PE-CE 405	Elective-I	2	0	0	2
6	MC-CE 406	Engineering Management	1	0	0	0
(15 Hours) Theory credits						**14**
Practical/ Sessional						
1	ES-CE 491	Fluid Mechanics Laboratory	0	0	3	1.5
2	ES-CE 492	Solid Mechanics & Geology Laboratory	0	0	3	1.5
3	PC-CE 493	Civil Engineering Material Laboratory-II	0	0	3	1.5
4	PC-CE 494	Soil Mechanics Laboratory-I	0	0	3	1.5
(12 Hours) Practical credits						**6**
(*Total hours – 27) Total credits						**20**

PE-CE 405 (Elective-I)	
405A: Construction Technique and Equipment 405B: Concrete Technology	

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SEMESTER - V

Sl. No.	Code	Course Title	Hours per week			Credits
			L	T	P	
Theory						
1	PC-CE 501	Design of Reinforced Concrete Structures	3	0	0	3
2	PC-CE 502	Foundation Engineering	3	0	0	3
3	PC-CE 503	Environmental Engineering-II	3	0	0	3
4	PC-CE 504	Transportation Engineering-II	3	0	0	3
5	PC-CE 505	Structural Analysis-I	3	0	0	3
6	PC-CE 506	Quantity Survey Estimation and Valuation	2	0	0	2
(17 Hours) Theory credits						17
Practical/ Sessional						
1	PC-CE 581	Reinforced Concrete Design Sessional	0	0	3	1.5
2	PC-CE 591	Soil Mechanics Laboratory-II	0	0	3	1.5
3	PC-CE 592	Environmental Engineering Laboratory	0	0	3	1.5
4	PC-CE 593	Transportation Engineering Laboratory	0	0	3	1.5
(12 Hours) Practical credits						**6**
(*Total hours - 29) Total credits						**23**

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SEMESTER - VI

Sl. No.	Code	Course Title	Hours per week			Credits
			L	T	P	
Theory						
1	HS-CE 601	Construction Management	2	0	0	2
2	PC-CE 602	Water Resources Engineering	3	0	0	3
3	PC-CE 603	Design of Steel Structures	3	0	0	3
4	PC-CE 604	Structural Analysis-II	3	0	0	3
5	PE-CE 605	Elective-II	2	0	0	2
6	OE-CE 606	Open Elective	2	0	0	2
(15 Hours) Theory credits						**15**
Practical/ Sessional						
1	PC-CE 681	Water Resource Engineering Sessional	0	0	3	1.5
2	PC-CE 682	Steel Structure Design Sessional	0	0	3	1.5
3	PC-CE 683	Quantity Survey Estimation and Valuation Sessional	0	0	3	1.5
4	PC-CE 691	Computer Application Laboratory	0	0	3	1.5
(12 Hours) Practical credits						**6**
(* Total hours – 27) Total credits						**21**

PE-CE 605 (Elective-II)	OE-CE 606 (Open Elective)
605A: Environmental Impact Assessment 605B: Ground Improvement Technique	606A: Disaster Management 606B: Metro System and Engineering

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SEMESTER - VII

Sl. No.	Code	Course Title	Hours per week			Credits
			L	T	P	
Theory						
1	PC-CE 701	Design of Structures	3	0	0	3
2	PE-CE 702	Elective-III	3	0	0	3
3	PE-CE 703	Elective-IV	3	0	0	3
4	PE-CE 704	Elective-V	3	0	0	3
5	PE-CE 705	Elective-VI	3	0	0	3
(15 Hours) Theory credits						**15**
Practical/ Sessional						
1	PW-CE 781	Industrial Training				4
2	PW-CE 782	Project-I	0	0	10	5
3	PC-CE 783	Structural Design Sessional	0	0	3	1.5
***Internship in semester gap**		**(13 Hours) Practical credits**				**10.5**
(* Total hours - 28) Total credits						**25.5**

PE-CE 702 (Elective-III)	**PE-CE 703 (Elective-IV)**
702A: Hydraulic Structures and Computational Hydraulics	703A: Prestressed Concrete
702B: Advanced Structural Analysis	703B: Repairs & Rehabilitation of Structure
PE-CE 704 (Elective-V)	**PE-CE 705 (Elective-VI)**
704A: Air and Noise Pollution and Control	705A: Structural Dynamics
704B: Advanced Soil Mechanics	705B: Coastal Hydraulics and Sediment Transport

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SEMESTER - VIII

Sl. No.	Code	Course Title	Hours per week			Credits
			L	T	P	
Theory						
1	PE-CE 801	Elective-VIII	2	0	0	2
2	PE-CE 802	Elective-IX	2	0	0	2
3	MC-CE 806	Constitution of India/ Essence of Indian Knowledge Tradition	1	-	-	0
(5 Hours) Theory credits						**4**
Practical/ Sessional						
1	PW-CE 881	Comprehensive Viva Voce	-	-	-	3
2	PW-CE 882	Project-II	0	0	10	5
(10 Hours) Practical credits						**8**
(* Total hours - 15) Total credits						**12**

PE-CE 801 (Elective-VIII)	PE-CE 802 (Elective-IX)
801A: Bridge Engineering 801B Traffic Engineering & Transportation planning	802A: Solid Waste Management 802B: Wind & Earthquake Engineering

TOTAL CREDITS

SEM 1 & SEM 2	SEM3	SEM4	SEM5	SEM6	SEM7	SEM8	Total
40	20.5	20	23	21	25.5	12	162

SEMESTER - III (Second Year)

Course Title: Engineering Mechanics

Course Code: ES-CE 301	**Category:** Engineering Science Courses
Course Title: Engineering Mechanics	**Semester:** 3rd
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Physics	
Course Outcomes:	
CO1: Remember fundamental principles of force systems, equilibrium, and equations of statics.	
CO2: Understand laws of friction and their application to motion and equilibrium problems.	
CO3: Apply methods of joints and sections to analyze trusses and frames.	
CO4: Analyze simple and composite sections to determine centroids and moments of inertia.	
CO5: Evaluate motion of particles and rigid bodies using kinematics, kinetics, and work-energy principles.	
CO6: Solving vibration problems for undamped SDOF systems, including pendulum motion.	
Module 1: Force Systems [6 Hours] 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 rigid body under System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy;	
Module 2: Friction [5 Hours] Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction.	
Module 3: Analysis of Truss [5 Hours] Equilibrium of trusses; Concept of redundancy; Method of Sections; Method of Joints; Simple Trusses; Zero force members; Beams & types of beams; Frames;	
Module 4: Centre of Gravity and Moment of Inertia [5 Hours] Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; 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;	
Module 5: Dynamics of Particles and Rigid Bodies: Kinematics, Kinetics, and Work-Energy Principles [10 Hours] Rectilinear motion; Plane curvilinear motion (cartesian and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law. Virtual Work, Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique); Basic terms, general principles in dynamics; Types of motion, Instantaneous center 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, Kinetics of rigid body rotation;	

Module 6: Fundamentals of Vibrations: Free Undamped Motion of Single Degree of Freedom Systems [5 Hours]
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, Pendulum**;**

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	3
CO6	3	3	3

Text Books:

1. Engineering Mechanics, D.S. Bedi, Khanna Publishing House
2. Engineering Mechanics, 4th Edition, Irving H. Shames Prentice Hall
3. Vector Mechanics for Engineers, Vol I- Statics, Vol II, –Dynamics, 9th Ed, F. P. Beer and E. R. Johnston Tata McGraw Hill
4. Engineering Mechanics: Principles of Statics and Dynamics, R.C. Hibbler Pearson Press
5. Introduction to Statics and Dynamics, Andy Ruina and Rudra Pratap Oxford University Press
6. Engineering Mechanics, Shanes and Rao, Pearson Education
7. Engineering Mechanics (Statics, Dynamics), Hibler and Gupta, Pearson Education

Course Title: Building Materials and Construction

Course code: ES-CE 302	**Category:** Engineering Science Courses
Course title: Building Materials and Construction	**Semester:** 3rd
L-T-P: 2-0-0	**Credit:** 2
Pre-requisites: Physics & Chemistry	
Course Outcome:	
CO1: Understand properties of different building materials.	
CO2: Recognize the need and process of manufacture of cement and lime.	
CO3: Identify function of various materials like wood, glass, paints and building components.	
CO4: Illustrate the importance of masonry, finishing and form woks.	
CO5: Design and supervise suitable type of floor and roof.	
CO6: Gain knowledge about doors, windows, plastering, painting, damp proofing, scaffolding, shoring, and underpinning and to take suitable engineering measures.	
Module 1: Bricks: [4 Hours] Classification, Characteristics of good bricks, Ingredients of good brick earth, Harmful substance in brick earth, Different forms of bricks, Testing of bricks as per BIS. Defects of bricks. Aggregates: Classification, Characteristics, Deleterious substances, Soundness, Alkali – aggregates reaction, Fine aggregates, Coarse aggregates, Testing of aggregates. Lime: Impurities in limestone, Classification, Slaking and hydration, Hardening, Testing, Storage, Handling	
Module 2: Cement & Concrete: [6 Hours] Cement: OPC: Composition, PPC, Slag cement, Hydration, setting time. Concrete: Types, ingredients, W/C ratio, Workability, Different grades in cement concrete, Tests on cement concrete. Mortars: Classification, Uses, Characteristics of good mortar, Ingredients. Cement mortar, Lime mortar, Lime cement mortar, special mortars	
Module 3: Wood and Wood Products: [4 Hours] Classification of Timber, Structure, Characteristics of good timber, Seasoning of timber, Defects in Timber, Diseases of timber, Decay of Timber, Preservation of Timber Testing of Timber, Veneers, Plywood, Fiber Boards, Particle Boards, Chip Boards, Black Boards, Button Board and Laminated Boards, Applications of wood and wood products	
Module 4: Paints, Enamels and Varnishes: [4 Hours] Composition of oil paint, characteristic of an ideal paint, preparation of paint, covering power of paints, Painting: Plastered surfaces, painting wood surfaces, painting metal Surfaces. Defects, Effect of weather, enamels, distemper, water wash and color wash, Varnish, French Polish, Wax Polish. Miscellaneous Materials: Gypsum, Heat and sound insulating materials, Geo- synthetics.	
Module 5: Brick masonry: [3 Hours] Definitions, Rules for bonding, Type of bonds – stretcher bond, Header bond, English bond, Flemish Bond, Comparison of English Bond and Flemish Bond (one and one and half brick thick wall) Wall, Doors and Windows: Load bearing wall, Partition wall, Reinforced brick wall Common types of doors and windows of timber and metal. Stairs: Technical Terms, Requirements of good stair, Dimension of steps, Classification, Geometric design of a dog legged staircase	

Module 6: Flooring: [3 Hours]
Components of a floor, selection of flooring materials, Brick flooring, Cement concrete flooring, mosaic, marble, Terrazzo flooring, Tiled roofing. Foundations: Function of Foundations, Essential requirement of good foundation. Pointing, white washing, color washing, Distempering, Roofs: Types, pitched roofs and their sketches, Lean – to roof, King Post – Truss, Queen post truss and Simple steel Truss, Roof Covering materials: AC sheets GI sheet

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	1	2
CO3	3	2	2
CO4	3	1	3
CO5	2	3	3
CO6	3	2	3

Textbooks:

1. Building Materials - S.K. Duggal, Fifth Edition published by New Age International in January 2019 (ISBN 978-9387788398)
2. Building Materials- P.C. Varghese, Second Edition published in 2015 by PHI Learning (308 pages, ISBN 978-8120350915), with updates on durability of concrete, revised IS codes, aluminium use, etc.
3. Engineering Materials-S.C. Rangwala, Engineering Materials (Material Science), published 2014 by Charotar Publishing House Pvt. Ltd., about 480 pages (ISBN 978-9385039119)
4. Concrete Technology-M. S. Shetty, 8th Edition**,** published in 2019 by S. Chand Publishing (636 pages, ISBN 978-9352533800)

Course Title: Fluid Mechanics

Course Code: ES-CE 303	**Category:** Engineering Science Courses
Course Title: Fluid Mechanics	**Semester:** 3rd
L-T-P: 3-0-0	**Credit**: 3
Pre-Requisites: Physics	
Course Outcomes:	
CO1: Recall and explain the properties of fluids (density, viscosity, compressibility, surface tension, etc.) and describe fundamental principles of fluid statics, including pressure measurement and stability of submerged/floating bodies.	
CO2: Apply fluid kinematics principles (velocity field, flow classification, continuity equation) to determine flow parameters in one-, two-, and three-dimensional flows.	
CO3: Analyze fluid flow problems using Bernoulli's equation and momentum principles for applications such as flow measurement (venturimeter, pitot tube) and hydraulic grade lines	
CO4: Analyze laminar and turbulent flows in pipelines, compute head losses, and design basic pipe network configurations for optimal performance	
CO5: Formulate and perform dimensional analysis using the Buckingham Pi theorem to develop model-prototype relationships for fluid flow and hydraulic machines.	
CO6: Evaluate the operational performance of hydraulic machines (pumps, turbines) under varying load conditions and recommend suitable selections for engineering projects	
Module 1: Properties of fluids [3 Hours] 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 [10 Hours] Pressure at a point, basic equation for pressure field, pressure variation in a fluid at rest, 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 [4 Hours] 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, Continuity Equation.	
Module 4: Fluid Dynamics [6 Hours] 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, Momentum Equation, Momentum equation, applications to pipe bends.	
Module 5: Flow through Pipes [10 Hours] 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, Pipes in series, pipes in parallel, equivalent pipes, branching pipes, pipe networks.	

Module 6: Dimensional Analysis & Hydraulic Machines [3 Hours]
Dimensional Analysis & Hydraulic Machines: Buckingham Pi Theorem, determination of Pi terms, examples. Basics of hydraulic machines- pumps and turbines.

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3
CO5	3	3	3
CO6	3	3	3

Text Books:

1. Sadhu Singh, Fluid Mechanics, Khanna Publishing House.
2. R.K. Bansal, A Textbook of Fluid Mechanics, Laxmi Publications.
3. P.N. Modi and S.M. Seth, Hydraulics and Fluid Mechanics Including Hydraulic Machines, Standard Book House.
4. S.K. Som, G. Biswas, and S. Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill.
5. F.M. White, Fluid Mechanics, Tata McGraw Hill.
6. Dr.A.K.Jain, Fluid Mechanics including Hydraulic Machines, Khanna Publisher.

Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology.)
Curriculum Structure for B.Tech courses in Civil Engineering
(Effective from the Academic Session 2024-2025)

Course Title: Surveying

Course Code: PC-CE 304	**Category:** Engineering Science Courses
Course Title: Surveying	**Semester:** 3rd
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Geography, Physics	
Course Outcomes:	
CO1: Define and state the scope of surveying in Civil Engineering	
CO2: Understand the basic principles of surveying.	
CO3: Apply the different methods of surveying to measure the features of interest.	
CO4: Analyze the traditional and advanced methods of surveying.	
CO5: Evaluate the different techniques of surveying in solving real world problems.	
Module 1: Introduction, Chain surveying [7 Hours] Definition, classification of surveying, objectives, principles of surveying, Chain and its types, Optical square, Cross staff, Reconnaissance and site Location, Locating ground features by offsets – Field book. Chaining for obtaining the outline of structures, Methods for overcoming obstacles, Conventional symbols, Plotting chain survey and Computation of areas, Errors in chain surveying and their elimination: Problems.	
Module 2: Compass Surveying, Plane Table Surveying [7 Hours] Details of prismatic compass, Use and adjustments, Bearings, Local attraction and its adjustments. Chain and compass surveying of an area, Booking and plotting, Adjustments of traverse, Errors in compass surveying and precautions: Problems. Equipment, Orientation, Methods of Plane Tabling, Two point & Three Point Problems.	
Module 3: Leveling, Contouring [6 Hours] Leveling – Principles, Precautions and Difficulties; Differential leveling, -- Concepts and numerical problems; Characteristics of Contour, Contour Interval. Methods of Locating Contours, Interpolation of Contours.	
Module 4: Theodolite Surveying, Engineering survey [7 Hours] Components of a Transit Theodolite, Measurement of horizontal and vertical Angles, Co-ordinates and traverse Table, Computation of area and volume – Trapezoidal rule, Simpson's rule etc. The concept of horizontal and vertical curves – practical applications – setting out of circular and transition curve.	
Module 5: Advanced Surveying, Total Station [6 Hours] Principle of Electronic Distance Measurement (EDM); Types of EDM instruments; Distomats; Parts, advantages, applications, field procedure and errors.	
Module 6: Global Positioning System (GPS) [3 Hours] Concept, applications, segments, location determination, errors; Principle of Differential GPS; Terrestrial laser scanner.	

CO & PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	1	1	1	-	2	-	2
CO2	3	2	-	-	2	1	1	1	-	2	-	3
CO3	3	3	2	-	2	-	1	-	2	2	-	3
CO4	3	3	2	2	3	1	2	-	1	2	1	3
CO5	3	3	3	3	3	2	2	2	3	3	2	3

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	3

Text Books:

1. N. N. Basak, Surveying & Levelling, McGraw Hill Education (India) Private Limited
2. B. C. Punmia Ashok Kumar Jain, Arun Kumar Jain, Surveying – Vol. I, II & III, Laxmi Publications (P) Ltd.
3. S. K. Duggal, Surveying – Vol. I & II, McGraw Hill Education (India) Private Limited.
4. Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, Remote Sensing and Image Interpretation, Wiley India Edition.
5. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press.
6. P.K. Garg, Principles of Geoinformatics, Khanna Publishing House.

Course Title: Engineering Mathematics

Course Code: BS-CE 305	**Category:** Basic Science Courses
Course Title: Engineering Mathematics	**Semester:** 3rd
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Basic knowledge in algebra, calculus, and foundational understanding of mathematical logic is required	
Course Outcomes:	
CO1: Apply probability and statistical methods to analyze and interpret engineering data	
CO2: Utilize Fourier and Z-transforms for solving engineering problems.	
CO3: Analyze vector fields using gradient, divergence, and curl in engineering contexts.	
CO4: Employ propositional logic for effective problem-solving in engineering decisions.	
CO5: Solve partial differential equations relevant to engineering applications.	
CO6: Understand and apply the concepts of partially ordered sets and lattices in engineering.	
Module 1: Probability and Statistics [8 Hours] Definition of probability; Conditional probability and independence; Bayes' theorem; Collection and Representation of Statistical data: Measures of Central Tendency & Dispersion; Correlation and Regression; Expectation and Variance; Random variables; Discrete and Continuous distribution; Poisson, Normal and Binomial distribution; Chebyshev's inequality.	
Module 2: Mathematical Transform [8 Hours] Fourier Integral Theorem (statement only), Fourier Transform of a function, Fourier Sine and Cosine Integral Theorem (statement only), Fourier Cosine & Sine Transforms. Fourier, Fourier Cosine & Sine Transforms of elementary functions. Properties of Fourier Transform, Linearity, Z-transform and Wavelet transforms: properties, methods, inverses and their applications.	
Module 3: Directional derivative [5 Hours] Gradient; Divergence and Curl; Vector Integration; Line integrals; Surface integrals and volume integrals; Green's theorem in the plane; Gauss Theorem; Stokes' Theorem and their application; Tangent Normal and Binormal of space curve; Serret Frenet formulae; Normal plane, Rectifying plane and oscillating plane.	
Module 4: Propositional Logic [5 Hours] Understand the basic principles of propositional logic. Apply logical reasoning to solve engineering problems. Propositions, truth values, negation, conjunction, disjunction. Detailed study of logical connectives. Logical equivalence. Validity and soundness of arguments. Applications of propositional logic. Logic in problem-solving and decision-making processes.	
Module 5: Partial Differential Equations [7 Hours] Classification of PDE, Solution of PDE by method of separation of variables; Solution of one-dimensional wave and diffusion equation; Laplace equation	
Module 6: Partially Order Relation and Lattice [3 Hours] PO Set, Hasse diagram, Minimal Maximal Greatest Least Elements, Complete partial ordering, chain, lattice and its properties, complete, distributive and complemented lattices. Boolean and pseudo-Boolean lattices.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	3	2	1
CO3	3	2	1
CO4	2	1	1
CO5	3	2	2
CO6	2	1	1

Text Books:

1. Elements of Discrete Mathematics C. L. Liu Tata McGraw-Hill
2. Discrete Mathematics and its Applications K. H. Rosen Tata McGraw-Hill
3. Advanced Engineering Mathematics Erwin Kreyszig John Wiley & Sons

Course Title: Effective Technical Communication

Course Code: HS-CE 306	**Category:** Humanities and Social Sciences including Management Courses
Course Title: Effective Technical Communication	**Semester:** 3rd
L-T-P: 2-0-0	**Credit:** 2
Pre-Requisites:	
Course Outcomes:	
CO1: Understand technical communication & organizational strategies and explain their role in professional settings.	
CO2: Apply technical writing, grammar and editing to create well-structured professional and academic documents.	
CO3: Analyze their own values, attitudes, and skills and develop personal goals for career planning.	
CO4: Demonstrate effective oral and written communication skills in professional contexts.	
CO5: Create technical reports, proposals, manuals, brochures, and other professional documents.	
CO6: Evaluate ethical practices, etiquette, time management, and workplace culture.	
Module 1: Introduction to Technical Communication [3 Hours] Forms of Technical Communication, Types of Advanced Communication - Oral and Written; Organizational Structure, Flow of communication and Organizational Strategies.	
Module 2: Technical Writing, Grammar and Editing [5 Hours] Technical writing process, 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. Reading Comprehension based on Case Studies	
Module 3: Self Attitudes development and Assessment [5 Hours] Self- assessment, Awareness, Perception and Values and Beliefs, Personal Goal Setting, Career Planning, Self-esteem. Managing Time; Rapid Reading, Taking Notes; Complex Problem Solving; Creativity	
Module 4: Communication and Technical Writing [6 Hours] Public speaking, Group Discussion, Oral presentation, Interviews, Graphic presentation, Presentation Aids, Personality Development. Writing Reports, Project Proposals, Brochures, Technical Articles, Manuals, Official Notes, Business Correspondence- Notice, Agenda, Minutes, Business Letters, Progress Reports, Event Reports and Feasibility Reports.	
Module 5: Ethics [5 Hours] 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 solving, and Creativity	

CO & PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	2	-	2	2	3	2	2
CO2	2	2	2	1	1	-	-	-	2	3	2	3
CO3	1	-	1	1	-	2	-	3	2	2	1	2
CO4	1	1	2	-	2	-	-	2	3	3	2	2
CO5	2	2	3	2	2	1	-	1	3	3	3	3

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	2	-	-
CO2	3	2	-
CO3	-	2	2
CO4	2	3	-
CO5	3	3	2

Text Books:

1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN0312406843)
3. Kulbhushan Kumar, Effective Communication Skills, Khanna Publishing House
4. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
5. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.
6. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN:07828357-4)
7. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi2002.
8. Xebec, Presentation Book, TMH New Delhi, 2000. (ISBN 0402213)

Haldia Institute of Technology, West Bengal
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Curriculum Structure for B.Tech courses in Civil Engineering
(Effective from the Academic Session 2024-2025)

LABORATORY/ SESSIONAL [Semester III-Second year]

Course Title: Computer-aided Engineering Drawing

Course Code: ES-CE 391	**Category:** Engineering Science Courses
Course Title: Computer-aided Engineering Drawing	**Semester:** 3rd
L-T-P: 0-0-3	**Credit:** 1.5
Pre-Requisites: Engineering Drawing	
Course Outcomes:	
CO1: Identify and illustrate standard architectural and structural symbols, commands, and conventions used in computer-aided engineering drawings.	
CO2: Develop accurate layout plans for buildings by applying standard drafting practices and measurement conventions.	
CO3: Prepare detailed ground and first floor plans by applying principles of functional planning and space utilization.	
CO4: Generate precise sectional views and front elevation drawings to represent building structures in compliance with IS codes.	
CO5: Design and detail reinforcement drawings for columns, beams, slabs, and footings using CAD tools and relevant codes.	
CO6: Construct and interpret engineering curves with accuracy for use in technical drawings.	
Drawings	
1. Introduction, symbols and commands.	
2. Layout plan of a building.	
3. Ground and first floor plan of a building.	
4. Sectional and front elevation view of a building.	
5. Reinforcement drawing of columns, beams, slabs, and footing.	
6. Drawing of engineering curves.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	2
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3
CO6	3	2	1

Text Books:

1. Subhash C Sharma & Gurucharan Singh (2005), "Civil Engineering Drawing",Standard Publishers.
2. Engineering Graphics & Design, Pradeep Jain & A.P. Gautam, Khanna Publishing House (2019).
3. Ajeet Singh (2002), "Working with AUTOCAD 2000 with updates on AUTOCAD 200I", Tata- McGraw-Hill Company Limited, New Delhi.
4. Sham Tickoo Swapna D (2009), "AUTOCAD for Engineers and Designers", Pearson Education.
5. Venugopal (2007), "Engineering Drawing AUTOCAD", New Age International Pvt. Ltd.
6. Engineering Drawings and Computers, Shah, Pearson Education (2000).

Course Title: Surveying Practice

Course Code: PC-CE 392	**Category:** Professional Core Courses
Course Title: Surveying Practice	**Semester:** 3rd
L-T-P: 0-0-3	**Credit:** 1.5
Pre-Requisites: Surveying Theory, Engineering Drawing	
Course Outcomes:	
CO1: State the interdependency and advancement of different surveying methods	
CO2: Comprehend the working principles of different surveying instruments and experiments.	
CO3: Execute the different methods of surveying to measure the features of interest.	
CO4: Evaluate the results obtained from the surveying experiments.	
CO5: Critically appraise the different techniques of surveying in measuring and assessing the features of interest.	
CO6: Design and construct solutions for real world problems related to surveying.	
Experiment 1: Chain surveying Preparing index plans, Location sketches, Ranging, Preparation of map.	
Experiment 2: Traverse surveying by Prismatic Compass Procedure; Computation and checks on closed traverse; Preparation of field book; Plotting the traverse; Sources of errors.	
Experiment 3: Plane Table surveying Temporary adjustments of plane table and Radiation method, Intersection, Traversing and Resection methods of plane tabling	
Experiment 4: Differential Levelling using Dumpy level Collimation and Rise and Fall methods, Contouring	
Experiment 5: Theodolite Traversing Closed traverse by transit theodolite, Preparation of field book.	
Experiment 6: Total Station Survey: Traversing and Leveling. Setting out of simple curve.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	3
CO6	3	3	3

Text Books:

1. N. N. Basak, Surveying & Levelling, McGraw Hill Education (India) Private Limited
2. B. C. Punmia Ashok Kumar Jain,Arun Kumar Jain, Surveying – Vol. I, II & III, Laxmi Publications (P) Ltd.
3. S. K. Duggal, Surveying – Vol. I & II, McGraw Hill Education (India) Private Limited.
4. Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, Remote Sensing and Image Interpretation, Wiley India Edition.
5. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press.
6. P.K. Garg, Principles of Geoinformatics, Khanna Publishing House

Course Title: Civil Engineering Material Laboratory-I

Course Code: PC-CE 393	**Category:** Professional Core Courses
Course Title: Civil Engineering Material Laboratory-I	**Semester:** 3rd
L-T-P: 0-0-3	**Credit:** 1.5
Pre-Requisites: Building Materials and Construction	
Course Outcomes:	
CO1: Explain the principles and quality control requirements for common civil engineering materials.	
CO2: Perform standard laboratory tests to determine the physical and mechanical properties of construction materials.	
CO3: Analyze experimental results to assess the suitability of materials for engineering applications.	
CO4: Interpret practical observations in relation to relevant IS codes and provisions.	
CO5: Evaluate the quality of construction materials and recommend their appropriate use in practice.	
CO6: Develop practical competence in handling materials, recording data, and presenting laboratory reports effectively.	
Module 1: Bricks Determination of water absorption of bricks. Measurement of shape and size of supplied bricks. Determination of compressive strength of bricks. Determination of efflorescence of bricks.	
Module 2: Fine Aggregates Determination of fineness modulus and grain size distribution. Assessment of bulking phenomena in sand samples. Determination of bulk and apparent specific gravity and water absorption.	
Module 3: Coarse Aggregates Determination of fineness modulus and grain size distribution. Determination of crushing value of coarse aggregate. Determination of bulk and apparent specific gravity, water absorption, bulk density, and percentage voids.	
Module 4: Cement Fineness test by 90-micron sieve. Blaine's air permeability test. Standard consistency test. Initial and final setting time determination. Soundness test by Le-Chatelier and autoclave methods. Strength test.	
Module 5: Reinforcement Steel Tensile test. Bend test. Re-bend test.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	2

Text Books:

1. Concrete Technology, M. S. Shetty, S. Chand and Co.
2. Concrete Technology, M. L. Gambhir, Tata McGraw Hill.
3. Properties of Concrete, A. M. Neville, Pearson India.

SEMESTER - IV (Second year)

Course Title: Solid Mechanics

Course Code: ES-CE 401	**Category:** Engineering Science Courses
Course Title: Solid Mechanics	**Semester:** 4th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Physics, Engineering Mechanics	
Course Outcomes:	
CO1: Remember fundamental concepts of stress, strain, material properties, and elastic behavior.	
CO2: Understand support reactions and construct shear force and bending moment diagrams for beams under various loading conditions.	
CO3: Apply bending and shear stress equations to symmetric beam sections and determine deflections of statically determinate beams.	
CO4: Analyze torsional stresses and deformations in shafts and helical springs.	
CO5: Evaluate principal stresses and maximum shear stresses using Mohr's circle, and determine stresses in thin cylindrical shells.	
CO6: Create effective design solutions for stability and buckling problems in columns under various end conditions and eccentric loading.	
Module 1: Review of basic concepts of stress and strain [4 Hours] 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;	
Module 2: Beam statics [4 Hours] Support reactions, concepts of redundancy, shear force and bending moment diagrams for concentrated, uniformly distributed, linearly varying load, concentrated moments in simply supported beams, cantilever and overhanging beams	
Module 3: Symmetric beam bending and Deflection of Statically Determinate Beam [11 Hours] Basic kinematic assumption, moment of inertia, elastic flexure formulae and its application, Bending and shear stress for regular sections, shear center Fundamental concepts: Elastic curve, moment Curvature relationship, governing differential equation, boundary conditions: Direct integration solution	
Module 4: Torsion [4 Hours] Pure torsion, torsion of circular solid shaft and hollow shafts, torsional equation, torsional rigidity, closed coil helical; springs	
Module 5: Stress Analysis in 2D and Thin Shells [8 Hours] Principal stresses, maximum shear stresses, Mohr's circle of stresses, construction of Mohr's circle Hoop stress and meridional - stress and volumetric changes	
Module 6: Columns [5 Hours] 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;	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	3
CO6	3	3	3

Text Books:

1. Strength of Materials, D.S. Bedi, Khanna Publishing House
2. Strength of Materials, R.K. Bansal, Laxmi Publication
3. Mechanics of Material Beer, Jhonston, DeWolf, Mazurek, McGrawHill Education
4. Strength of Materials S S Bhavikatti Vikas Publishing House Ltd.

Course Title: Soil Mechanics-I

Course Code: PC-CE 402	**Category:** Professional Core Courses
Course Title: Soil Mechanics-I	**Semester:** 4th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Engineering Mechanics	
Course Outcomes:	
CO1: Explain the origin, formation, types, and index properties of soils.	
CO2: Classify soils using IS codes and international standards, and explain soil hydraulics and its engineering relevance.	
CO3: Apply Darcy's law and flow net principles to determine permeability and seepage, and analyze quicksand and piping conditions.	
CO4: Analyze vertical stress distribution in soils using Boussinesq's and Westergaard's theories, and Newmark's chart.	
CO5: Evaluate compaction characteristics and field control methods to achieve desired soil properties.	
CO6: Determine consolidation and settlement characteristics of soils using Terzaghi's theory, and predict field performance.	
Module 1: Introduction and Phase relationship [6 Hours] Origin and types, Origin of Soil, Formation and Types of soil, Formative classification, Typical Indian Soil Index Properties: Phase relationship, Grain Size distribution, consistency, sensitivity.	
Module 2: Classification of Soil and Soil Hydraulics [6 Hours] Classification by Structure, Particle Size Classification, Textural System, PRA System (AASHTO Classification), Unified Classification System, As per IS Code Recommendation, Field Identification of Soil, Plasticity Chart. 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 of Flow through Soils.	
Module 3: Permeability and Seepage Analysis [8 Hours] Darcy's law of permeability, Determination of co- efficient of permeability, Equivalent permeability of stratified soil, Flow nets- principles, construction and application. (Effective stress analysis, quick sand condition, piping & filtration criteria).	
Module 4: Stress Distribution in Soil [6 Hours] Introduction, Boussinesq's Equation, Determination of Stress due to Point Load, Line and Strip Loads. Westargaard Analysis, Vertical Stress on a Horizontal Plane, Isobar and Pressure Bulb, Newmark's Influence Chart,	
Module 5: Compaction of soil [4 Hours] Principle of compaction, Light and heavy compaction, field compaction control, factors affecting compaction.	
Module 6: Consolidation of soil [6 Hours] Terzaghi's Theory of One- Dimensional Consolidation, Secondary Consolidation, Estimation of Consolidation Settlement.	

CO & PO Mapping:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	-	-	2	1	-	2	-	2
CO2	3	3	3	2	-	1	2	1	1	2	-	2
CO3	3	3	3	3	2	2	2	1	2	2	1	2
CO4	3	3	3	3	2	2	2	2	2	2	1	2
CO5	3	3	3	3	2	2	2	2	3	2	2	2
CO6	3	3	3	3	2	2	2	2	3	2	2	2

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	2

Text Books:

1. Textbook of Soil Mechanics and Foundation Engineering (Geotechnical Engineering Series), V.N.S. Murthy. CBS Publishers
2. Soil Mechanics and Foundations, Punmia, B.C. and Jain A. K. Laxmi Publications (P) Ltd.
3. Basic and Applied Soil Mechanics, Gopal Ranjan & A.S.R. Rao. New Age International Pvt. Ltd Publishers
4. Principles of Geotechnical Engineering B.M. Das Thomson Brooks / Cole

Course Title- Environmental Engineering-I

Course Code: PC-CE 403	**Category:** Professional Core Courses
Course Title: Environmental Engineering-I	**Semester:** 4th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Class-XII level knowledge of Physics, Chemistry, Mathematics, Biology and Environmental Science; Undergraduate level knowledge of Engineering Mechanics, Fluid Mechanics and Hydraulics.	
Course Outcomes:	
CO1: Explain fundamental concepts of water supply engineering, types of water demand, and forecasting methods.	
CO2: Analyze various surface and groundwater sources and assess their sustainability under changing climatic conditions.	
CO3: Evaluate water quality parameters (physical, chemical, biological) and compare them with BIS, WHO, and USEPA standards to recommend suitable treatment needs.	
CO4: Design unit operations and processes for water treatment plants, considering public health, environmental sustainability, and operational efficiency.	
CO5: Apply hydraulic principles and modern tools to solve problems related to water conveyance, distribution networks, and plumbing systems in residential and high.	
CO6: Evaluate and recommend sustainable and green plumbing systems for buildings, integrating efficiency, safety, and resource conservation principles.	
Module 1: Water Requirement Estimation [8 Hours] 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 [5 Hours] Surface Water Sources; Ground Water Sources.	
Module 3: Water Quality [6 Hours] 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 [8 Hours] 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 [5 Hours] Hydraulic design of pressure pipes; Analysis of distribution network; Storage and distribution reservoirs; Capacity of reservoirs.	
Module 6: Building Plumbing [4 Hours] 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.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	3
CO4	3	3	2
CO5	3	3	2
CO6	3	3	2

Text Books:

1. Environmental Engineering. S.C. Sharma,Khanna Publishing House
2. Environmental Engineering. Volume-1 and Volume-2. Garg, S.K. Khanna Publishers.
3. Environmental Engineering, Peavy, H.S, Rowe, D.R, Tchobanoglous, G. Tata McGraw Hill Indian Edition
4. Introduction to Environmental Engineering and Science. bMasters, G.M., Ela, W.P., Prentice Hall / Pearson
5. Elements of Environmental Pollution Control. O.P. Gupta. Khanna Publishing House
6. Elements of Solid & Hazardous Waste Management. O.P. Gupta. Khanna Publishing House
7. Manual on Water Supply and Treatment. CPHEEO. Govt. of India

Course Title: Transportation Engineering-I

Course Code: PC-CE 404	**Category:** Professional Core Courses
Course Title: Transportation Engineering-I	**Semester:** 4th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Physics, Mathematics	
Course Outcomes:	
CO1: Understand the historical development, classification and planning principles of roads in India.	
CO2: Apply knowledge of alignment principles and surveying methods for the geometric layout of highways.	
CO3: Design horizontal alignment components such as camber, sight distance and horizontal curve based on IRC guidelines. Analyze and design vertical alignment including gradients, summit and valley curves, ensuring safe and efficient highway operation.	
CO4: Evaluate basic traffic flow parameters, conduct traffic studies and interpret volume and speed data for traffic planning.	
CO5: Design and assess intersection layouts and traffic control devices including signs, markings and signal system.	
CO6: Identify and classify different types of pavements and their materials and interpret standard cross-sectional elements used in pavement construction.	
Module 1: Introduction to Highway Engineering [3 Hours] Introduction to Highway Engineering 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: Highway alignment [4 Hours] Factors controlling Highway Alignment; Engineering Surveys for Highway Alignment.	
Module 3: Geometric Design Cross-sectional elements of the highway; [10 Hours] Design Parameters (as per IRC) – Vehicle dimensions, Carriageway width, Design speed, Frictional coefficients (Lateral and Longitudinal), etc; Design Principles of Horizontal Alignment: Camber, Sight Distance (PIEV theory, SSD, OSD, ISD); Horizontal Curves – [Radius, Super elevation, Extra widening, Set back distance, Transition curve]; Design Principles of Vertical Alignment: Gradients; Grade Compensation; Vertical Curves – Summit Curve, Valley Curve.	
Module 4: Traffic Engineering [8 Hours] Traffic studies: Fundamental parameters of Traffic Flow (speed, flow, density, capacity) and their basic relations; Basics of Spot Speed Studies- Speed and Delay study- 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 Design [8 Hours] Pavement materials: Bitumen, Aggregate, Subgrade soil; Types of Pavements: Flexible and Rigid pavements and their typical cross- sections; Design parameters: Wheel Load, ESWL, Tire 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 Warping Stresses; Expansion, Contraction and Construction Joints; Design of Rigid Pavement thickness, Dowel Bar and Tie Bar. Distresses in Pavements
Module 6: Sustainability [3 Hours] Scope of adoption of sustainable construction techniques by using recyclable hazardous materials- fly ash, plastics, and recyclable construction materials.

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	1	1
CO2	3	2	1
CO3	3	3	1
CO4	3	3	2
CO5	3	3	2
CO6	3	3	2

Text Books:

1. Transportation Engineering PUBLISHING HOUSE Kadiyali L.R Khanna Book Publishing Co. (P) Ltd.
2. Traffic Engineering and Transport Planning Kadiyali L.R Khanna Publishers.
3. Highway Engineering Khanna, S.K. and C.E.G. Justo Nem Chand and Bros.
4. Transportation Engineering – An Jotin Khisty C. and B. Prentice Hall of India Pvt. Introduction Kent Lall Ltd.
5. Principles of Transportation and Highway Engineering Rao G.V. Tata McGraw-Hill Publishing Company Ltd.
6. Specifications for Road and Bridge Works, Fourth Edition Indian Roads Congress Ministry of Road Transport and Highways

Course Title: Construction Technique and Equipment

Course code: PE-CE 405A	**Category:** Engineering Science Courses
Course title: Construction Technique and Equipment	**Semester:** 4th
L-T-P: 2-0-0	**Credit:** 2
Pre-requisites: Building Materials and Construction	
Course Outcome:	
CO1: Explain the various techniques and tools used in construction.	
CO2: Apply safety procedures and handling measures in construction practices.	
CO3: Classify different types of earth-moving equipment based on their functions.	
CO4: Analyze the performance and applications of balancing, hauling, and excavating equipment.	
CO5: Evaluate the suitability of drilling, blasting, and tunneling equipment for specific site conditions.	
CO6: Assess the impact energy of hammers used for pile driving.	
Module 1: Construction Techniques [4 Hours] Slip form construction. High rise building construction. Bridge construction, Tunnel construction etc. Use of Heavy equipment for construction Excavators, bulldozers, loaders, cranes, and dump trucks, Boom Lift. Forklift. Single Man Lift. Telehandler, Wheel Tractor-Scraper. Skid Steer Loader Backhoe Loader Excavator Asphalt Paver, Motor Grader. Compactor Cold Planer, Drum Roller etc.	
Module 2: Safety in construction [4 Hours] Causes, classification, cost and measurement of an accident, safety program for construction, protective equipment, accident report, safety measure: (a) For storage and handling of building materials. (b) Construction of elements of a building (c) In demolition of buildings Safety lacuna in Indian scenario.	
Module 3: Earth Moving Equipment [4 Hours] Crawler and wheel tractors their functions, types and specifications; Grade ability Bull dozers and their use; tractor pulled scrapers, their sizes and output; effect of grade and rolling resistance on the output of tractor pulled scrapers Earth loaders; Placing and compacting earth fills. Power shovels-functions, selection, sizes, shovel dimension and clearances, output, Draglines functions, types sizes, output clamshells; Safe lifting capacities and working ranges cranes; Hoes, Trenching machine types and production rate calculation of producing rates of equipment; examples.	
Module 4: Hauling Equipment [4 Hours] Trucks; Bottom dump wagons; capacities of trucks and wagons Balancing the capacities of hauling units with the size of the excavator; effect of grade, rolling resistance and altitude on the cost/performance of hauling equipment; balancing excavating hauling equipment examples.	
Module 5: Drilling, Blasting and Tunneling Equipment [4 Hours] Definition of terms, bits, Jackhammers, Drifters, wagon drills, piston drills, blast hole drills, shot drills, diamond drills, tunneling equipment, selecting the drilling method equipment; selecting drilling pattern; Rates for drilling rock, compressors.	

Module 6: Pile Driving Equipment [4 Hours]
Pile hammers, selecting a pile hammer, loss of energy due to impact, Energy losses due to causes other than impact.

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	2	1	3
CO3	3	2	3
CO4	2	3	3
CO5	2	3	3
CO6	2	3	3

Textbooks:

1. Construction Techniques, Equipment and Practice - Dr. P. Purushothama
2. Raj Building Materials- P.C. Varghese
3. Construction Techniques and Practice - V.Sankara Subramanian
4. Construction Techniques, Equipment and Practice - Dr.B.Mahalingam

Course Title: Concrete Technology

Course Code: PE-CE 405B	**Category:** Professional Elective Courses
Course Title: Concrete Technology	**Semester:** 4th
L-T-P: 2-0-0	**Credit:** 2
Pre-Requisites: Building Materials and Construction	
Course Outcomes:	
CO1: Test all the required properties of cement & aggregate as per IS code.	
CO2: Compute the properties of concrete at a fresh and hardened state.	
CO3: Ensure quality control while testing/sampling.	
CO4: Design special types of concrete for specific application purposes.	
CO5: Design the concrete mix as per the latest IS code methods.	
CO6: Conduct Non-destructive tests.	
Module 1: Cement [4 Hours] Manufacturing, chemical composition, heat of hydration, types of cement (OPC, RPC, PPC, etc.), and various tests on cement (fineness, consistency, setting time, soundness, strength, specific gravity).	
Module 2: Aggregates [4 Hours] Classification, grading, alkali-aggregate reaction, deleterious substances, physical properties, and testing of aggregates (fineness modulus, bulking, sieve analysis, etc.). Quality of water for mixing and curing.	
Module 3: Properties of Concrete [4 Hours] Workability, segregation, bleeding, and tests for fresh concrete (slump, compacting factor, vee-bee). Properties of hardened concrete including strength (tensile, compressive, flexural), stress-strain characteristics, creep, shrinkage, and permeability	
Module 4: Strength of Concrete and Admixtures [4 Hours] Curing methods, water-cement ratio, gel-space ratio, maturity of concrete, and various types of admixtures (superplasticizers, plasticizers, etc.).	
Module 5: Mix Design [4 Hours] Objectives, factors influencing mix proportion, and mix design by I.S. 10262-2019 (with and without admixtures).	
Module 6: Non-destructive Testing and Special Concrete [4 Hours] Rebound hammer and ultrasonic pulse velocity tests. Introduction to Ferro cement, Fiber-reinforced concrete, Polymer concrete, Self-compacting concrete, and Ready-mix concrete.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	2	2
CO3	3	3	2
CO4	2	3	3
CO5	2	3	3
CO6	2	3	3

Text Books

1. *Concrete Technology (Theory & Practice)* by M.S. Shetty, published by S. Chand and Co.
2. *Concrete Technology* by M.L. Gambhir, published by Tata McGraw Hill.
3. *Concrete Technology* by A. M. Nevillie and J.J. Brooks.
4. *Properties of Concrete* by A.M. Neville, published by Pearson India**.**

Course Title: Engineering Management

Course Code: MC-CE 406	**Category:** Mandatory Courses (non-credit)
Course Title: Engineering Management	**Semester:** 4th
L-T-P: 1-0-0	**Credit:** 0
Pre-Requisites: Basic level of management	
Course Outcomes:	
CO1: Understand the basic concepts, principles and practices of management	
CO2: Demonstrate the roles and skills of managers	
CO3: Emphasize on the conceptual development in the area of planning, organizing, leading and controlling managerial functions.	
CO4: Analyze effective application of management knowledge to diagnose and solve organizational problems and develop optimal managerial decisions	
CO5: Understand the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities	
CO6: Learn about management in technology, finance, marketing and operations	
Module 1: General Management [2 Hours] Basic concepts of management: Definition - Essence, Functions, Roles, Level. Functions of Management: Planning - Concept, Nature, Types, Analysis, Management by objectives.	
Module 2: OB & HR [2 Hours] Organization Structure: Concept, Structure, Principles, Centralization, Decentralization, Span of Management; Organizational Effectiveness. People Management: Overview, Job design, Recruitment & Selection, Training & Development, Stress Management, Communication, Motivation, Leadership, Team Effectiveness, Conflict Management.	
Module 3: Economics & Finance [2 Hours] Economic, Financial Analysis: Production, Markets, National Income, Accounting, Financial Function & Goals, Financial Statement & Ratio Analysis Decision making: Concept, Nature, Process, Tools & techniques	
Module 4: Marketing [2 Hours] Customer Management: Market Planning & Research, Marketing Mix, Advertising & Brand Management.	
Module 5: Operations & Technology Management [2 Hours] Operations & Technology Management: Production & Operations Management, Logistics & Supply Chain Management, TQM, Kaizen & Six Sigma, MIS	
Module 6: Entrepreneurship [2 Hours] Introduction to Entrepreneurship: Start-ups, Prospects & Challenges., Environmental Issues, CSR, Sustainability Management and Society: Concept, External Environment, CSR, Corporate Governance, Ethical Standards.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	1	1	2
CO2	2	2	2
CO3	2	2	3
CO4	3	3	3
CO5	2	3	2
CO6	2	2	2

Text Books:

1 Essentials for Management - Koontz, (Pearson)
2 Management - Stoner, James A. F (TMH)
3 Management: Principles, Processes & Practices Bhat, A & Kumar, A (OUP)

LABORATORY/ SESSIONAL [Semester IV-Second year]

Course Title: Fluid Mechanics Laboratory

Course Code: ES-CE 491	**Category:** Engineering Science Courses
Course Title: Fluid Mechanics Laboratory	**Semester:** 4th
L-T-P: 0-0-3	**Credit:** 1.5
Pre-Requisites: Fluid Mechanics	
Course Outcomes:	
CO1: Recall principles, terms, and standard measurements for notches, orifices, meters, pumps, turbines, and hydraulic jumps.	
CO2: Explain working principles, applications, and safe operating practices of hydraulic devices and machines.	
CO3: Perform calibration and coefficient determination for notches, orifice meters, and venturimeters, maintaining ethical data recording.	
CO4: Analyze performance data of pumps, turbines, and hydraulic jumps using appropriate tools.	
CO5: Evaluate experimental results against theory, prepare technical reports, and present findings clearly.	
CO6: Recommend design or operational improvements for hydraulic systems considering sustainability and ethics.	
Experiment 1: Calibration of Notches	
Experiment 2: Determination of Hydraulic Coefficient of an Orifice.	
Experiment 3: Calibration of Orifice meter and venturimeter.	
Experiment 4: Performance Test on Centrifugal Pump.	
Experiment 5: Performance Test on Pelton Wheel Turbine.	
Experiment 6: Measurement of water surface profile for a hydraulic jump.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	1	2
CO2	3	2	2
CO3	2	3	2
CO4	2	3	1
CO5	2	2	3
CO6	3	3	2

Text Books:

1. Dr.A.K.Jain, Fluid Mechanics including Hydraulic Machines, Khanna Publisher.
2. R.K. Bansal, A Textbook of Fluid Mechanics, Laxmi Publications.
3. P.N. Modi and S.M. Seth, Hydraulics and Fluid Mechanics Including Hydraulic Machines, Standard Book House.
4. S.K. Som, G. Biswas, and S. Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill.
5. F.M.White, Fluid Mechanics, Tata McGraw Hill

Course Title: Solid Mechanics and Geology Laboratory

Course Code: ES-CE 492	**Category:** Engineering Science Courses
Course Title: Solid Mechanics and Geology Laboratory	**Semester:** 4th
L-T-P: 0-0-3	**Credit:** 1.5
Pre-Requisites: Solid Mechanics, Building Materials and Construction	
Course Outcomes:	
CO1: Recall the fundamental principles and procedures of hardness, impact, and spring tests for ferrous and non-ferrous materials.	
CO2: Explain the distinguishing features and classification of minerals, igneous, sedimentary, and metamorphic rocks.	
CO3: Perform hardness, impact, and spring tests using standard testing equipment and record results accurately.	
CO4: Analyze geological maps and structural models to interpret folds, faults, and bedding patterns.	
CO5: Evaluate the engineering suitability of tested materials and identified rock types for construction purposes.	
Experiments:	
Experiment 1: Hardness Tests on Ferrous and Non-Ferrous Metals: Brinnel and Rockwell Tests	
Experiment 2: Test on closely coiled helical spring	
Experiment 3: Impact Test: Izod and Charpy, Demonstration of Fatigue Test	
Experiment 4: Identification of minerals, igneous rocks, sedimentary rocks, metamorphic rocks in hand specimen	
Experiment 5: Study of crystals with the help of crystal models, Study of geologic structures with the help of models, Microscopic study of rocks and minerals	
Experiment 6: Interpretation of geological maps: horizontal, vertical, uniclinal, folded and faulted structures	

CO & PO Mapping:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	–	–	–	–	–	–	2
CO2	3	3	2	2	1	1	1	–	–	–	–	2
CO3	3	3	3	2	2	–	–	–	1	1	1	2
CO4	3	3	3	3	2	1	2	–	1	1	1	2
CO5	3	3	3	2	2	2	3	1	1	1	1	3

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	2	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2

Text Books:

1.Callister, W. D., & Rethwisch, D. G. (2018). Materials Science and Engineering: An Introduction (10th ed.). Wiley.
2.Shigley, J. E., & Mischke, C. R. (2015). Mechanical Engineering Design (10th ed.). McGraw-Hill Education.
3.Bhandari, V. B. (2010). Design of Machine Elements (3rd ed.). Tata McGraw-Hill Education.
4.Dieter, G. E. (1986). Mechanical Metallurgy (3rd ed.). McGraw-Hill.
5.Suresh, S. (1998). Fatigue of Materials (2nd ed.). Cambridge University Press.
6.Perkins, D. (2011). Mineralogy (3rd ed.). Pearson.
7.Blatt, H., Tracy, R. J., & Owens, B. E. (2006). Petrology: Igneous, Sedimentary, and Metamorphic (3rd ed.). W.H. Freeman.
8.Nesse, W. D. (2012). Introduction to Optical Mineralogy (4th ed.). Oxford University Press.
9.Marshak, S., & Mitra, G. (2007). Basic Methods of Structural Geology. Prentice Hall.

IS Codes:

1. **IS 1500:2019** – *Brinell Hardness Test for Metallic Materials (Second Revision)*
2. **IS 1586:2018** – *Rockwell Hardness Test (Scales A, B, C, D, E, F, G, H, K, N and T) for Metallic Materials*
3. **IS 7906 (Part 1):1976** – *Guide for fatigue testing of springs: Part 1 Helical compression springs*
4. **IS 1135:2022** – *Method for tensile testing of metallic springs*
5. **IS 1598:1977** – *Method for Izod Impact Test of Metals*
6. **IS 1757:1988** – *Method for Charpy Impact Test (U-notch) for Metals*
7. **IS 11315 (Part 11):2021** – *Classification and Identification of Rocks for Engineering Purposes*
8. **IS 3025 (Part 8):1984** – *Methods of Physical Tests for Water and Wastewater – Mineral Identification*
9. **IS 11315 Series** – For rock classification and geological description.
10. **IS 1123:1975** – *Method of Identification of Natural Building Stones* (contains petrographic examination methods)

Course Title: Civil Engineering Material Laboratory-II

Course Code: PC-CE 493	**Category:** Professional Core Courses
Course Title: Civil Engineering Material Laboratory-II	**Semester: 3rd**
L-T-P: 0-0-3	**Credit:** 1.5
Pre-Requisites: Civil Engineering Material Laboratory I, Building Materials and Construction, Concrete Technology	
Course Outcomes:	
CO1: Explain quality control aspects of fresh and hardened concrete in accordance with relevant codes.	
CO2: Perform standard tests to evaluate the workability and quality of fresh concrete, including mix design.	
CO3: Conduct experiments to determine the strength and durability properties of hardened concrete.	
CO4: Analyze experimental observations and interpret them in the context of applicable IS/IRS standards.	
CO5: Apply non-destructive testing methods to assess in-situ concrete properties.	
Module 1: Tests on Fresh Concrete Workability of concrete: slump test, compacting factor test, vee-bee consistometer test. Concrete mix design.	
Module 2: Tests on Hardened Concrete Compressive strength, flexural strength, and splitting tensile strength of concrete. Permeability tests (IS:3085 and IRS: CBC).	
Module 3: Modulus of Elasticity and Poisson's Ratio Determination of modulus of elasticity of hardened concrete. Determination of Poisson's ratio and ductility of hardened concrete.	
Module 4: Non-Destructive Tests Rebound hammer test. Ultrasonic pulse velocity test.	

CO & PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	3	2	2	-	2	1	2
CO2	2	-	-	3	3	2	2	1	2	2	-	2
CO3	2	3	2	3	3	2	-	1	2	2	-	2
CO4	2	2	-	2	2	3	-	3	2	3	-	2
CO5	2	2	3	2	3	2	2	2	2	3	1	2

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2

Text Books:

1. Concrete Technology, M. S. Shetty, S. Chand and Co.
2. Concrete Technology, M. L. Gambhir, Tata McGraw Hill.
3. Properties of Concrete, A. M. Neville, Pearson India.

Course Title: Soil Mechanics Laboratory-I

Course Code: PC-CE 494	**Category**: Professional Core Courses
Course Title: Soil Mechanics Laboratory-I	**Semester**: 4th
L-T-P: 0-0-3	**Credit**: 1.5
Pre-Requisites: Physics, Engineering Mechanics, Soil Mechanics-I	
Course Outcomes:	
CO1: Identify and classify different types of soils and determine their physical properties through standard laboratory and field tests.	
CO2: Apply appropriate experimental procedures to determine index properties such as natural moisture content, specific gravity, and Atterberg limits.	
CO3: Analyze grain size distribution of soils using sieve and hydrometer methods to assess soil gradation and suitability for engineering applications.	
CO4: Evaluate in-situ soil density using core cutter and sand replacement methods to assess field compaction quality.	
CO5: Determine compaction characteristics and permeability of soils through Proctor tests and permeability tests, and interpret their significance in geotechnical design.	
CO6: Interpret and integrate experimental results to draw conclusions on soil behavior, and prepare technical reports in line with geotechnical engineering practices.	
Experiment 1: Field identification of different types of soil.	
Experiment 2: Determination of natural moisture content.	
Experiment 3: Determination of specific gravity of cohesionless soil.	
Experiment 4: Determination of specific gravity of cohesive soils.	
Experiment 5: Determination of in-situ density by core cutter method.	
Experiment 6: Determination of in-situ density by sand replacement method.	
Experiment 7: Determination of grain size distribution by sieve analysis.	
Experiment 8: Determination of grain size distribution by hydrometer analysis	
Experiment 9: Determination of Atterberg limits (liquid limit and plastic limit).	
Experiment 10: Determination of Atterberg limits (shrinkage limit).	
Experiment 11: Determination of compaction characteristics of soil by standard proctor compaction test.	
Experiment 12: Determination of compaction characteristics of soil by modified proctor compaction test.	
Experiment 13: Determination of co-efficient of permeability by constant head permeability tests.	
Experiment 14: Determination of co-efficient of permeability by variable head permeability tests.	

CO & PO Mapping:

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

CO & PSO Mapping

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	2	2	2
CO3	3	2	2
CO4	2	2	2
CO5	3	3	2
CO6	2	3	3

Text Books:

1. Braja M. Das, Soil Mechanics Laboratory Manual, Oxford University Press, New York, 2002;
2. R.K. Sharma, Soil Mechanics and Laboratory Testing Manual, I K International Publishing House Pvt. Ltd.;
3. BIS, SP:36 (Part I and Part II);
4. P. Purushothama Raj, Soil Mechanics and Foundation Engineering, Pearson

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Curriculum Structure for B.Tech courses in Civil Engineering
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SEMESTER - V (Third Year)

Course Title: Design of Reinforced Concrete Structures

Course Code: PC-CE 501	**Category:** Professional Core Courses
Course Title: Design of Reinforced Concrete Structures	**Semester:** 5th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Engineering Mechanics, Solid Mechanics, Building Materials and Construction	
Course Outcomes:	
CO1: Understand material properties and design methodologies for reinforced concrete structures.	
CO2: Assess different type of loads and prepare layout for reinforced concrete structures.	
CO3: Identify and apply the applicable industrial design codes relevant to the design of reinforced concrete members.	
CO4: Analyse and design various structural elements of reinforced concrete building like beam, slab, column, footing, and staircase.	
CO5: Assessment of serviceability criteria for reinforced concrete beam and slab.	
CO6: Prepare structural drawings and detailing and produce design calculations and drawing in appropriate professional format.	
Module 1: Introduction [2 Hours] Principles of design of reinforced concrete members- Working stress and Limit State method of design.	
Module 2: Working stress method of design [5 Hours] 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 [5 Hours] 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 and Slab Design by LSM [10 Hours] Beam Design by LSM: Analysis, design and detailing of singly reinforced rectangular 'T', 'L' and doubly reinforced beam sections by limit state method. Slab Design by LSM: Design and detailing of one-way and two- way slab panels as per IS code provisions. Continuous slab and beam design by LSM: Design and detailing of continuous beams and slabs as per IS code provisions.	
Module 5: Design of Staircases and Columns by LSM **[10 Hours]** Design of Staircases by LSM: Types; Design and detailing of reinforced concrete dog legged staircase. 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 6: Design of Foundation by LSM [4 Hours]
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.

CO & PO Mapping

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

CO & PSO Mapping

CO/PSO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	2

Text Books:

1 Reinforced Concrete, Design Pillai and Menon, TMH
2 Reinforced Concrete Design, Krishna Raju &Pranesh, New Age
3 R.C.C. Design, B.C. Punmia, Laxmi Publication
4 Reinforced concrete structures, N. Subramanian OXFORD, University Press
5 Limit State Design of Reinforced Concrete, P. C. Varghese, PHI
6 Reinforced concrete, S.N. Sinha, TMH

IS Code:

1 IS: 456 – 2000: Plain and reinforced concrete - Code of practice
2 a) IS 875 Part 1: Dead Loads - Unit Weights of Building Materials and Stored Materials
b) IS 875 Part 2: Imposed Loads - Live Loads and Wind Loads
c) IS 875 Part 3: Wind Loads on Buildings and Structures
d) IS 875 Part 4: Snow Loads
e) IS 875 Part 5: Special Loads and Load Combinations
3 SP: 16: Design Aid to IS 456

Course Title: Foundation Engineering

Course Code: PC-CE 502	**Category**: Professional Core Courses
Course Title: Foundation Engineering	**Semester**: 5th
L-T-P: 3-0-0	**Credit**: 3
Pre-Requisites: Engineering Mechanics, Soil Mechanics-I	
Course Outcomes:	
CO1: Define and list fundamental terms related to shear strength of soils, earth pressure theories, foundation types, soil exploration methods, and slope stability concepts.	
CO2: Explain the concepts of strength envelopes, stress paths, pore pressure, and principles of Rankine's and Coulomb's earth pressure theories with suitable examples.	
CO3: Apply IS codes and theoretical methods to determine active/passive earth pressures, bearing capacity of shallow foundations, and basic settlement analysis.	
CO4: Analyze soil exploration data and results of in-situ and laboratory tests to classify soils and evaluate suitability for foundation design.	
CO5: Evaluate foundation and slope stability problems by comparing alternative solutions and selecting the most appropriate design parameters.	
CO6: Design safe and economical shallow and deep foundations, and propose slope stabilization measures considering geotechnical data and site conditions.	
Module 1: Shear Strength of Soil [6 hours] Strength envelope, total and effective stress paths, pore pressure, evaluation of shear strength parameters, direct shear, triaxial shear, vane shear & unconfined compression test.	
Module 2: Lateral Earth Pressure [6 hours] Earth pressure at rest, active and passive earth pressure, Rankine's and Coulomb's earth pressure theories, Graphical Solutions.	
Module 3: Bearing capacity of Shallow Foundation & Settlement of Shallow foundation [10 hours] Bearing Capacity, Failure Modes, Theories, Factors, Bearing Capacity by IS Code: IS 6403. Settlement Analysis, Immediate & Consolidation Settlement, Corrections (Rigidity & Depth), IS 1904 Recommendations.	
Module 4: Soil Exploration [4 hours] Planning, Boring Methods, Sampling, Bore Log, Report, In-situ Tests: SPT, Static Cone, Dynamic Cone, Field Vane Shear, Plate Load, Indirect Methods, Seismic Refraction & Electrical Resistivity methods.	
Module 5: Pile Foundations [8 hours] Pile Types, Material, Installation: Techniques & Selection, Load Capacity Calculation (Static & Dynamic), Group Action & Efficiency, Pile Load Testing, Settlement & Lateral Load & Uplift load Capacity.	
Module 6: Introduction of Slope Stability [2 hours] Stability of earth slopes, finite and infinite slopes.	

CO & PO Mapping:

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

CO & PSO Mapping

CO/PSO	PSO1	PSO2	PSO3
CO1	2	2	1
CO2	2	3	2
CO3	2	3	2
CO4	3	2	2
CO5	2	3	2
CO6	3	3	3

Text Books:

1. Gopal Ranjan & A. S. R. Rao – Basic and Applied Soil Mechanics, Wiley.
2. J. E. Bowles – Foundation Analysis and Design, McGraw-Hill Education.
3. Prakash and Sharma – Pile Foundations in Engineering Practice, S. Chand Publishing.
4. N. P. Kurian – Design of Foundation Systems – Principles and Practices, CRC Press.
5. Braja M. Das – Principles of Foundation Engineering, Cengage Learning.
6. M. J. Tomlinson – Foundation Design and Construction, Pearson Education.
7. V. N. S. Murthy – Advanced Foundation Engineering, CBS Publishers & Distributors.

Haldia Institute of Technology, West Bengal
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Curriculum Structure for B.Tech courses in Civil Engineering
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Course Title: Environmental Engineering-II

Course Code: PC-CE 503	**Category:** Professional Core Courses
Course Title: Environmental Engineering-II	**Semester:** 5th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Class-XII level knowledge of Physics, Chemistry, Mathematics, Biology and Environmental Science; Undergraduate level knowledge of Engineering Mechanics, Fluid Mechanics and Hydraulics; Environmental Engineering-I	
Course Outcomes:	
CO1: Explain the basic concepts, terminologies, and principles of wastewater engineering, including sewerage systems and sanitation planning.	
CO2: Calculate and forecast sanitary and storm sewage quantities using conventional methods.	
CO3: Analyze the hydraulic design parameters and operational requirements of sewer systems using partial flow diagrams, nomograms.	
CO4: Evaluate wastewater characteristics and assess compliance with effluent discharge standards for environmental protection.	
CO5: Design wastewater treatment units, sludge handling systems, and process control strategies incorporating sustainable and smart technology solutions.	
CO6: Evaluate sludge treatment and disposal systems.	
Module 1: Sewage and Drainage [4 Hours] Definition of Common Terms: 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: Determination of Sewage and Drainage Quantity [5 Hours] Quantity estimation for sanitary sewage; Quantity estimation for storm sewage.	
Module 3: Conveyance of Sewage [6 Hours] Sewers: Shapes; Design parameters; Operation and maintenance of sewers; Sewer appurtenances. Hydraulic Design of Sewers: Partial flow diagrams and Nomograms.	
Module 4: Wastewater Characteristics [6 Hours] Physical, chemical and biological characteristics of municipal and domestic sewage; Effluent discharge standards.	
Module 5: Wastewater Treatment [10 Hours] Primary, secondary and tertiary treatment of wastewater; aerobic and anaerobic treatment options. Primary and Secondary Treatment of Domestic Wastewater: Typical Flow Chart of STP; Screen and Bar Racks; Grit Chamber; Primary and Secondary Sedimentation Tank; Activated Sludge Process; Trickling Filter.	
Module 6: Sludge Handling and Disposal [5 Hours] Sludge Thickening; Sludge Digestion; Sludge Drying Bed.	

CO & PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	2	3	2	3	1	3	1	–	2
CO2	2	1	3	2	1	2	3	1	2	1	2	3
CO3	2	2	2	3	2	1	2	1	3	1	1	2
CO4	2	2	2	3	3	2	1	3	–	1	2	2
CO5	2	3	1	3	2	3	2	1	3	1	3	2
CO6	2	2	2	3	3	2	3	2	–	2	2	3

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	2	2
CO3	3	2	2
CO4	3	3	3
CO5	3	3	2
CO6	3	3	2

Text Books:

1. Environmental Engineering. S.C. Sharma. Khanna Publishing House
2. Environmental Engineering. Volume-1 and Volume-2. Garg, S.K.. Khanna Publishers
3. Environmental Engineering. Peavy, H.S, Rowe, D.R, Tchobanoglous, G. TataMcGraw Hill Indian Edition.
4. Elements of Environmental Pollution Control.O.P. Gupta. Khanna Publishing House
5. Elements of Solid & Hazardous Waste Management. O.P. Gupta. Khanna Publishing House
6. Introduction to Environmental Engineering and Science.Masters, G.M., W.P. Ela, Prentice Hall / Pearson
7. Manual on Sewerage and Sewage Treatment CPHEEO.Govt. of India
8. Manual on Municipal Solid Waste Management. CPHEEO. Govt. of India
9. Hazardous and other waste (Management and Transboundary
10. Movement) Rules, 2016. MoEF. Govt. of India

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Curriculum Structure for B.Tech courses in Civil Engineering
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Course Title: Transportation Engineering-II

Course Code: PC-CE 504	**Category:** Professional Elective Courses
Course Title: Transportation Engineering-II	**Semester:** 5th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Transportation Engineering-I	
Course Outcomes:	
CO1: Explain functional components of permanent way and their roles in railway engineering.	
CO2: Analyze railway alignment requirements considering topography, curves, and gradients.	
CO3: Design geometric elements of railway track, yards, points & crossings, and signaling systems.	
CO4: Apply principles of construction and maintenance of railway tracks including track drainage.	
CO5: Evaluate site selection and design parameters for airports including runway orientation.	
CO6: Design airport pavements, taxiways, aprons, lighting, and drainage systems.	
Module 1: Introduction to Railway Engineering [6 Hours] Introduction to Railway Engineering: Socio-economic impact of Indian Railways; Zonal classification of Indian Railways; Railway track components; Gauges; Classification of Indian Railways based on Speed Criteria.	
Module 2: Permanent way and track alignment survey [7 Hours] Permanent way component parts, rails, railway sleepers, types, railway creep, anti-creep devices check and guard rails, ballast requirements, types specification, formation, cross section and drainage. Track Alignment and Engineering Survey: Basic requirement of good alignment; Factors in selection of good alignment; Engineering Survey, Track Stresses;	
Module 3: Traction and Geometric Design of Railway Tracks [7 Hours] Tractive Resistance: Resistance to traction, various resistances and their evaluation, hauling capacity and tractive effort. Geometric Design: Alignment, horizontal curves, super elevation, equilibrium cant and cant deficiency, Gradients and grade compensation	
Module 4: Points and Crossings, stations, Signalling and Interlocking [6 Hours] Points and Crossings; Station and Yards; Site, requirements, classification of railway stations. Signalling and Inter looking: Objectives, principles of signalling, classification and types of signals in stations and yards & methods of interlocking.	
Module 5: Introduction to airport planning and development [5 Hours] General philosophy of airport planning and development, ICAO classification of airports, site selection factors characteristics and jet aircraft. Airport Site Selection;	
Module 6: Airport Engineering [5 Hours] Design of Airfield components: Runway, Taxiway apron hanger, terminal building and control tower; Runway orientation: Windrose diagrams. Airport planning: Centralized and decentralized planning concepts, terminal requirements, terminal facilities and Typical layout of airports.	

CO & PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	1	1	–	–	1	–	1
CO2	3	3	3	2	2	1	1	–	1	1	–	2
CO3	3	3	3	3	2	1	1	1	2	2	1	2
CO4	3	3	3	2	2	2	2	1	2	2	1	2
CO5	3	3	3	2	2	2	2	2	2	2	2	3
CO6	3	3	3	3	3	2	2	2	2	2	2	3

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	-
CO2	2	3	-
CO3	3	3	2
CO4	2	3	2
CO5	2	3	2
CO6	3	2	-

Text Books:

1. Saxena, S.C. and Arora, S.P., A Text Book of Railway Engineering, Dhanpat Rai and Sons.
2. Khanna, S.K., Arora, M.G. and Jain, S.S., Airport Planning and Design, Nem Chand & Bros.
3. Rangwala, S.C., Railway Engineering, Charotar Publishing House.
4. Relevant IRC, BIS and ICAO Codes.

Course Title: Structural Analysis-I

Course Code: PC-CE 505	**Category**: Professional Core Courses
Course Title: Structural Analysis-I	**Semester**: 5th
L-T-P: 3-0-0	**Credit**: 3
Pre-Requisites: Solid Mechanics	
Course Outcomes:	
CO1: Recall and explain the concepts of static and kinematic indeterminacy, and differentiate between stable, unstable, determinate, and indeterminate structures.	
CO2: Apply equations of equilibrium to compute reactions and internal forces in determinate structures including cables, three-hinged arches, and portal frames.	
CO3: Calculate deflections in beams, trusses, and portal frames using energy-based methods such as the unit load method, Castigliano's theorems, and virtual work principles.	
CO4: Construct and interpret influence line diagrams for reactions, shear forces, and bending moments in beams and trusses subjected to moving loads.	
CO5: Analyze statically indeterminate beams and arches using the theorem of three moments, energy methods, and the method of consistent deformation.	
CO6: Integrate analytical results with structural behavior to assess the suitability of different methods for practical design and performance evaluation.	
Module 1: Introduction to Structural Analysis [2 Hours] Concept of static and kinematic indeterminacy; determination of degree of indeterminacy for different structural forms.	
Module 2: Basics of Structural Analysis [2 Hours] Theorem of minimum potential energy; law of conservation of energy; principle of virtual work; Castigliano's first and second theorems; Betti's law; Maxwell's reciprocal theorem; conjugate beam method; moment area method.	
Module 3: Analysis of Determinate Structures [8 Hours] Analysis of portal frames, three-hinged arches, and cables under different loading conditions.	
Module 4: Deflection of Determinate Structures [8 Hours] Energy methods and unit load method for beams, trusses, and simple portal frames.	
Module 5: Influence Line Diagrams [8 Hours] Influence lines for statically determinate beams and trusses under series of concentrated and uniformly distributed rolling loads; criteria for maximum and absolute maximum moments and shear forces.	
Module 6: Analysis of Statically Indeterminate Beams [8 Hours] Theorem of three moments; energy methods; force method; method of consistent deformation; analysis of propped cantilever, fixed beams, and continuous beams; analysis of two-hinged arches.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	2

Text Books:

1. Agor, R. *Structural Analysis*. Khanna Publishing House.
2. Bhavikatti, S. S. *Structural Analysis (Vol. I & II)*. Vikas Publishing House Pvt. Ltd.
3. Ramamrutham, S. *Theory of Structures*. Dhanpat Rai Publishing Company Pvt. Ltd.
4. Punmia, B. C., Jain, A. K., & Jain, A. K. *Strength of Materials and Theory of Structures (Vol. I & II)*. Laxmi Publications.
5. Hibbeler, R. C. *Structural Analysis*. Prentice Hall.
6. Timoshenko, S., & Young, D. H. *Theory of Structures*. McGraw-Hill.
7. Pandit, G. S., & Gupta, S. P. *Structural Analysis*. Tata McGraw-Hill.

Course Title: Quantity Survey Estimation and Valuation

Course Code: PC-CE 506	**Category:** Professional Core Courses
Course Title: Quantity Survey Estimation and Valuation	**Semester:** 5th
L-T-P: 2-0-0	**Credit:** 2
Pre-Requisites: Building Materials and Construction	
Course Outcomes:	
CO1: Illustrate the fundamental concepts, procedures, and standards used in estimation, specifications, rate analysis, tendering, valuation, and relevant acts in civil engineering projects.	
CO2: Apply Indian Standard Specifications and measurement techniques to prepare quantity estimates, bar bending schedules, and rate analysis for various civil works.	
CO3: Analyze alternative construction options and their cost implications using thumb rules, material surveys, and productivity norms.	
CO4: Prepare tender documents, valuation reports, and bid price build-ups considering material, labor, equipment costs, and associated risks.	
CO5: Integrate Building Information Modeling (BIM) tools and modern quantity take-off techniques for accurate estimation and documentation.	
CO 6: Assess the legal and contractual implications of acts related to wages, compensation, contracts, arbitration, and property rights in construction projects.	
Module 1: Estimation / Measurements for various items [5 Hours] 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, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labor costs; rate analysis; Material survey- Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost. Case Study: Estimation of a Residential Building (G+1).	
Module 2: Specifications [4 Hours] Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures. Specification of materials: Brick, cement, fine and coarse aggregates. 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. Case Study: Importance of Specifications in a Multi-storey Building Project.	
Module 3: Rate analysis [4 Hours] Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity. Case Study: Rate Analysis of RCC Work (1:1.5:3) for a Residential Slab.	
Module 4: Tender [4 Hours] Preparation of tender documents, the importance of inviting tenders, contract types, relative merits, and prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, insurance, claims, price variation, etc. Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct and indirect Overheads, Profits; Bid conditions, alternative specifications. Case Study: E-Tendering in a Government Building Project.	
Module 5: Valuation [4 Hours]	

Values and cost, gross income, outgoing, net income, scrap value, salvage value, market value, Book Value, sinking fund, capitalized value, Y. P., depreciation, obsolescence, deferred income, freehold and leasehold property, mortgage, rent fixation, valuation table. Case Study: Valuation of a Residential Property for Bank Loan.
Module 6: Introduction to Acts [3 Hours] Introduction to Acts - Pertaining to Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights. Case Study: Legal Issues in a Large Construction Project.

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3
CO5	2	3	2
CO6	2	2	3

Text Books:

1. Estimating, Costing Specifications & Valuation - M Chakravarty.
2. Estimating and Costing in Civil Engineering (Theory & Practice) - B.N. Dutta, UBS Publishers.
3. Sociology & Economics for Engineers - Premvir Kapoor, Khanna Publishing House.
4. Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations, UBS Publishers
5. Typical PWD Rate Analysis documents.

LABORATORY/ SESSIONAL [Semester V-Third year]

Course Title: Reinforced Concrete Design Sessional

Course Code: PC-CE 581	**Category:** Professional Core Courses
Course Title: Reinforced Concrete Design Sessional	**Semester:** 5th
L-T-P: 0-0-3	**Credit:** 1.5
Pre-Requisites: Design of Reinforced Concrete Structures	
Course Outcomes:	
CO1: Remember IS code provisions and fundamental concepts for the design and detailing of RCC structural members in multi-storey buildings.	
CO2: Explain the structural behaviour and load transfer mechanism in slabs, beams, columns, staircases, and footings.	
CO3: Apply IS code guidelines to design and detail slabs, beams, staircases, columns, and isolated footings for a three-storey RCC framed building.	
CO4: Analyze load distribution and structural safety for combined footing design in different site conditions.	
CO5: Evaluate different design options for structural members considering safety, serviceability, cost, and construction feasibility.	
CO6: Create complete structural drawings and reinforcement detailing for RCC structural members, integrating analysis, design, and drafting standards.	
Module 1: Design and detailing of a three storied RCC framed building. Slab, Beam, Staircase, column and isolated footing	
Module 2: Design and detailing of combined footing.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO\PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	2	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	3

Text Books:

1 Reinforced Concrete, Design Pillai and Menon, TMH
2 Reinforced Concrete Design, Krishna Raju &Pranesh, New Age
3 R.C.C. Design, B.C. Punmia, Laxmi Publication
4 Reinforced concrete structures, N. Subramanian OXFORD, University Press
5 Limit State Design of Reinforced Concrete, P. C. Varghese, PHI
6 Reinforced concrete, S.N. Sinha, TMH

IS Code:

1 IS: 456 – 2000: Plain and reinforced concrete - Code of practice
2 a) IS 875 Part 1: Dead Loads - Unit Weights of Building Materials and Stored Materials
b) IS 875 Part 2: Imposed Loads - Live Loads and Wind Loads
c) IS 875 Part 3: Wind Loads on Buildings and Structures
d) IS 875 Part 4: Snow Loads
e) IS 875 Part 5: Special Loads and Load Combinations
3 SP: 16: Design Aid to IS 456

Course Title: Soil Mechanics Laboratory-II

Course Code: PC-CE 591	**Category:** Professional Core Courses
Course Title: Soil Mechanics Laboratory-II	**Semester:** 5th
L-T-P: 0-0-3	**Credit:** 1.5
Pre-Requisites: Soil Mechanics-I and Soil Mechanics Laboratory-I	
Course Outcomes:	
CO1: Recall and explain the objectives, principles, and IS code provisions for advanced soil tests including shear strength, bearing capacity, compressibility, and density determination	
CO2: Perform laboratory and field experiments such as direct shear, vane shear, triaxial, CBR, consolidation, relative density, and SPT using standard geotechnical procedures.	
CO3: Analyze test data to compute engineering properties such as cohesion, angle of internal friction, CBR value, compression index, and relative density, identifying influencing factors.	
CO4: Design experimental layouts, select suitable test procedures, and develop data recording formats to ensure accurate and reliable soil property determination.	
CO5: Integrate results from multiple soil tests to prepare a soil investigation plan for practical geotechnical engineering applications.	
CO6: Evaluate and interpret laboratory and field test results by comparing with theoretical predictions, IS code standards, and project requirements to prepare a comprehensive soil investigation report.	
Experiment 1: Determination of shear strength parameters of soil by direct shear test (cohesion-less soil)	
Experiment 2: Determination of shear strength parameters of soil by direct shear test (Cohesive soil)	
Experiment 3: Determination of undrained shear strength of soil by vane shear test.	
Experiment 4: Determination of unconfined compressive strength of soil by unconfined compression test.	
Experiment 5: Determination of shear strength parameters of soil by UU Triaxial test (Cohesion-less soil)	
Experiment 6: Determination of shear strength parameters of soil by UU Triaxial test (Cohesive soil).	
Experiment 7: Determination of California Bearing Ratio (CBR) of soil: Soaked CBR.	
Experiment 8: Determination of California Bearing Ratio (CBR) of soil: Unsoaked CBR.	
Experiment 9: Determination of compressibility characteristics by Consolidation test.	
Experiment 10: Determination of relative density of soil	
Experiment 11: Standard Penetration Test (SPT)	
Experiment 12: Preparation of Soil Investigation Report	

CO & PO Mapping:

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

CO & PSO Mapping:

CO\PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3
CO5	3	3	3
CO6	3	3	3

Text Books:

1. Soil Mechanics Laboratory Manual Braja Mohan Das Oxford University Press
2. Method for standard penetration test for soils. IS 2131 (1981)
3 Method of load test on soils. IS 1888 (1982).

Course Title: Environmental Engineering Laboratory

Course Code: PC-CE 592	**Category:** Professional Elective Courses
Course Title: Environmental Engineering Laboratory	**Semester:** 5th
L-T-P: 0-0-3	**Credit:** 1.5
Pre-Requisites: Class-XII level knowledge of Physics, Chemistry, Mathematics, Biology and Environmental Science; Undergraduate level knowledge of Environmental Engineering, Chemistry Laboratory, Physics Laboratory	
Course Outcomes:	
CO1: Measure and interpret physical characteristics of water and wastewater samples using standard laboratory methods.	
CO2: Determine chemical quality parameters of water and wastewater to assess compliance with IS and WHO standards.	
CO3: Analyze bacteriological quality of water and wastewater through standard microbiological testing.	
CO4: Evaluate suitability of various treatment options for different water and wastewater quality scenarios.	
CO5: Demonstrate teamwork, problem-solving skills, and adherence to safety protocols during environmental laboratory investigations.	
CO6: Demonstrate effective teamwork, safety practices, and problem-solving skills in environmental engineering laboratory settings.	
List of Experiments	
1. Determination of turbidity for a given sample of water	
2. Determination of electrical conductivity for a given sample of water	
3. Determination of Total Solids, Suspended Solids, Dissolved Solids and Volatile Solids in a given sample of water	
4. Determination of pH for a given sample of water	
5. Determination of carbonate, bi-carbonate and hydroxide alkalinity for a given sample of water	
6. Determination of acidity for a given sample of water	
7. Determination of hardness for a given sample of water	
8. Determination of concentration of Iron in a given sample of water	
9. Determination of concentration of Chlorides in a given sample of water	
10. Determination of the Optimum Alum Dose for a given sample of water through Jar Test	
11. Determination of the Chlorine Demand and Break-Point Chlorination for a given sample of water	
12. Determination of amount of Dissolved Oxygen (DO) in a given sample of water	
13. Determination of the Biochemical Oxygen Demand (BOD) for a given sample of wastewater	
14. Determination of the Chemical Oxygen Demand (COD) for a given sample of wastewater	
15. Determination of Coliform Bacteria: presumptive test, Confirmative test and Determination of MPN	

CO & PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	2	3	3	2	2	1	3	2	3
CO2	2	3	3	2	3	3	2	2	1	3	2	3
CO3	2	3	3	2	3	3	2	2	1	3	2	3
CO4	2	3	3	2	3	3	2	2	1	3	2	3
CO5	1	3	3	2	2	3	2	2	2	2	3	2
C06	1	2	2	3	2	3	2	3	3	2	3	2

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3
CO5	2	3	3
CO6	2	3	3

Text Books:

1. Environmental Engineering.S.C. Sharma.Khanna Publishing House
2. Environmental Engineering.Volume-1 and Volume-2. Garg, S.K. Khanna Publishers
3. Environmental Engineering. Peavy, H.S, Rowe, D.R, Tchobanoglous, G Tata McGraw Hill Indian Edition.
4. Chemistry for Environmental Engineering and Science. Sawyer, C.N., McCarty, P.L., Parkin, G.F McGraw Hill International Edition / Tata McGraw Hill Indian Edition.
5. "METIHODS OF SAMPLING AND TEST (PHYSICAL AND CHEMICAL) FOR WATER AND WASTE WATER". IS: 3025 (Different Parts).
6. APHA Standard Methods for the Examination of Water and Wastewater.
7. "DRINKING WATER SPECIFICATION (SECOND REVISION)". IS: 10500 – 2012

Course Title: Transportation Engineering Laboratory

Course Code: PC-CE 593	**Category:** Professional Elective Courses
Course Title: Transportation Engineering Laboratory	**Semester:** 5th
L-T-P: 0-0-3	**Credit:** 1.5
Pre-Requisites: Transportation Engineering	
Course Outcomes:	
CO1: Perform standard laboratory tests on aggregates to determine shape, crushing, impact, abrasion, and specific gravity properties.	
CO2: Conduct penetration, viscosity, softening point, ductility, and flash & fire point tests to characterize bituminous binders.	
CO3: Analyze subgrade performance using CBR and plate load tests for evaluating soil strength and suitability.	
CO4: Design and validate bituminous mixes using Marshall Stability test.	
CO5: Demonstrate advanced testing methods such as stripping value, loss on heating, Benkelman Beam deflection, and Bump Integrator for pavement evaluation.	
CO6: Interpret experimental data and prepare technical reports to support decision-making in pavement design and maintenance.	
List of Experiments	
1. Introduction to pavement construction materials.	
2. Shape test of aggregate.	
3. Crushing strength test of aggregate.	
4. Impact test of aggregate.	
5. Los Angeles abrasion test of aggregate.	
6. Specific gravity and water absorption test of aggregate.	
7. Specific gravity test of bitumen.	
8. Penetration test of bitumen.	
9. Static or kinematic viscosity of bitumen.	
10. Softening point test of bitumen.	
11. Flash and fire point test of bitumen.	
12. Ductility test of bitumen.	
13. CBR value of subgrade (soaked and unsoaked).	
14. Marshall stability test of bituminous mix.	
15. Demonstrations: Stripping value test, loss on heating test of bitumen, Benkelman beam deflection, bump integrator.	

CO & PO Mapping:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	2	2	2	2	–	–	–	1	1	–	1
CO2	3	3	2	2	2	–	–	–	1	1	–	2
CO3	3	3	3	3	2	2	2	–	1	2	–	2
CO4	3	3	3	3	3	2	2	–	2	2	2	3
CO5	3	3	3	2	2	2	2	1	2	2	2	3
CO6	3	3	3	3	3	2	2	1	2	3	2	3

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	2
CO3	3	2	2
CO4	3	3	3
CO5	3	2	1
CO6	3	2	2

Text Books:

1. Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., Highway Engineering, Nem Chand & Bros.
2. Relevant IS and IRC codes for material testing.
3. Laboratory Manual for Transportation Engineering, prepared by the department.

Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology.)
Curriculum Structure for B.Tech courses in Civil Engineering
(Effective from the Academic Session 2024-2025)

SEMESTER - VI (Third year)

Course Title: Construction Management

Course code: PC-CE 601	**Category:** Professional Core Courses
Course title: Construction Management	**Semester:** 6th
L-T-P: 2-0-0	**Credit:** 2
Pre-requisites: Building Materials and Construction	
Course Outcome:	
CO1: Interpret the building bye-laws applicable to various building facilities in the area.	
CO2: Apply project planning techniques using PERT for effective scheduling and control.	
CO3: Apply project planning techniques using CPM for resource optimization and timely completion.	
CO4: Identify and analyze the functions of construction equipment used for excavation, earth moving, and concreting operations.	
CO5: Evaluate different construction methods for bridges and tall structures.	
CO6: Prepare tenders, contracts, and related documents in accordance with standard practices.	
Module 1: Planning [4 Hours] General consideration, aspect definition, prospect, roominess, grouping, circulation, Privacy. Regulation and 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 public assembly buildings, offices Fire Protection: Firefighting arrangements in public assembly buildings, planning, offices, auditorium.	
Module 2: Planning and scheduling of construction Projects [3 Hours] Planning by CPM Preparation of network, Determination of slacks or floats. Critical activities. Critical path. Project duration.	
Module 3: Planning by PERT [6 Hours] Expected meantime, probability of completion of the project, Estimation of the critical path, problems.	
Module 4: Construction Plants & Equipment [3 Hours] Plants and equipment for earth moving, road constructions, excavators, dozers, scrapers, spreaders, rollers, and their uses. Plants and equipment for concrete construction Batching plants, Ready Mix Concrete, concrete mixers, Vibrators, etc., quality control.	
Module 5: Construction Methods Basic [4 Hours] Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with block work 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: Management [4 Hours] Professional practice, Definition, Rights and responsibilities of owner, engineer, Contractors, types of contracts. Departmental Procedures: Administration, Technical and financial sanction, operation of PWD, Tenders and its notification, EMD and SD, Acceptance of tenders, Arbitration.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	2	3	3
CO3	2	3	3
CO4	3	2	3
CO5	3	3	3
CO6	2	1	3

Text books:

1. Construction Project management Planning, Scheduling and Controlling - K.K. Chitkara, Tata McGraw-Hill Education.
2. Construction management - Dr. R. P. Rethaliya, Atul Prakashan
3. Construction and Project Management- KG Krishnamurthy, SV Ravindra, Sri Lakshmi Publications.

Course Title: Water Resources Engineering

Course Code: PC-CE 602	**Category:** Professional Core courses
Course Title: Water Resources Engineering	**Semester:** 6th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Fluid Mechanics, Soil Mechanics	
Course Outcomes:	
CO1: Recall key concepts of precipitation, evaporation, infiltration, runoff, floods, open channel flow, and groundwater.	
CO2: Explain measurement principles and methods for rainfall, evaporation, infiltration, and streamflow.	
CO3: Apply hydrological methods to compute parameters from field or given data.	
CO4: Analyze rainfall–runoff, hydrographs, and flood frequency data for planning purposes.	
CO5: Evaluate hydrological models and methods for specific catchments.	
CO6: Design hydrological solutions for flood control, groundwater extraction, and water resource management.	
Module 1: Precipitation [6 Hours] Precipitation, Description and Functioning of Various Types of Rain gauges, Rain gauge Network- Codal Provisions, Optimum Number of Raingauge Stations, 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 2: Evaporation & Transpiration [6 Hours] Evaporation- Evaporation Process, Factors affecting Evaporation, Measurement of Evaporation, Description and Functioning of Pan Evaporimeter, Pan Coefficient, Evapotranspiration: 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 3: Runoff & Hydrograph [8 Hours] Description of the Process, Components of Runoff, Factors Affecting Runoff, Characteristics of Streams, Rainfall Runoff Relationships. Hydrographs: Types, Base Flow Separation, Effective Rainfall. Unit Hydrograph– Definition, Assumptions, Applications– Derivation of Unit Hydrograph, Distribution Graph, Unit Hydrograph of Different Durations– Method of Superposition and S-Curve.	
Module 4: Flood [4 Hours] 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. 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.	

Module 5: Open Channel Flow [8 Hours] Channel Characteristics and parameters, Energy-depth relationships, Specific Energy concept, Critical Flow, Hydraulic Jump, Uniform flow, Efficient sections, Slope profiles, Gradually Varied Flow, Water surface profiles.
Module 6: Groundwater [4 Hours] Occurrence of groundwater– Aquifers, Various Types of Aquifers, Aquifer Parameters: Specific Yield, Specific Retention, Storage Coefficient, Transmissivity. Introduction to ground water flow, Darcy law; Wells: Definition, Types, cavity formation in open wells, construction of open wells, Yield of an open well – Equilibrium pumping test, Recuperating test, Examples.

CO & PO Mapping:

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

CO & PSO Mapping:

	PSO1	PSO2	PSO3
CO1	3	1	2
CO2	3	2	2
CO3	2	3	2
CO4	2	3	2
CO5	3	3	3
CO6	3	3	2

Text Books:

1. K. Subramanya, Engineering Hydrology, McGraw Hill Education (India) Private Limited, New Delhi.
2. R.Srivastava and A. Jain, Engineering Hydrology, McGraw Hill Education (India) Private Limited, New Delhi.
3. V. T. Chow, D. Maidment, L. Mays, Applied Hydrology, Tata McGraw-Hill, Delhi.
4. M. M. Das, M. Das Saikia, Hydrology, PHI Learning Private Limited, New Delhi.
5. K. Subramanya, Flow in Open Channels, McGraw Hill Education (India) Private Limited, New Delhi.
6. Saiful Islam, Open Channel Flow, Khanna Publishing House.

Course Title: Design of Steel Structures

Course Code: PC-CE 603	**Category:** Professional Core Courses
Course Title: Design of Steel Structures	**Semester:** 6th
L-T-P: 3-0-0	**Credit**: 3
Pre-Requisites: Solid Mechanics, Structural Analysis, Building Materials and Construction, Basics of IS Codes (IS 800:2007, IS 875: Parts I–V)	
Course Outcomes:	
CO1: Explain properties of steel, relevant IS codes, and design philosophies (WSD & LSD)	
CO2: Analyze and design bolted, riveted, and welded connections including eccentric connections.	
CO3: Design steel tension members under axial loads.	
CO4: Analyze and design compression members, built-up columns, lacing, battening, and column bases.	
CO5: Design steel beams considering bending, shear, and buckling.	
CO6: Design plate girders including stiffeners as per IS 800:2007.	
Module 1: Materials and Specifications [2 Hours] Properties of structural steel, stress–strain behavior, design philosophy: Working Stress Design vs Limit State Design (LSD). IS 800:2007 provisions, safety factors, partial safety factors Modern steel production, sustainability aspects.	
Module 2: Structural Connections [6 Hours] Bolted, riveted and welded joints: failure modes, strength and detailing. Eccentric connections: tension + shear, torsion. Introduction to High Strength Friction Grip (HSFG) bolts (update). Practical detailing guidelines as per IS 800:2007.	
Module 3: Design of Tension Members [6 Hours] Net effective area, block shear, slenderness. Design of single and built-up tension members. Code-based examples (IS 800:2007).	
Module 4: Design of Compression Members [6 Hours] Buckling modes, effective length concept. Slenderness limits, column curves. Built-up columns, lacing, battening. Column bases: slab base, gusseted base. (Update: include IS 800:2007 design curves for compression).	
Module 5: Design of Beams [6 Hours] Classification of sections, lateral–torsional buckling. Design for bending, shear, deflection, web buckling & crippling. Beam-column connections, detailing. (Update: include IS 800:2007 LSD provisions).	
Module 6: Design of Plate Girders [10 Hours] Economical depth, flange/web design. Web buckling, crippling, shear buckling. Intermediate & end stiffeners (bolted/welded). Modern design as per IS 800:2007.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	2

Text Books:

1. Subramanian, *Design of Steel Structures*, Oxford.
2. Duggal, *Limit State Design of Steel Structures*, TMH.
3. Bhavikatti, *Design of Steel Structures*, I.K. Publishing.
4. IS 800:2007, IS 875 (Parts I–V).
5. INSDAG design handbooks (for updated detailing).

Course Title: Structural Analysis-II

Course Code: PC-CE 604	**Category:** Professional Core Courses
Course Title: Structural Analysis-II	**Semester:** 6th
L-T-P: 3-0-0	**Credit**: 3
Pre-Requisites: Solid Mechanics, Structural Analysis-I	
Course Outcomes:	
CO1: Explain and apply slope deflection and moment distribution methods for beams and frames with and without side sway.	
CO2: Analyze suspension bridges and stiffening girders under static loads.	
CO3: Examine curved beam behavior in hooks, rings, and bow girders and assess unsymmetrical bending effects.	
CO4: Apply principles of plastic analysis to beams and portal frames using the kinematic approach.	
CO5: Evaluate structural response using approximate methods (portal and cantilever method) for multi-storey frames.	
CO6: Apply stiffness and flexibility matrix methods to continuous beams and frames, integrating numerical approaches with analytical concepts.	
Module 1: Analysis of Statically Indeterminate Structures [6 Hours] Moment distribution method; solution of continuous beams; effects of settlement and rotation of supports; analysis of frames with and without side sway; column analogy method.	
Module 2: Influence Line Diagram for Indeterminate Structures [6 Hours] Müller–Breslau principle and its application to continuous beams and frames.	
Module 3: Slope Deflection Method [6 Hours] Fundamentals and applications of slope deflection method to continuous beams and frames; application of the three-moment equation to continuous beam analysis.	
Module 4: Plastic Analysis of Structures [6 Hours] Plastic analysis of beams and portal frames; introduction to model analysis and its applications.	
Module 5: Approximate Method of Analysis of Structures [4 Hours] Portal method and cantilever method for approximate frame analysis.	
Module 6: Matrix Methods of Structural Analysis [8 Hours] Application of matrix methods to plane trusses and beams; formulation and solution of stiffness matrices.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	2

Text Books:

1. Theory of Structures, Stephen P. Timoshenko and Donovan H. Young, McGraw Hill Education.
2. Structural Analysis, Vol-I, S. S. Bhavikatti, Vikas Publishing House.
3. Structural Analysis, Vol-II, S. S. Bhavikatti, Vikas Publishing House.
4. Theory of Structures, B. C. Punmia, Ashok Kumar Jain, and Arun Kumar Jain, Laxmi Publications.
5. Theory of Structures, S. Ramamrutham, Dhanpat Rai Publishing Company.

Course Title: Environmental Impact Assessment

Course Code: PC-CE 605A	**Category:** Professional Core Courses
Course Title: Environmental Impact Assessment	**Semester:** 6th
L-T-P: 2-0-0	**Credit:** 2
Pre-Requisites: Basic Sciences, Biology, Environmental Science and Environmental Engineering	
Course Outcomes:	
CO1: Analyze environmental impacts of small- and large-scale projects using EIA principles, legal frameworks, and sustainable development concepts.	
CO2: Formulate mitigation strategies and management plans to minimize adverse environmental impacts while ensuring compliance with regulations.	
CO3: Apply life cycle assessment (LCA) principles to evaluate environmental performance and resource efficiency.	
CO4: Evaluate baseline environmental data, screening, scoping, and public consultation outcomes for decision-making in EIA processes.	
CO5: Integrate traditional and modern environmental management tools, including EMS, ISO 14001, and green rating systems, into sustainable project planning.	
CO6: Integrate traditional resource management approaches and modern LCA tools to design sustainable solutions.	
Module 1: Introduction [4 Hours] Definition, Objective with legal aspect of Environmental Impact Assessment (EIA)	
Module 2: Methodology [4 Hours] Methodology for EIA with Base Line Studies, Screening, Scoping and Public Consultation	
Module 3: EIA Analysis [4 Hours] Data Collection & Environmental Impact Analysis, preparation of EIA report.	
Module 4: EIA Mitigation and Audit- [3 Hours] Mitigation and Impact Management with various case studies, Environmental Audit.	
Module 5: Life Cycle Interpretation and Inventory [5 Hours] Limitation of LCA, Identification of significant issues, Evaluation, Reporting, Critical Review. Inventory: Data Collection, Data Bases, Allocation, Validation	
Module 6: LCA Impact Assessment and Practice [4 Hours] Categories, Classification, Normalization, LCA Management, Life Cycle thinking, Sustainability	

CO & PO Mapping:

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

CO & PSO Mapping:

CO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3
CO5	3	3	2
CO6	3	3	3

Text Books:

1. Environmental Assessment Impact . R. R. Barthwal, New Age International Publication
2. Environmental Assessment Impact. Canter. McGraw Hill Publications
3. Environmental Impact Assessment: Theory and Practice. M. Anji Reddy. B. S. Publication
4. Environmental Impact Assessment: Theory and Practice. Peter Wathern .CRC Press
5. Life Cycle Assessment (LCA): A Guide to Best Practice. Walter Klöpffer , Birgit Grahl. Wiley Publishers
6. Environmental Life Cycle Assessment. Olivier Jolliet, Myriam Saade-Sbeih, Shanna
7. Shaked, Alexandre Jolliet, Pierre Crettaz,CRC Press
8. Life Cycle Student Handbook. Mary Ann Curran,Scrivener Publishing, Wiley

Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology.)
Curriculum Structure for B.Tech courses in Civil Engineering
(Effective from the Academic Session 2024-2025)

Course Title: Ground Improvement Technique

Course Code: PE-CE 605B	**Category**: Professional Elective Courses
Course Title: Ground Improvement Technique	**Semester**: 6th
L-T-P: 2-0-0	**Credit**: 2
Pre-Requisites: Soil Mechanics-I, Foundation Engineering	
Course Outcomes:	
CO1: Define fundamental concepts, methods, and terminologies related to ground modification, densification, geo-synthetics, grouting, and soil stability techniques.	
CO2: Explain the working principles, applications, and advantages of various ground improvement techniques such as vibro-replacement, stone columns, preloading, and soil reinforcement methods.	
CO3: Apply suitable in-situ densification methods and geo-synthetic design procedures to solve site-specific geotechnical problems.	
CO4: Analyze field and laboratory data to select appropriate ground improvement and densification techniques for granular and cohesive soils.	
CO5: Evaluate the effectiveness and limitations of grouting methods, reinforced earth systems, soil nailing, and anchoring solutions for given geotechnical scenarios.	
CO6: Design suitable ground improvement schemes including sand drains, stone columns, geo-synthetic applications, and preloading systems considering soil conditions and project requirements.	
Module 1: Introduction [4 Hours] Ground modification by Vibro-replacement, stone columns, preloading and prefabricated drains, Reinforced earth structure.	
Module 2: In-situ densification [5 Hours] Introduction, Compaction: methods and controls Densification of granular soil: Vibration at ground surface, Impact at ground surface, Vibration at depth (Vibro- flotation), Impact at depth.	
Module 3: Geo-textiles [4 Hours] Introduction to geo-textiles and geo-membranes, applications of geo-textiles, design methods using geo-textiles, geo- grids, geo-nets, geo-membranes, geo-tubes,	
Module 4: Grouting [4 Hours] Over view: Suspension and Solution grout, Grouting equipment and methods, Grout design and layout, Grout monitoring schemes.	
Module 5: Soil stability [4 Hours] Underpinning Reinforced earth fundamentals, Soil nailing, Soil and Rock Anchors,	
Module 6: Densification of Cohesive Soils [3 Hours] Preloading and dewatering, Design of Sand drains and Stone columns, Electrical and thermal methods.	

CO & PO Mapping:

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

CO & PSO Mapping

CO/PSO	PSO1	PSO2	PSO3
CO1	2	2	1
CO2	2	3	2
CO3	3	3	2
CO4	3	3	2
CO5	2	3	2
CO6	3	3	3

Text Books:

1. Construction and Geotechnical Methods in Foundation Engineering – R.M. Koener, McGraw Hill;
2. Reinforced Earth – T.S. Ingold, Thomas Telford;
3. Designing with Geosynthetics – R.M. Koerner, Prentice Hall;
4. Ground Improvement Techniques – P. Purushothama Raj, Laxmi Publications Limited;
5. Principles and Practice of Ground Improvement – Jie Han, Wiley Publishers.

Course Title: Disaster Management

Course Code: OE-CE 606A	**Category:** Open Elective courses
Course Title: Disaster Management	**Semester:** 6th
L-T-P: 2-0-0	**Credit:** 2
Pre-Requisites: Environmental Science and Environmental Engineering	
Course Outcomes:	
CO1: To understand about Hazards and Disasters, Risk and Vulnerability	
CO2: To acquire knowledge about Man-made disasters	
CO3: To identify Earthquakes and its types, magnitude and intensity,	
CO4: To understand drought types and its management	
CO5: To analyze and design Building and construction in highly seismic zones, retrofitting buildings.	
CO6: To spread Awareness generation program, Usages of GIS and Remote sensing techniques	
Module 1: Definition and types of disaster: [6 Hours] : Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.	
Module 2: Study of Important disasters: [6 Hours] Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements case studies of disasters in Sikkim (e.g) Earthquakes, Landside). Social Economics and Environmental impact of disasters.	
Module 3: Mitigation and Management techniques of Disaster: [6 Hours] Basic principles of disasters management, Disaster Management cycle, Disaster management policy, National and State Bodies for Disaster Management, Early Warming Systems, building design and construction in highly seismic zones, retrofitting of buildings.	
Module 4: Training, awareness program and project on disaster management: [6 Hours] Training and drills for disaster preparedness, Awareness generation program, Usages of GIS and Remote sensing techniques in disaster management, Mini project on disaster risk assessment and preparedness for disasters with reference to disasters in Haldia and its surrounding areas.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO	PSO1	PSO2	PSO3
CO1	3	2	-
CO2	3	2	-
CO3	3	3	2
CO4	3	3	2
CO5	3	3	3
C06	3	3	3

Text Books:

1. Disaster Management in India A.K. Singh; Nishith Rai New Royal Book Company
2. Disaster management S C Sharma Khanna Publishing
3. Disaster Management and Preparedness Nidhi Gauba Dhawan CBS Publication
4. Fundamentals of Disaster Management, Pravin Khandve Notion Press

Course Title: Metro System and Engineering

Course Code: OE-CE 606B	**Category:** Open Elective courses
Course Title: Metro System and Engineering	**Semester:** 6th
L-T-P: 2-0-0	**Credit:** 2
Pre-Requisites: Transportation Engineering, Structural Engineering, Geotechnical Engineering, Surveying, Basic Electrical & Mechanical Engineering, Environmental Engineering, and Introductory Electronics & Communication	
Course Outcomes:	
CO1: Explain the need, planning, and routing of metro systems with financial implications.	
CO2: Analyze construction methods for elevated and underground metro structures considering quality, safety, and environmental safeguards.	
CO3: Illustrate the role of electronics and communication engineering in metro systems, including signaling, SCADA, and platform safety systems.	
CO4: Evaluate mechanical and thermal systems such as rolling stock dynamics, tunnel ventilation, and fire safety measures.	
CO5: Design sustainable and energy-efficient electrical systems for metro operations, including traction power, substations, and backup facilities.	
Module 1: Overview [3 Hours] Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financial.	
Module 2: Civil Engineering [9 Hours] 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 [4 Hours] Signaling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors.	
Module 4: Mechanical & TV + AC [4 Hours] Rolling stock, vehicle dynamics, and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators.	
Module 5: Electrical [4 Hours] OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits, and clear air mechanics.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	3
CO3	2	3	2
CO4	3	3	2
CO5	3	3	3

Text Books:

1. Urban Transit Systems and Technology – *Vukan R. Vuchic*, Wiley, 2007
2. Civil Engineering for Underground Rail Transport – *J.A. Charles & M.D. Davies*, Butterworth-Heinemann, 1981
3. Civil Engineering101: Beginner's Guide for Metro Rail System & Engineering – *Puspal Dey*, Notion Press, 2023
4. The Great Society Subway: A History of the Washington Metro – *Zachary M. Schrag*, Johns Hopkins University Press, 2014
5. 722 Miles: The Building of the Subways and How They Transformed New York – *Clifton Hood*, Johns Hopkins University Press, 2004

LABORATORY/ SESSIONAL [Semester VI-Third year]

Course Title: Water Resource Engineering Sessional

Course Code: PC-CE 681	**Category:** Professional Core Courses
Course Title: Water Resource Engineering Sessional	**Semester:** 6th
L-T-P: 0-0-3	**Credit:** 1.5
Pre-Requisites: Water Resources Engineering	
Course Outcomes:	
CO1: Recall concepts of unit hydrograph, hydrologic routing, Probability and flood frequency.	
CO2: Explain unit hydrograph, Muskingum method, and statistical tools in hydrology.	
CO3: Apply hydrograph, routing, and probability methods to hydrologic datasets.	
CO4: Analyze data for flood frequency, IDF curves, and hydroeconomic studies.	
CO5: Evaluate hydrologic models and statistical methods for specific conditions.	
CO6: Design hydrologic and economic solutions for flood and water resource planning.	
Module 1: Hydrograph analysis: unit hydrograph, synthetic unit hydrograph & S-curve hydrograph.	
Module 2: Hydrologic river routing: Muskingum method.	
Module 3: Fitting of probability distribution to a hydrologic data: Normal distribution.	
Module 4: Flood frequency analysis using frequency factor.	
Module 5: Hydroeconomic analysis.	
Module 6: Intensity-Duration-Frequency analysis.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	2	2
CO3	2	3	2
CO4	2	3	3
CO5	3	3	3
CO6	3	3	2

Text Books:

1. K. Subramanya, Engineering Hydrology, McGraw Hill Education (India) Private Limited, New Delhi.
2. R.Srivastava and A. Jain, Engineering Hydrology, McGraw Hill Education (India) Private Limited, New Delhi.
3. V. T. Chow, D. Maidment, L. Mays, Applied Hydrology, Tata McGraw-Hill, Delhi.
4. M. M. Das, M. Das Saikia, Hydrology, PHI Learning Private Limited, New Delhi.

Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology.)
Curriculum Structure for B.Tech courses in Civil Engineering
(Effective from the Academic Session 2024-2025)

Course Title: Steel Structure Design Sessional

Course Code: PC-CE 682	**Category:** Professional Core Courses
Course Title: Steel Structure Design Sessional	**Semester:** 6th
L-T-P: 0-0-3	**Credit:** 1.5
Pre-Requisites: Design of Steel Structures	
Course Outcomes:	
CO1: Analyze and design steel roof trusses for industrial buildings using IS codes.	
CO2: Design bolted and welded structural connections for truss and frame elements.	
CO3: Design steel members under axial compression and tension (columns & ties).	
CO4: Design column bases for various loading conditions.	
CO5: Design roof purlins and bracing systems for stability.	
CO6: Design welded plate girders including stiffeners and prepare detailed drawings.	
Module 1: Industrial Steel Structure Design Design of roof truss for an industrial building (using IS 800:2007). Design of structural connections (bolted/welded) in truss members. Design of column bases (slab base and gusseted base). Design of purlins and bracing systems for stability. Use of IS 875 (I–V) for load estimation (DL, LL, WL). (Update: Include exposure to software tools such as STAAD.Pro / ETABS for truss analysis & verification).	
Module 2: Plate Girder Design Design of welded plate girders: flange, web, stiffeners. Load combinations and checks for shear buckling and crippling. Design project: preparation of drawings for a plate girder bridge/industrial girder. (Update: Introduce detailing standards using INSDAG/SP-6).	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	2

Text Books:

1. Subramanian, N. – *Design of Steel Structures*. Oxford University Press.
2. Duggal, S.K. – *Limit State Design of Steel Structures*. Tata McGraw Hill.
3. Bhavikatti, S.S. – *Design of Steel Structures*. I.K. International Publishing House.
4. Ramchandra & Virendra Gehlot – *Design of Steel Structures (Vol. I & II)*. Scientific Publishers.
5. INSDAG Publications – *Steel Designers' Manual* and *Practical Handbooks* (useful for detailing & sessional work).

Indian Standard Codes (for practice sessions)

1. **IS 800:2007** – *General Construction in Steel – Code of Practice*.
2. **IS 875 (Parts I–V)** – *Code of Practice for Design Loads (DL, LL, WL, etc.)*.
3. **SP: 6(1) – 1964** – *Handbook for Structural Engineers – Structural Steel Sections*.
4. **IS 1161:2014** – *Steel Tubes for Structural Purposes*.
5. **IS 883:1994** – *Code of Practice for Design of Structural Timber in Building* (optional reference for roof trusses when timber/steel comparison is needed).

Course Title: Quantity Survey Estimation and Valuation Sessional

Course Code: PC-CE 683	**Category:** Professional Core Courses
Course Title: Quantity Survey Estimation and Valuation Sessional	**Semester:** 6th
L-T-P: 0-0-3	**Credit:** 1.5
Pre-Requisites: Introduction to Civil Engineering, Construction Engineering & Management, Engineering Economics, Estimation & Costing	
Course Outcomes:	
CO1: Illustrate the fundamental concepts of quantity surveying, types of estimates, items of work, unit of measurement, and unit rate of payment.	
CO2: Prepare quantity estimates and bar bending schedules for different civil engineering works, including buildings, roads, reservoirs, drains, and septic tanks.	
CO3: Calculate detailed measurements, quantities, costs, and prepare bills of quantities and abstracts in compliance with IS codes.	
CO4: Analyze rates for various civil works using appropriate specifications of materials and works.	
CO5: Design and integrate cost estimation techniques with modern tools (e.g., BIM, digital measurement) for accuracy and efficiency.	
CO6: Evaluate valuation methods, legal aspects, and economic factors to determine the financial viability of construction projects.	
Module 1: Quantity Surveying: Types of estimates, approximate estimates, items of work, unit of measurement, unit rate of payment.	
Module 2: Quantity estimate of a single-storied building	
Module 3: Bar bending schedule.	
Module 4: Details of measurement and calculation of quantities with cost, bill of quantities, and abstract of quantities.	
Module 5: Estimate of quantities of road, Underground reservoir, Surface drain, and Septic tank.	
Module 6: Analysis and schedule of rates: Earthwork, brick flat soling, DPC, PCC and RCC, brick work, plastering, flooring and finishing, Specification of materials: Brick, cement, fine and coarse aggregates. 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. 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	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	2	3	2
CO6	2	2	3

Text Books:

1. Estimating, Costing Specifications & Valuation - M Chakravarty.
2. Estimating and Costing in Civil Engineering (Theory & Practice) - B.N. Dutta, UBS Publishers.
3. Sociology & Economics for Engineers - Premvir Kapoor, Khanna Publishing House.
4. Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations, UBS Publishers
5. Typical PWD Rate Analysis documents.

Course Title: Computer Application Laboratory

Course Code: PC-CE 691	**Category:** Professional Core Courses
Course Title: Computer Application Laboratory	**Semester:** 6th
L-T-P: 0-0-3	**Credit:** 1.5
Pre-Requisites: Introduction to Civil Engineering	
Course Outcomes:	
CO1: Able to perform Drawing and detailing of different RCC structural elements.	
CO2: Able to create Drawing and detailing of different Steel structures.	
CO3: Able to Develop programs on M.S. EXCEL for quantity estimation of structures.	
CO4: Able to Identify and know available open-source software for civil engineering applications.	
CO5: Manage suggested activity in teams and able to correlate the concept of drafting with ready structures.	
Module 1: Use of commercial software for the analysis of truss	
Module 2: Use of commercial software for the analysis of frames	
Module 3: Use of commercial software for the analysis of slab	
Module 4: Computer coding for analysis and design for structural members – Application of MATLAB etc.	

CO & PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	2	2		2					
CO2	3	3	2	-	2	2	-	1	-	-	1	3
CO3	1	-	-	-	-	1	2	2	3	1	-	3
CO4	-	-	1	1	1	3	3	2	1	2	-	3
CO5	-	-	-	-	2	1	2	1	2	3	1	3

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	3	3
CO4	3	2	2
CO5	1	2	3

Textbooks:

1. Ghose, P. & Majumder, S. – Computer Analysis of Structures (Prentice Hall of India). Covers matrix methods for truss and frame analysis, good base for software validation. Krishna Raju, N. – Structural Analysis: A Matrix Approach.
2. McCormac, J.C. & Nelson, J.K. – Structural Analysis. Pearson.
3. STAAD.Pro / ETABS / SAP2000 User Manuals (Bentley Systems, CSI).
4. Wang, C.K. & Salmon, C.G. – Reinforced Concrete Design.
5. Strong foundation for slab design principles, later checked via software.
6. Varghese, P.C. – Advanced Reinforced Concrete Design.
7. Includes slab behavior and analysis methods that can be compared with ETABS/SAP2000.
8. Chopra, A.K. – Dynamics of Structures.
9. C.S. Krishnamoorthy – Finite Element Analysis: Theory and Programming.
10. Classic book for coding FEM algorithms in MATLAB/C++.
11. M.A. Bhatti – Fundamental Finite Element Analysis and Applications with MATLAB. Direct MATLAB implementations for structural members.
12. Kwon, Y.W. & Bang, H. – The Finite Element Method using MATLAB. CRC Press.
13. Practical book with ready MATLAB codes for beams, frames, trusses, and plates.
14. J.N. Reddy – An Introduction to the Finite Element Method.

SEMESTER - VII (Fourth Year)

Course Title: Design of Structures

Course Code: PC-CE 701	**Category:** Professional Core Courses
Course Title: Design of Structures	**Semester:** 7th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Design of R. C. Structures, Design of Steel Structures	
Course Outcomes:	
CO1: Design and detail pile foundations for various soil and loading conditions using IS codes and geotechnical data.	
CO2: Analyze and design retaining walls considering earth pressure theories, stability checks, and code-based detailing.	
CO3: Design gantry girders subjected to combined vertical, horizontal, and impact loads according to steel design codes.	
CO4: Develop designs and prepare working drawings for steel or RCC foot over bridges ensuring safety, serviceability, and aesthetics.	
CO5: Design thin-walled structural members considering buckling, shear lag, and stability per relevant codes.	
CO6: Design and analyze composite structural members considering load sharing, stiffness, and interaction as per relevant standards.	
Module 1: Design and detailing of Pile foundation [8 Hours] Design, and reinforcement detailing of pile foundations for different soil conditions and load requirements.	
Module 2: Design of Retaining wall [7 Hours] Focuses on the stability analysis and structural design of cantilever and counterfort retaining walls against lateral earth pressures	
Module 3: Design of Gantry Girder [7 Hours] Deals with the design of gantry girders to support moving loads from overhead cranes, considering impact and fatigue effects.	
Module 4: Design of Foot over bridge [6 Hours] Involves the structural planning and design of steel or concrete footbridges for pedestrian movement, ensuring safety and functionality.	
Module 5: Design of thin wall sections [3 Hours] Introduces the principles and design of thin-walled structural elements under axial, bending, and torsional loads.	
Module 6: Design of composite structures [5 Hours] Covers the behaviour and design of structures made from a combination of steel and concrete to utilize the benefits of both materials efficiently.	

CO & PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	2	–	–	2	2	2
CO2	3	3	3	2	2	2	2	–	–	2	2	2
CO3	3	3	3	2	3	–	–	–	–	2	2	2
CO4	3	3	3	3	3	2	3	2	2	3	3	3
CO5	3	3	3	2	3	–	2	–	–	2	2	3
CO6	3	3	3	3	3	2	2	–	2	2	2	3

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	2

Text Books:

1. Comprehensive Design of Steel Structures, B.C. Punmia, Ashok Kumar Jain, and Arun Kumar Jain, Laxmi Publications
2. STEEL STRUCTURES: DESIGN AND PRACTICE, N. Subramanian, Oxford University press
3. Design of steel structures, S. Duggal, McGraw Hill Education
4. Foundation Design and Construction, M.J. Tomlinson Pearson
5. Design of Foundation systems: Principles and Practices, Nainan P. Kurian, CRC Press

Course Title: Hydraulic Structures and Computational Hydraulics

Course Code: PE-CE 702A	**Category:** Professional Elective courses
Course Title: Hydraulic Structures and Computational Hydraulics	**Semester:** 7th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Fluid Mechanics, Soil Mechanics	
Course Outcomes:	
CO1: Recall basic concepts, types, techniques, efficiencies, and problems associated with irrigation systems.	
CO2: Explain the design principles, classifications, and construction features of canals, dams, diversion headworks, and spillways.	
CO3: Apply empirical and analytical methods (Kennedy's, Lacey's, Khosla's) for the design and analysis of canals, weirs, and hydraulic structures.	
CO4: Analyze stability, seepage, and hydraulic performance of gravity and embankment dams under various loading conditions.	
CO5: Evaluate irrigation schemes, hydraulic designs, and seepage control measures for efficiency, economy, and sustainability.	
CO6: Design hydraulic structures and irrigation layouts integrating computational hydraulics and modern numerical methods.	
Module 1: Irrigation [6 Hours] Definition, Necessity, Scope, Benefits of Irrigation; Types, techniques and sources of irrigation; Development of irrigation in India, 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. Water logging issues in irrigation.	
Module 2: Canals [6 Hours] Classification of irrigation canals, canals in alluvium; Design of unlined canals: Kennedy's method, Lacey's method; Lined canals: advantages, materials used, typical sections, design of lined canals, economics of canal lining.	
Module 3: Dams [12 Hours] Site investigations, initial study, reconnaissance survey, geophysical investigations, preliminary selection, detailed investigations; selection of type of dam. Gravity Dam: Definition, Features of some important gravity dams, Forces acting on a gravity dam, estimation of forces due to: selfweight, water pressure on upstream and downstream face, Uplift pressure, wave pressure, silt pressure, wind pressure, earthquake forces, hydrodynamic forces; 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.
Module 4: Diversion headworks [6 Hours] 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 5: Spillways [3 Hours] Necessity, types, selection, spillway gates; High overflow ogee spillway - profile, discharge computation, flow equations, factors affecting coefficient of discharge.
Module 6: Computational Hydraulics [3 Hours] Introduction, Modelling Fluid Flow Problems, Numerical Solution Schemes, Finite Difference Method, Finite Volume Method, Examples.

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	2	2
CO3	2	3	3
CO4	2	3	3
CO5	3	3	3
CO6	3	3	2

Text Books:

1. B. C. Punmia, A. K. Jain and P. B. Lal, Irrigation and Water Power Engineering, Laxmi Publications (P) Ltd., New Delhi.
2. P. N. Modi, Irrigation, Water Resources and Water Power Engineering, Standard Book House, New Delhi.
3. S. K. Sharma, Irrigation Engineering and Hydraulic Structures, S Chand Publishing, New Delhi.
4. S. K. Garg, Irrigation Engineering and Hydraulic Structures, Khanna Publishers.
5. M. B. Abbott and A. W. Minns, Computational Hydraulics, Routledge, London.
6. C. A. Brebbia and A. J. Ferrante, Computational Hydraulics, Butterworth-Heinemann.

Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology.)
Curriculum Structure for B.Tech courses in Civil Engineering
(Effective from the Academic Session 2024-2025)

Course Title: Advanced Structural Analysis

Course Code: PE-CE 702B	**Category:** Professional Elective courses
Course Title: Advanced Structural Analysis	**Semester:** 7th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Solid Mechanics, Structural Analysis-I, Structural Analysis-II	
Course Outcomes:	
CO1: Explain the fundamentals of matrix methods, including degrees of freedom, indeterminacy, and coordinate systems.	
CO2: Formulate stiffness and flexibility matrices for structural elements such as beams, trusses, and frames.	
CO3: Perform coordinate transformations and assemble global stiffness matrices using the direct stiffness method.	
CO4: Apply flexibility and stiffness methods to analyze indeterminate trusses, beams, frames, and grid structures.	
CO5: Analyze plate structures using classical and numerical methods under various loading and boundary conditions.	
CO6: Integrate computational tools and algorithms in structural analysis, preparing for advanced applications in structural engineering.	
Module 1: Introduction to matrix methods of analysis [3 Hours] Static indeterminacy and kinematic indeterminacy, degree of freedom, coordinate system	
Module 2: Structure idealization stiffness and flexibility matrices [3 Hours] Suitability element stiffness equations, elements flexibility equations, mixed force, displacement equations for truss element, beam element etc.	
Module 3: Transformation of coordinates [6 Hours] Element stiffness matrix, and load vector, local and global coordinates.	
Module 4: Assembly of stiffness matrix from element stiffness matrix [8 Hours] Direct stiffness method, general procedure, band matrix, semi bandwidth, computer algorithm for assembly by direct stiffness matrix method.	
Module 5: Flexibility and stiffness methods [8 Hours] Analysis of plane truss, Continuous beam, Plane frame and grids.	
Module 6: Plate Analysis [8 Hours] Classical and numerical methods for thin and thick plates; bending, deflection, and buckling behavior under various loading and boundary conditions. Circular and skew plates.	

CO & PO Mapping:

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

CO & PSO Mapping:

	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	2

Text Books:

1. Timoshenko & Woinowsky-Krieger – *Theory of Plates and Shells*
2. Szilard – *Theory and Analysis of Plates: Classical and Numerical Methods*
3. R. K. Bansal – *Advanced Structural Analysis*
4. V. L. Shah & S. R. Karve – *Illustrated Structural Analysis*

Course Title: Prestressed Concrete

Course Code: PE-CE 703A	**Category:** Professional Elective Courses
Course Title: Prestressed Concrete	**Semester:** 7th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Solid Mechanics, Structural Analysis, Design of RC Structures	
Course Outcomes:	
CO1: Recall the fundamental principles, materials, prestressing systems, and losses in prestressed concrete members.	
CO2: Explain deflection behaviour, shear and torsional resistance, and the inadequacy of earlier design methods compared to limit state design.	
CO3: Apply limit state design criteria to prestressed concrete sections for flexure, shear, and torsion using methods by Lin and Magnel.	
CO4: Analyze anchorage zone stresses, secondary moments in statically indeterminate members, and composite construction behaviour.	
CO5: Evaluate design alternatives for prestressed concrete poles, sleepers, and composite members considering strength, serviceability, and economy.	
CO6: Create complete design documentation and detailing for prestressed concrete structures, integrating analysis, design, and code compliance.	
Module 1: Introduction of Pre-stressed concrete [10 Hours] Materials, pre-stressing system, analysis of pre-stress and bending stress, losses. Deflections of pre-stressed concrete members: Importance, factors, short term and long-term deflection	
Module 2: Shear and Tensional Resistance [10 Hours] 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 Pre-stressed Concrete Section: for Flexure & methods by Lin and Magnel	
Module 3: Anchorage Zone stresses in post tensioned members [4 Hours] Stress distribution in end block, anchorage zone reinforcement	
Module 4: Statically Indeterminate Structures [4 Hours] 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 [4 Hours] Types, Analysis of Stresses	
Module 6: Prestressed Concrete Poles and Sleepers [4 Hours] Design of Sections for Compression and Bending. Introduction to Partial Prestressing.	

CO & PO Mapping:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	–	–	–	–	–	–	2
CO2	3	3	2	2	1	–	–	–	–	–	–	2
CO3	3	3	3	2	2	–	–	–	1	1	1	2
CO4	3	3	3	3	2	1	–	–	1	1	1	2
CO5	3	3	3	2	2	2	2	1	1	1	1	3
CO6	3	2	3	2	3	1	1	1	3	3	2	3

CO & PSO Mapping:

CO\PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	2	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	3

Text Books:

1 Prestressed Concrete, N. KrishnaRaju, TMH
2 Prestressed Concrete, Ramamuthram, Dhanpat Rai Publishing Company
3 Prestressed Concrete, Srikant Vanakudre Khanna, PublishingHouse
4 Fundamentals of Prestressed Concrete, N.C.Sinha and S.K.Roy, S. Chand

IS Code: IS: 1343: 2012: PRESTRESSED CONCRETE — CODE OF PRACTICE

Course Title: Repairs & Rehabilitation of Structures

Course Code: PE-CE 703B	**Category:** Professional Elective Courses
Course Title: Repairs & Rehabilitation of Structures	**Semester:** 7th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Solid Mechanics I, Structural Analysis – I, Design of RC Structures	
Course Outcomes:	
CO1: Diagnose damage and deterioration in structures using non-destructive and other appraisal techniques, and identify causes including environmental and seismic effects.	
CO2: Plan and execute repair and strengthening techniques for superstructure components, including load-bearing and panel walls.	
CO3: Apply appropriate strengthening methods for foundations, including grouting, guniting, shotcreting, and underpinning.	
CO4: Develop repair strategies for various structures such as buildings, bridges, towers, monuments, and heritage structures.	
CO5: Implement preventive measures for water leakage and perform underwater repair works.	
CO6: Evaluate the durability and performance of repair materials through case study analysis.	
Module 1: Damage Appraisal and Deterioration [5 Hours] Appraisal of damage and deterioration of structures by non-destructive and other techniques; Causes of deterioration – Environmental, earthquake effects, etc.	
Module 2: Repair and Strengthening of Superstructures [6 Hours] Repair and strengthening of superstructure – structural components, load-bearing wall, panel walls.	
Module 3: Foundation Strengthening Techniques [5 Hours] Strengthening of foundation – Grouting, grout material, guniting, shotcreting, underpinning, etc.	
Module 4: Repair of Various Structures [5 Hours] Repair of structures – Buildings, bridges, towers, monuments, and historical structures.	
Module 5: Water Leakage and Underwater Repairs [5 Hours] Prevention of water leakage in structures; Underwater repair.	
Module 6: Durability and Case Studies [5 Hours] Durability of repairing material; Case histories.	
Module 7: Damage Appraisal and Deterioration [5 Hours] Appraisal of damage and deterioration of structures by non-destructive and other techniques; Causes of deterioration – Environmental, earthquake effects, etc.	

CO & PO Mapping:

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

CO & PSO Mapping:

	PSO1	PSO2	PSO3
CO1	3	2	3
CO2	3	2	2
CO3	3	2	3
CO4	3	3	3
CO5	3	3	2
CO6	3	3	2

Text Books / References

1. Shetty, M.S., *Concrete Technology: Theory and Practice*, S. Chand & Co.
2. Raina, V.K., *Concrete for Construction: Facts and Practice*, Tata McGraw Hill.
3. Denison Campbell, Allen and Harold Roper, *Concrete Structures: Materials, Maintenance and Repair*, Longman Scientific and Technical, UK.
4. Peter H. Emmons, *Concrete Repair and Maintenance Illustrated*, Galgotia Publications Pvt. Ltd.
5. Dension Campbell & Roper, *Repair of Concrete Structures*, CRC Press.

Course Title: Air and Noise Pollution and Control

Course Code: PE-CE 704A	**Category:** Professional Elective Courses
Course Title: Air and Noise Pollution and Control	**Semester:** 7th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Class-XII level knowledge of Physics, Chemistry, Mathematics, Biology and Environmental Science; Undergraduate level knowledge of Statistics and Environmental Engineering.	
Course Outcomes:	
CO1: Identify and classify various air and noise pollutants, their sources, and effects on humans, vegetation, materials, and the environment.	
CO2: Interpret meteorological parameters, plume behavior, and atmospheric stability for predicting pollutant dispersion.	
CO3: Apply Gaussian plume and other dispersion models to estimate pollutant concentration and design stack heights.	
CO4: Evaluate air and noise quality using national/international standards, indices, and measurement techniques.	
CO5: Design suitable control systems for gaseous and particulate pollutants, including automotive pollution control measures.	
CO6: Propose noise pollution control strategies based on psychoacoustic principles, noise measurement data, and regulatory standards.	
Module 1: Air Pollutants [6 Hours] 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 [5 Hours] Lapse Rate; Atmospheric Stability; Inversion; Plume Pattern	
Module 3: Dispersion of Air Pollutants [5 Hours] Point Source Gaussian Plume Model, Stability Classes, Stability Charts, Design of Stack Height.	
Module 4: Air Quality [6 Hours] 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 [6 Hours] 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: Source and Effect of Noise [8 Hours] Psychoacoustics and noise criteria; effects of noise on health; annoyance rating schemes 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: LN, Leq, Ldn,, LNP Noise Pollution Control- Noise Standards and Limits; Methods of Noise Pollution Control.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	3	3	2

Text Books:

1. Air Pollution and Control, Keshav Kant, Rajni Kant, Khanna Publishing House
2. Environmental Engineering, S.C. Sharma, Khanna Publishing House
3. Introduction to Environmental Engineering and Science, Masters, G.M., Ela, W.P., Prentice Hall / Pearson
4. Environmental Engineering: A Design Approach., Sincero, A., Sincero, G., Prentice Hall
5. Environmental Engineering. Volume-1 and Volume-2., Garg, S.K, Khanna Publishers
6. Air Pollution, Rao, M.N., Rao, H.V.N., Tata McGraw Hill

Course Title: Advanced Soil Mechanics

Course Code: PE-CE 704B	**Category:** Professional Elective Courses
Course Title: Advanced Soil Mechanics	**Semester:** 7th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Soil Mechanics-I, Foundation Engineering	
Course Outcomes:	
CO1: Understand the importance of advanced concepts and theories in soil mechanics.	
CO2: Understand the concepts of three-dimensional consolidation and secondary consolidation and apply them to solve engineering problems	
CO3: Ability to design soils related civil engineering structure using appropriate geotechnical principles	
CO4: Analyze and interpret the state of stress in soils, evaluate various failure criteria for soils, and develop critical state models for the deformation and strength of soils.	
CO5: Evaluate critical issues in soil mechanics and apply appropriate principles to analyze and solve real-world geotechnical engineering problems	
Module 1: State of Stress and Strain in Soils [7 hours] Effective and total stress concept; Stress-Path concept; Stress path in triaxial tests, Different types of triaxial shear tests and their practical use; choice of test. Critical void ratio and Liquefaction of soil.	
Module 2: Failure Theories [7 hours] Theory of elastic and plasticity, different failure envelops, Yield criteria and failure theories, Yield surfaces	
Module 3: Consolidation [7 hours] Consolidation in layered soil, Pre-consolidation pressure, Secondary consolidation, Constant rate-of-strain consolidation, Constant-gradient consolidation, Sand drains.	
Module 4: Stability of Slope [7 hours] Stability analysis by Swedish method of slices; stability number; tension cracks.	
Module 5: Sheet Pile Structures [5 hours] Types, Design (Cantilever & Anchored), Earth Support Methods, Analysis with Anchored Bulkheads.	
Module 6: Analytical methods in geotechnical engineering [3 hours] Analytical methods in geotechnical engineering as applied to various real life geotechnical problems	

CO & PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	-	2	1	-	1	-	2
CO2	3	2	2	1	1	3	-	1	-	1	-	2
CO3	3	3	3	2	2	2	2	3	1	2	2	3
CO4	3	3	2	3	3	3	-	3	1	2	3	3
CO5	3	3	2	3	3	2	-	3	1	2	3	3

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	1	3
CO2	3	2	3
CO3	3	2	3
CO4	3	3	3
CO5	3	3	3

Text Books:

1. Textbook of Soil Mechanics and Foundation Engineering (Geotechnical Engineering Series) V.N.S. Murthy CBS Publishers
2. Soil Mechanics and Foundations Punmia, B.C. andJain A. K Laxmi Publications (P) Ltd
3. Basic and Applied Soil Mechanics Gopal Ranjan & A.S.R. Rao New Age International Pvt.Ltd, Publishers
4. Principles of Geotechnical Engineering B.M. Das Thomson Brooks / Cole
5. Advanced Soil Mechanics B. M. Das CRC Press
6. Soil Mechanics R. F. Craig Taylor & Francis
7. An introduction to the Mechanics of soils and Foundations J. H. Atkinson Macmillan Education

Course Title: Structural Dynamics

Course Code: PE-CE 705A	**Category:** Professional Elective Courses
Course Title: Structural Dynamics	**Semester:** 7th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Introduction to Solid Mechanics, Structural Analysis-I, Structural Analysis-II, and Engineering Mathematics (Differential Equation)	
Course Outcomes:	
CO1: Recall basic concepts, equations of motion, and parameters of structural dynamics.	
CO2: Explain free and forced vibration behavior of SDOF systems with damping.	
CO3: Apply vibration measurement and isolation techniques in practical scenarios.	
CO4: Analyze structural responses to dynamic loads using different numerical methods.	
CO5: Evaluate structural performance using response spectrum methods.	
CO6: Develop and analyze MDOF systems for earthquake loading.	
Module 1: Basics of Structural Dynamics [3 Hours] Introduction of Structural Dynamics, Differential Equations in Civil Engineering, Static and Dynamic load, Types of Analysis: Static and Dynamic Degrees of Freedom, Stiffness, Flexibility, Dynamic Equilibrium Equation.	
Module 2: Free Vibration and Forced Vibration of SDOF [8 Hours] Undamped free Vibration, Natural Period/Frequency, Energy in Free Vibration, Damped Free Vibration, Types of damping, Logarithmic decrement equation Undamped Forced vibration, Amplitude & Phase Angle, Dynamic amplification factor for deflection (Rd), Damped Forced vibration, Relationship between R_d, R_v and R_a.	
Module 3: Force Transmission and Vibration Measurement [4 Hours] Resonant frequency and Half power band width, Force Transmission and Isolation, Design of Vibration Measuring Instruments	
Module 4: Response to General loading and Numerical Methods of Solution [8 Hours] Response to Unit Impulse, Response to Arbitrary Force (Duhamel's Integral), Response to Step and Ramp Forces, Response to Rectangular Pulse, Half Sinusoidal wave Time Stepping Methods, Central Difference Method, Newmark's Method	
Module 5: Response Spectrum [4 Hours] Concept of Response Spectrum, Uses of Response Spectrum, Special Cases in Spectrum, Development of Tripartite Plot, Example: Base Shear and Base Moment, Response of Structure in Frequency Domain	
Module 6: Multi-Degree of Freedom Systems and Earthquake Response of MDOF Systems [9 Hours] Equation of Motion for MDOF System, Solution of Equation, Natural Frequencies and mode Shapes (60), Modal Orthogonality, Approximate Method for finding Natural frequenc. Time History Analysis, Response Spectrum Analysis, 3D Dynamic Analysis	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	3
CO6	3	3	3

Text Books:

1. Structural Dynamics (Theory and Computation), Mario Paz., CBS Publishers.
2. Dynamics of Structure (Theory and Application to Earthquake Engineering), A. K. Chopra, Pearson Education
3. Dynamics of Structures, Ashok K. Jain, Pearson Education

Course Title: Coastal Hydraulics and Sediment Transport

Course Code: PE-CE 705B	**Category:** Professional Elective courses
Course Title: Coastal Hydraulics and Sediment Transport	**Semester:** 7th
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: Fluid Mechanics	
Course Outcomes:	
CO1: Recall basic concepts of wave mechanics, tides, currents, sediment transport, littoral drift, and coastal structures.	
CO2: Explain wave generation, propagation, transformation, tidal processes, sediment transport mechanisms, and littoral drift phenomena.	
CO3: Apply wave theories, sediment transport equations, and littoral drift calculations to coastal engineering problems.	
CO4: Analyze wave transformation, shoreline changes, and the impact of sediment movement on coastal stability.	
CO5: Evaluate the effects of coastal processes and structures on shoreline configuration and stability.	
CO6: Design basic coastal protection measures and shoreline management plans integrating wave, tide, and sediment transport data.	
Module 1: Introduction [6 Hours] Basic understanding of wave mechanics, including wave generation, propagation, form and assessment in the coastal zone. Statistical and spectral analysis of recorded wave data and prediction in coastal zones.	
Module 2: Tides and currents [6 Hours] The equilibrium tide, Dynamic modifications of the equilibrium tide, Modification of tidal pattern, Tidalstreams, Tidalbores.	
Module 3: Waves [6 Hours] The linear theory of waves, Waves of finite height, Wind waves, Waves in shoaling water, Refraction of waves, Reflection of waves, Diffraction of waves, Oscillations in a harbour, Ship waves.	
Module 4: Sediment transport [6 Hours] Basic concepts, Transport modes, Material in suspension, Bed-Load, Turbidity and density currents, Banks and channels in river estuaries, Regime of the sea-bed; Vertical distribution of suspended sediment in waves and current over a plane bed.	
Module 5: Littoral drift [6 Hours] Definition of limit for littoral drift, The effect of grain size, The beach profile, Longshore transport of material, Coastal features.	
Module 6: Coastal Structures [6 Hours] Types and use; Effect of construction of coastal structures on stability of shoreline/ beaches, shoreline configuration.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	3	2	-
CO3	2	3	2
CO4	3	3	2
CO5	3	3	2
CO6	2	3	3

Text Books:

1. J. S. Mani, Coastal hydrodynamics, Prentice-Hall of India Ltd.
2. V. Panchang, J. Kaihatu, Advances in Coastal Hydraulics, World Scientific Publishing Company.
3. R. M. Sorensen, Basic Coastal Engineering, Springer.

LABORATORY/ SESSIONAL [Semester VII-Fourth year]

Course Title: Industrial Training

Course Code: PW-CE 781	**Category:** Internship
Course Title: Industrial Training	**Semester:** 7th
L-T-P: 0-0-0	**Credit**: 4
Pre-Requisites: Basic knowledge of surveying, construction materials, soil and concrete fundamentals, drawing interpretation, and safety practices	
Course Outcomes:	
CO1: Understand the functioning and organizational structure of construction/consultancy firms.	
CO2: Demonstrate knowledge of field practices such as surveying, concreting, steel reinforcement, and quality control.	
CO3: Apply classroom learning to analyze real-world project problems.	
CO4: Develop professional ethics, teamwork, and communication skills.	
CO5: Prepare structured technical reports and presentations.	

CO & PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	-	2	1	2	2	2	3
CO2	3	2	2	-	2	2	2	1	2	2	2	3
CO3	3	3	3	2	2	-	2	2	2	1	2	2
CO4	2	-	1	-	-	2	2	3	3	3	-	-
CO5	2	1	2	2	2	2	-	-	2	3	2	-

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	2	2	-
CO2	3	2	2
CO3	3	3	3
CO4	-	-	2
CO5	-	2	3

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Course Title: Project-I

Course Code: PW-CE 782	**Category:** Project
Course Title: Project-I	**Semester:** 7th
L-T-P: 0-0-10	**Credit**: 5
Pre-Requisites: Prior exposure to advanced surveying, RCC and steel basics, foundation and highway engineering, estimation & costing, CAD/project tools, and technical reporting.	
Course Outcomes:	
CO1: Understand advanced civil engineering construction methods and apply them in field situations.	
CO2: Analyze project planning, estimation, and contract management practices in real projects.	
CO3: Evaluate sustainability and environmental aspects of civil works, proposing improvements.	
CO4: Demonstrate leadership, teamwork, and professional ethics in multidisciplinary settings.	
CO5: Create technical documentation and present project outcomes effectively using modern tools.	

CO & PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	-	2	1	2	2	2	3
CO2	3	2	2	-	2	2	2	1	2	2	2	3
CO3	3	3	3	2	2	-	2	2	2	1	2	2
CO4	2	-	1	-	-	2	2	3	3	3	-	-
CO5	2	1	2	2	2	2	-	-	2	3	2	-

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	2	-	3
CO4	-	2	2
CO5	-	3	3

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Course Title : Structural Design Sessional

Course Code: PC-CE 783	**Category:** Professional Core Courses
Course Title: Structural Design sessional	**Semester:** 8th
L-T-P: 0-0-3	**Credit**: 1.5
Pre-Requisites: Design of R. C. Structures, Design of Steel Structures	
Course Outcomes:	
CO1: To learn lift, suction and drag of wind	
CO2: To learn variation of wind force with height of structures.	
CO3: To learn the use of IS 875	
CO4: To learn the use of IS 1893 &IS 13827.	
CO5: To learn the design of stiffeners in girders	
CO6: To learn the design of plated structures.	
Module 1: Design and detailing of a RCC multistoried framed building including preparation of necessary working drawing and report	
Module 2: Design of Gantry Girder	

CO & PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	-	-	2	-	-	-	-	-
CO2	3	3	2	-	-	-	2	-	-	-	-	-
CO3	3	3	3	2	-	2	2	2	-	-	-	-
CO4	3	3	3	2	-	2	2	2	-	-	-	-
CO5	3	3	3	-	2	-	-	-	2	-	2	-
CO6	3	3	3	-	2	-	-	-	2	-	2	-

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	–
CO2	3	2	–
CO3	3	3	–
CO4	3	3	–
CO5	3	3	2
CO6	3	3	2

Text Books:

1. **Reinforced Concrete Structures**, *Author:* N. Subramanian, *Publisher:* Oxford University Press
2. **Design of Steel Structures,** *Author:* S. K. Duggal, *Publisher:* Tata McGraw-Hill (TMH)

SEMESTER - VIII (Fourth year)

Course Title: Bridge Engineering

Course Code: PC-CE 801A	**Category:** Professional Elective Courses
Course Title: Bridge Engineering	**Semester:** 8th
L-T-P: 2-0-0	**Credit**: 2
Pre-Requisites: Structural Analysis-1, Structural Analysis-II, Design of RC Structure, Design of Steel Structures	
Course Outcomes:	
CO1: To understand and apply the concept of IRC loading	
CO2: To know Different types of RCC and steel bridges	
CO3: To perform Site investigation procedures for bridges.	
CO4: To analyze and design of small RCC Bridges	
CO5: To analyze and apply principles of cable stayed bridges	
Module 1: Introduction to Bridge Engineering [4 Hours]: Different types of RCC and steel bridges and IRC loading.	
Module 2: Design Philosophy and Consideration in Bridge Engineering [4 Hours] Principles and application of bridges, Site investigation, Bridge hydrology and hydraulics.	
Module 3: Design of reinforced concrete solid slab bridge [8 Hours]: Design of small RCC Bridges and culverts as per IRC Loading.	
Module 4: Introduction and Design of Bridge connections: [5 hours] Details of bearing, joints, articulation, abutments, pier and well foundation	
Module 5: Design of cable stayed bridge [3 Hours]: General features, Philosophy of design.	

CO & PO Mapping:

C/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	1	2	-	-	1	-	2
CO2	2	2	2	-	1	1	2	-	-	1	-	2
CO3	3	3	2	2	2	2	2	-	-	1	1	2
CO4	3	3	3	2	3	2	3	-	-	2	2	2
CO5	3	3	3	2	3	2	3	2	-	2	2	3

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	-
CO2	2	2	-
CO3	3	3	2
CO4	3	3	2
CO5	3	3	3

Text Books:

1. DESIGN OF BRIDGE STRUCTURES JAGADEESH, T. R. JAYARAM, M. A. PHI Learning
2. Bridge Engineering Handbook Wai-Fah Chen, Lian Duan CRC Press
3. Bridge engineering classifications, design loading & analysis methods Teruhiko Yoda and Weiwei Lin. Institution of structural engineers.

Course Title: Traffic Engineering & Transportation Planning

Course Code: PE-CE 801B	**Category:** Professional Elective Courses
Course Title: Traffic Engineering & Transportation Planning	**Semester:** 8th
L-T-P: 2-0-0	**Credit:** 2
Pre-Requisites: Transportation Engineering-I & II	
Course Outcomes:	
CO1: Conduct origin–destination surveys and analyze vehicle volume, classification, and occupancy data to understand travel patterns.	
CO2: Identify and evaluate traffic control devices and street furniture for effective traffic management.	
CO3: Apply traffic regulation principles and safety measures to improve road user safety and operational efficiency.	
CO4: Analyze travel demand management strategies and assess highway capacity using traffic flow theory.	
CO5: Develop traffic forecasting models to support transportation planning and decision-making.	
CO6: Integrate information technology solutions and public–private partnership models into transportation systems for improved service delivery.	
Module 1: Traffic Surveys [3 Hours] Traffic Survey, Vehicle volume count, classification and occupancy, Origin–Destination Survey	
Module 2: Traffic Control [4 Hours] Parking, Traffic control, Road Markings, Traffic Signals, Control aids and Street Furniture	
Module 3: Traffic Regulation & Safety [4 Hours] Traffic Regulation, Traffic Safety, Street Lighting	
Module 4: Traffic Management & Flow Theory [5 Hours] Traffic Management: Travel Demand management, Highway Capacity, Theory of Traffic Flow	
Module 5: Traffic Planning & Forecasting [4 Hours] Traffic Planning Process, Traffic Forecasting	
Module 6: IT & PPP in Transportation [4 Hours] Application of Information Technology in Transportation, Public–Private Partnership in Transport Projects	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	2	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2
CO6	2	–	3

Text Books:

1. Coleman O'Flaherty, Transport Planning and Traffic Engineering, Elsevier.
2. Kevin J. Krizek, David A. King, Advanced Introduction to Urban Transport Planning, Edward Elgar Publishing.
3. Prabir Kumar Sarkar, Vinay Maitri, G. J. Joshi, Transportation Planning, PHI Learning Pvt. Ltd.

Course Title: Solid Waste Management

Course Code: PC-CE 802A	**Category:** Professional Core Courses
Course Title: Solid Waste Management	**Semester:** 8th
L-T-P: 2-0-0	**Credit**: 2
Pre-Requisites: Class-XII level knowledge of Physics, Chemistry, Mathematics, Biology and Environmental Science; Undergraduate level knowledge of Statistics and Environmental Engineering	
Course Outcomes:	
CO1: Classify and interpret the types, sources, and characteristics of solid waste, and explain the principles of collection, storage, transport, and processing.	
CO2: Analyze and evaluate various disposal techniques including sanitary landfills, composting, incineration, and biomedical/e-waste management, considering environmental and legal constraints.	
CO3: Design resource recovery and energy conversion systems such as anaerobic digestion, incineration, pyrolysis, and gasification for effective waste utilization.	
CO4: Assess hazardous waste properties, contaminant transport mechanisms, and site remediation techniques using quantitative risk assessment tools.	
CO5: Apply sustainable practices, legal frameworks, and environmental ethics in planning and executing solid waste management systems.	
CO6: Apply sustainability principles, modern tools, and innovative approaches for integrated solid waste management in urban and industrial contexts.	
Module 1: Introduction: [5 Hours] Definition, Solid waste classification, Characteristics, Sources, -Solid waste management– Overviews of solid waste quantity, onsite handling and generation of solid waste; collection, Processing, storage, including segregation; Transfer and transport-route layout; Processing and Disposal.	
Module 2: Ultimate Disposal of Municipal Solid Waste: [5 Hours] Sanitary Landfill-criteria for landfill, landfill stability and operational procedure, gas and leachate control, Composting-aerobic and anaerobic, vermi-compost, Incineration; Biomedical Waste, e-waste management.	
Module 3: Resource and Energy recovery form solid waste: [3 Hours] Processing and separation of components, recovery systems, system design and layout, energy recovery from aerobic and anaerobic digestion, incineration, combustion and energy recovery, gasification, pyrolysis, energy recovery system and system efficiency.	
Module 4: Hazardous waste: [3 Hours] Definition and episodes, Sources and types, Classification and testing-EP Toxicity Test, TCLP, Future endeavors.	
Module 5: Physical and chemical properties: [3 Hours] Solubility, Vapor pressure, diffusion, portioning: Octanol-water, soil-water, bio-concentration factor	
Module 6: Fate and contaminant transport: [5 Hours] Groundwater flow and contaminant transport, factors affect groundwater contaminants Transport, Hazardous waste removal mechanism and site remediation techniques. Quantitative risk assessment, remedial measures, Laws and environmental ethics, legal framework.	

CO & PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	–	–	2	3	1	–	1	–	2
CO2	2	3	2	1	–	2	3	2	2	2	1	2
CO3	3	2	3	2	3	3	3	2	–	3	–	3
CO4	3	3	2	3	3	3	3	2	1	–	–	3
CO5	2	2	3	2	2	3	3	3	1	1	2	3
CO6	3	2	3	2	3	3	3	2	2	1	2	3

CO & PSO Mapping:

COs	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	3
CO6	3	3	3

Text Books:

1. Environmental Engineering, H.S.Peavy, D.R.Rowe and G. Tchobanoglous. McGraw-Hill
2. Evans and Environmental Resources Management, Hazardous Waste Management. M.D. LaGrega, P.L.Buckinghum, J.C. McGraw-Hill.
3. Environmental Pollution and Control in Chemical Process Industries, S.C. Bhatia. Khanna Publishers.

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Course Title: Wind & Earthquake Engineering

Course Code: PE-CE 802B	**Category:** Professional Elective Courses
Course Title: Wind & Earthquake Engineering	**Semester:** 8th
L-T-P: 2-0-0	**Credit**: 2
Pre-Requisites: Engineering Mechanics, Solid Mechanics, Structural Analysis-I, Structural Analysis-II	
Course Outcomes:	
CO1: To understand effect of wind on structures	
CO2: To evaluate the wind pressure	
CO3: To analyze the seismic effect on the structures	
CO4: To understand and apply the concept of soil dynamics	
CO5: To analyze and design earthquake resistant structures	
CO6: To apply the codes of practices for wind and earthquake	
Module 1: Concept of Wind [5 Hours] Concept of wind, wind mechanics, effect of wind on buildings, chimneys etc	
Module 2: Code of practices [5 Hours] Code of practices on analysis and design of wind sensitive Structures & Wind tunnel testing.	
Module 3: Seismic behavior [3 Hours] Seismic behavior of structures and soil dynamics	
Module 4: Earthquake analysis [4 Hours] Earthquake analysis of structures	
Module 5: Earthquake Resistant Design [4 Hours] Concept of earthquake resistant design	
Module 6: Codal provision [3 Hours] Codal provision for design of buildings and liquid storage tanks.	

CO & PO Mapping:

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

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	2	-
CO2	3	3	-
CO3	3	3	2
CO4	3	3	2
CO5	3	3	3
CO6	3	3	3

Text Books:

1. IS 875 (Part 3,4 & 5): 2015
2. IS 1893 (Part I), 2002
3. IS 4326, 1993
4. Wind and Earthquake Engineering: Jonathan B. Calibara
5. Wind Energy Explained Theory, Design and Application SECOND EDITION,J.F. MANWELL J.G. MCGOWAN A.L. ROGERS

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Course Title: Constitution of India

Course Code: MC-CE 806	**Category:** Mandatory Courses (Non- credit)
Course Title: Constitution of India	**Semester:** 8th
L-T-P: 1-0-0	**Credit**:0
Pre-Requisites: History of India, Political Science (Basic Civics)	
Course Outcomes:	
CO1: Explain the historical background, preamble, and key features of the Indian Constitution.	
CO2: Analyze the Fundamental Rights, Duties, and Directive Principles of State Policy in the context of civil engineering practice and social responsibility.	
CO3: Describe the structure, powers, and functions of Union and State Governments for understanding administrative and legal frameworks.	
CO4: Assess the role of Judiciary and Constitutional Bodies in maintaining justice, transparency, and accountability in governance.	
CO5: Interpret the concept of federalism and local self-governance for sustainable development and inclusive planning in civil engineering projects.	
CO6: Evaluate contemporary constitutional issues and amendments in relation to professional ethics, sustainable development, and civil engineering practice.	
Module 1: Introduction to Constitution of India [4 Hours] Historical background, Making of the Constitution. Preamble: Philosophy, Objectives and Key Features. Salient features of the Constitution.	
Module 2: Fundamental Rights & Duties [4 Hours] Fundamental Rights: Nature, scope and limitations. Directive Principles of State Policy (DPSP). Fundamental Duties and their significance.	
Module 3: Union and State Government [4 Hours] Union Executive: President, Prime Minister, Council of Ministers. Parliament: Composition, Powers and Functions. State Executive: Governor, Chief Minister, State Legislature.	
Module 4: Judiciary & Constitutional Bodies [4 Hours] Supreme Court, High Courts: Structure, Powers and Functions. Judicial Review and Judicial Activism. Constitutional Bodies: Election Commission, Finance Commission, UPSC, CAG.	
Module 5: Federalism & Local Self-Government [4 Hours] Nature of Indian Federalism: Centre-State Relations. Panchayati Raj Institutions (73rd Amendment). Municipalities and Urban Local Bodies (74th Amendment).	
Module 6: Contemporary Issues & Amendments [4 Hours] Constitutional Amendments: Procedure & Important Amendments. Emergency Provisions. Recent trends: RTI, Lokpal, GST, Environmental provisions in Constitution.	

CO & PO Mapping:

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

CO & PSO Mapping:

COs	PSO1	PSO2	PSO3
CO1	3	-	2
CO2	3	2	-
CO3	2	3	-
CO4	3	2	-
CO5	2	3	-
CO6	2	2	3

Text Books:

1.*Introduction to the Constitution of India,* D.D. Basu, Lexis Nexis / Prentice Hall, Latest Edition
2. *Indian Government and Politics,* J.C. Johari, Sterling Publishers, Latest Edition
3. *Indian Polity,* M. Laxmikanth, *McGraw* Hill Education
4. *Our Constitution: An Introduction to India's Constitution and Constitutional Law,* Subhash Kashyap, National Book Trust
5. *Shorter Constitution of India,* Durga Das Basu, A condensed but detailed legal perspective for deeper study.

LABORATORY/ SESSIONAL [Semester VIII-Fourth year]

Course Title: Comprehensive Viva Voce

Course Code: PW-CE 881	**Category:** Comprehensive Viva Voce
Course Title: Comprehensive Viva Voce	**Semester:** 8th
L-T-P: 0-0-0	**Credit**: 3
Pre-Requisites: Comprehensive understanding of core civil engineering subjects and prior exposure to project/industrial training.	
Course Outcomes:	
CO1: Recall and explain fundamental concepts of civil engineering from core subjects.	
CO2: Apply theoretical knowledge to answer practical and design-based questions.	
CO3: Analyze case-based or problem-oriented questions critically.	
CO4: Demonstrate clarity of communication, professional ethics, and confidence during oral examination.	
CO5: Reflect on strengths, weaknesses, and adopt lifelong learning skills.	

CO & PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	-	2	1	2	2	2	3
CO2	3	2	2	-	2	2	2	1	2	2	2	3
CO3	3	3	3	2	2	-	2	2	2	1	2	2
CO4	2	-	1	-	-	2	2	3	3	3	-	-
CO5	2	1	2	2	2	2	-	-	2	3	2	-

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	2	-
CO3	3	3	2
CO4	-	-	2
CO5	-	-	2

Course Title: Project-II

Course Code: PW-CE 882	**Category:** Project
Course Title: Project-II	**Semester:** 8th
L-T-P: 0-0-10	**Credit**: 5
Pre-Requisites: Basic knowledge of design principles, project planning, estimation, and use of civil engineering software tools.	
Course Outcomes:	
CO1: Identify a civil engineering problem of practical relevance and formulate project objectives.	
CO2: Apply engineering principles, codes, and modern tools to develop design/solutions.	
CO3: Analyze and evaluate data, results, and design alternatives for project optimization.	
CO4: Demonstrate teamwork, ethics, and project management skills in multidisciplinary settings.	
CO5: Create a comprehensive project report and present outcomes effectively.	

CO & PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	-	2	1	2	2	2	3
CO2	3	2	2	-	2	2	2	1	2	2	2	3
CO3	3	3	3	2	2	-	2	2	2	1	2	2
CO4	2	2	1	-	-	2	2	3	3	3	-	-
CO5	2	1	2	2	2	2	-	-	2	3	2	1

CO & PSO Mapping:

CO/PSO	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	3	2
CO3	3	3	3
CO4	-	2	2
CO5	2	3	3

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MOOCs for B.tech Honours Degree in Civil Engineering**

MOOCs courses for Civil Engineering 2nd year students					
Sl.No	**Course Name**	**Duration (Weeks)**	**Credit**	**Name of the Moocs websites**	**Link**
1	Energy Resources, Economics and Environment	12	3	Swayam	https://swayam.gov.in
2	Characterization of Construction Materials	12	3	Swayam	https://swayam.gov.in
3	Introduction to Civil Engineering Profession	8	2	Swayam	https://swayam.gov.in
4	Environmental Geomechanics	12	3	Swayam	https://swayam.gov.in
5	Modern Construction Materials	12	3	Swayam	https://swayam.gov.in
6	Landscape Architecture and Site Planning-Basic Fundamentals	8	2	Swayam	https://swayam.gov.in
7	Introduction to Geographic Information system	4	1	Swayam	https://swayam.gov.in
8	Maintenance and Repair of Concrete Structure	12	3	Swayam	https://swayam.gov.in
9	Introduction to Internet of Things	12	3	NPTEL	
10	Introduction to Industry 4.0 & Industrial Internet of Things	12	3	NPTEL	

MOOCs courses for Civil Engineering 3rd year students					
Sl.No	**Course Name**	**Duration (Weeks)**	**Credit**	**Name of the Moocs websites**	**Link**
1	Economic Growth and Development	8	2	Swayam	https://swayam.gov.in
2	Quality Design and Control	12	3	Swayam	https://swayam.gov.in
3	Characterization of Construction Materials	12	3	Swayam	https://swayam.gov.in
4	Environmental Geomechanics	12	3	Swayam	https://swayam.gov.in
5	Modern Construction Materials	12	3	Swayam	https://swayam.gov.in
6	Geotechnical Engineering II Foundation Engineering	12	3	Swayam	https://swayam.gov.in
7	Structural Dynamics	12	3	Swayam	https://swayam.gov.in
8	Soil Structure Interaction	12	3	Swayam	https://swayam.gov.in
9	Geo Spatial Analysis in Urban Planning	4	1	Swayam	https://swayam.gov.in
10	Environmental Remediation of Contaminated Site	12	3	Swayam	https://swayam.gov.in
11	Introduction to Accounting and Finance for Civil Engineering	8	2	Swayam	https://swayam.gov.in
12	IBM DATA SCIENCE	12	3	Coursera	https://www.coursera.org

13	Data Analysis and Presentation Skills: the PwC Approach Specialization	12	3	Coursera	https://www.coursera.org
14	Machine Learning with Python	12	3	Coursera	https://www.coursera.org
15	Data Processing Using Python	12	3	Coursera	https://www.coursera.org
16	Advanced Data Science with IBM Specialization	8	2	Coursera	https://www.coursera.org
17	Data Analytics with Python	12	3	NPTEL	
18	Machine Learning	8	2	NPTEL	
19	Introduction to Machine Learning	12	3	NPTEL	
20	An Introduction to Artificial Intelligence	12	3	NPTEL	
21	Artificial Intelligence: Knowledge Representation and Reasoning	12	3	NPTEL	
22	Data Science for Engineers	8	2	NPTEL	

MOOCs courses for Civil Engineering 4th year students

Sl.No	Course Name	Duration (Weeks)	Credit	Name of the Moocs websites	Link
1	Industrial Automation and Control	12	3	Swayam	https://swayam.gov.in
2	Fire Protection services and Maintenances Management of Building	12	3	Swayam	https://swayam.gov.in
3	Water Supply Engineering	12	3	Swayam	https://swayam.gov.in
4	Geo Spatial Analysis in Urban Planning	4	1	Swayam	https://swayam.gov.in
5	Remote Sensing Essentials	12	3	Swayam	https://swayam.gov.in
6	Hydraulic Engineering	12	3	Swayam	https://swayam.gov.in
7	IBM DATA SCIENCE	12	3	COURSERA	https://www.coursera.org
8	Data Analysis and Presentation Skills: the PwC Approach Specialization	12	3	COURSERA	https://www.coursera.org
9	Machine Learning with Python	12	3	COURSERA	https://www.coursera.org
10	Advanced Data Science with IBM Specialization	8	2	COURSERA	https://www.coursera.org
11	Data Science: Foundations using R Specialization	12	3	COURSERA	https://www.coursera.org
12	Python for Data Science and AI	8	2	COURSERA	https://www.coursera.org
13	Data Science: Statistics and Machine Learning Specialization	12	3	COURSERA	https://www.coursera.org
14	Python and Statistics for Financial Analysis	4	1	COURSERA	https://www.coursera.org
15	Applied Machine Learning in Python	12	3	COURSERA	https://www.coursera.org

16	Machine Learning, ML	12	3	COURSERA	https://www.coursera.org
17	Fuzzy sets, Logic and System Applications	12	3	NPTEL	
18	Machine Learning	8	2	NPTEL	
19	Artificial Intelligence: Knowledge Representation and Reasoning	12	3	NPTEL	

**** NOTE –** All the above mentioned courses may vary from time to time.

ATTENDANCE SHEET FOR BOS MEETING AS PER THE FOLLOWING DETAILS

Agenda: Board of Studies (BoS) meeting for discussion and finalization of Curriculum and Syllabus for Under-Graduate (UG)

Date: 24.05.2024

Time: 2 PM onwards

Sl. No.	Name	Designation	Affiliation	Sign with Date
1.	PROF. SASANK SEKHAR HOTA	Professor and HOD	Haldia Institute of Technology	24.5.24
2.	PROF. (DR.) AMIYA KUMAR SAMANTA	Professor	NIT Durgapur	25/05/24
3.	DR. DIBYENDU ADAK	Assistant Professor	NIT Meghalaya	24/5/24
4.	PROF. (DR.) RAMENDU BIKASH SAHU	Professor	Jadavpur University	24/05/2024
5.	MR. ABHISHEK PAUL	Sr. Engineer Manager	L&T Ltd.	24/5/24
6.	MS. ARPITA PAL	Assistant Engineer	PWD, Govt. of West Bengal	24/5/24
7.	PROF. SOMNATH GHOSH	Professor	Haldia Institute of Technology	24/5/24
8.	SRI NAVAL KISHOR YADAV	Associate Professor	Haldia Institute of Technology	24-05-2024
9.	DR. BIJOLI MONDAL	Associate Professor	Haldia Institute of Technology	Bijoli Mondal 24.05.2024
10.	SOUVIK DAS	Assistant Professor	Haldia Institute of Technology	24/5/24
11.	KAUSIK BERA	Assistant Professor	Haldia Institute of Technology	24/5/24
12.	SAIKAT SHOME	Assistant professor	Haldia Institute of Technology	24/5/24
13.	SURAJ PRAKASH DANDAPAT	Assistant Professor	Haldia Institute of Technology	24.05.24
14.	SAIKAT PANJA	Assistant Professor	Haldia Institute of Technology	24.05.24
15.	AJIT KUMAR PARIA	Assistant Professor	Haldia Institute of Technology	24/5/24
16.	DEBANJAN DAS	Assistant Professor	Haldia Institute of Technology	24.05.24
17.	BIMALENDU MANDAL	Assistant Professor	Haldia Institute of Technology	24/5/24
18.	YELLANKI DEEPTI	Assistant professor	Haldia Institute of Technology	Y. Deepti 24/5/24
19.	DR. ATRAYEE BANDYOPADHYAY	Assistant professor	Haldia Institute of Technology	24/05/24
20.	ABHISHEK NASKAR	Assistant professor	Haldia Institute of Technology	24/5/24
21.	SOUMI RAJBANSHI	Assistant professor	Haldia Institute of Technology	24/05/2024

22.	Dr. AMIT GOLDER	Assistant Professor	Haldia Institute of Technology	Amit Golder 24/05/24
23.	SATYABRATA PATRA	Assistant Professor	Haldia Institute of Technology	Satyabrata Patra 24/05/24
24.	AVIK SAHOO	Assistant professor	Haldia Institute of Technology	Avik Sahoo 24/05/24
25.	DR. PAYEL CHAUDHURI	Assistant professor	Haldia Institute of Technology	Payel 24/5/24