COEP Technological University Pune

(A Unitary Public University of Govt. of Maharashtra)

School of Engineering and Technology

Curriculum Structure & Detailed Syllabus

Final Year B. Tech.

Civil Engineering

(Effective from: A.Y. 2026-27)

Program Educational Objectives (PEOs)

After the completion of the program,

I. Student will be employable in the diversified sectors of the industry, government organizations, public sector and research organizations.

II. Student will pursue higher education in engineering or other fields of their interests, at institutes of repute and high ranking.

III. Student will demonstrate effective communication, lifelong learning ability, integrity, teamwork, leadership qualities, concern to environment and commitment to safety, health, legal and cultural issues in the fields they choose to pursue.

Program Outcomes (POs):

Engineering Graduate will be able to:

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

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

PO3: Design/Development Solution: Design solution for complex engineering problems and design system component or process that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, social and environmental conditions.

PO4: Conduct Investigation of Complex Problem: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusion.

PO5: Method, Tool Usage: Create, select and apply appropriately technique, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with understanding the limitation.

PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to access societal health, safety, legal and cultural and consequent responsibility relevant to the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solution in societal and environmental context, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principle and commitment to professional ethics and responsibilities and norms of the engineering practices.

PO9: Individual and Team Work: Function effectively as an individual, and as the member or leader in diverse team and multidisciplinary setting.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, and being able to comprehend and write effective reports and design documentation and effective presentation and give and receive clear instructions.

PO11: Project management and Finance: Demonstrate knowledge & understanding of the engineering and management principles and apply these to one's work, as the member and the leader in a team to manage projects and in multidisciplinary environment.

PO12: Lifelong Learning: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in broadest context of technological change.

Final Year B. Tech.
Civil Engineering
List of Abbreviations

Abbreviation	Title	No of Courses	Credits	% of Credits
BS	Basic Science Course	--	--	--
ESC	Engineering Science Course	--	--	--
PCC	Programme Core Course (PCC)	02	07	21.21
PEC	Programme Elective Course (PEC)	04	12	36.36
OE/SE	Open/School Elective (OE/SE) other than particular program	--	--	--
MDM	Multidisciplinary Minor (MDM)	01	03	9.1
VSEC	Vocational and Skill Enhancement Course (VSEC)	--	--	--
HSMC	Humanities Social Science and Management	--	--	--
IKS	Indian Knowledge System (IKS)	--	--	--
VEC	Value Education Course (VEC)	--	--	--
RM	Research Methodology (RM)	01	02	6.06
ELC	Internship	02	04	12.12
ELC	Project	01	05	15.15
CEA	Community Engagement Activity (CEA)/Field Project	--	--	--
CCA	Co-curricular & Extracurricular Activities (CCA)	--	--	--
	Total	**13**	**33**	**100**

B. Tech. Civil Engineering

Semester -VII (NEP) Syllabus

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
01	PCC	<tbd>	Quantity Surveying and Valuation	2	0	2	1	3	30	20	50	60	40
02	PCC	<tbd>	Environmental Engineering	3	0	2	1	4	30	20	50	60	40
03	PEC	<tbd>	**Elective III** 1. Introduction to Earthquake Engineering 2. Advanced Foundation Engineering 3. Building Information Management 4. Rail and Metro Construction	3	0	0	1	3	30	20	50	--	--
04	PEC	<tbd>	**Elective IV** 1. Prestressed Concrete Structures 2. Design of Hydraulic Structures 3. Construction Technology & Machinery 4. Finite Element Method	3	0	0	1	3	30	20	50	--	--
05	MDM	<tbd>	Multidisciplinary Minor – IV	3	0	0	1	3	30	20	50		
06	RM	<tbd>	Research Methodology	2	0	0	1	2	30	20	50	--	--
07	ELC	<tbd>	Internship- II	0	0	0	0	1	--	--	--	60	40
08	ELC	<tbd>	Project- III	0	0	10	2	5	--	--	--	60	40
			Total	**16**	**00**	**14**	**08**	**24**					

Summer Internship-II (Industry /R&D / Academic Institute) after VI semester, during summer vacation, and evaluation will be done at the start of VII semester.

Semester -VIII (NEP) Syllabus

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
01	PEC	<tbd>	**Elective V** Massive Open Online Course – I (MOOC-I)- (12 weeks)	3	0	0	0	3	30	20	50	--	--
02	PEC	<tbd>	**Elective VI** Massive Open Online Course -II (MOOC-I)- (12 weeks)	3	0	0	0	3	30	20	50	--	--
03	ELC	<tbd>	Internship- III	0	0	0	0	3					
			Total	**06**	**00**	**00**	**00**	**09**					

Legends: **L**-Lecture, **T**-Tutorial, **P**-Practical, **S**-Self Study, **Cr**-Credits
ISE-In-Semester-Evaluation, **ESE**-End-Semester-Evaluation, **MSE**-Mid-Semester-Evaluation, **TA**-Teachers' Assessment, **CIE**-Continuous-Internal-Evaluation

Semester - VII

Quantity Surveying and Valuation						
Course Code			**Examination Scheme**			
Teaching Scheme	2-0-2-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	3		**Laboratory**	CIE: 60	ESE: 40	--

Course Outcomes: Students will be able to:

1. Apply standard methods to calculate quantities and prepare detailed estimates for various construction projects.
2. Analyze cost components to perform rate analysis for different items of construction work.
3. Develop and formulate technical specifications for various construction activities in accordance with standard practices.
4. Design and draft tender notices for different types of construction projects following established procedures.
5. Evaluate building parameters to prepare valuation reports for residential structures using appropriate methods and standards.

Unit 1: Estimating **[4 Hrs]**

Definition, importance of quantity surveying for civil engineer, purpose, types of estimates, data required for estimates. Item of work, Description of an item work, units of measurement and principles deciding the units, I.S. & PWD mode of measurements of building. Definition and purpose of approximate estimate, methods of approximate estimating of building and other civil engineering projects like roads, irrigation & water supply and sanitary engineering

Unit 2: Taking out Quantities **[6 Hrs]**

Principles, methods of taking out quantities for different assignments mentioned in term work, use of software for taking out quantities. Abstracting bill of quantities, provisional and prime cost items, contingencies, establishment charges, Centage charges.

Unit 3: Specifications and Analysis of Rates **[8 Hrs]**

Definition and purpose, types, drafting specifications, legal aspect, specifications of stone masonry, wood work, earth work, reinforcing brick work of R.C.C. work.
Factors affecting cost of an item of work materials, labour, tools, and plant, overheads and profit. Task work-definition and factors affecting task work, Transportation of material and cost Schedule of materials and labour, schedule of rates (D.S.R). Analysis of rates of different items mentioned in T.W

Unit 4: Valuation of Property **[6 Hrs]**

Purpose, nature of value, price, constant value, factors affecting value of a property. Free hold and leasehold property. Depreciation and methods of working out depreciation, sinking fund, years purchase, out goings. Methods of Valuation : i) Land and building basis. ii) Rental basis. iii) Reproduction and replacement cost basis. iv) Profit basis, fixation of rent.

Unit 5: Tenders **[6 Hrs]**

Tenders and tender Notice Tender, Types of tenders, invitation of tender notice, documents, methods of preparation and submission of tenders, scrutiny of tenders, acceptance of tenders, general idea of global tenders. Methods of Extending Work PWD procedure of execution of work, Administrative approval, budget provision technical 37 sanction, Different methods of execution of work in PWD, like piecework, rate list, day work, daily labour, DPR. BOT for large project.

Self-Study (SS): Contracts

General idea, Types of contracts. Law of contract, definition, objects and essentials of contract conditions specific condition, condition regarding EM, SD, Time limits (its importance). Liquidated damages and other more important condition regarding addition, alteration , extra items, testing and materials, defective work, subletting powers delegated to engineer in charge, regarding the above aspect, defect liability period, retention money, termination of contract, condition regarding payment to contractors, interim payment or running amount bills, advance payment, secure advance ,final bill

Textbooks:

[1]	B.N.Dutta, “Estimating and costing”, 28th Edition,UBH Publishing
[2]	B.S.Patil,“Civil Engineering Contracts and Estimates”, 4th Edition, Universities press.
[3]	Bhasin P.L., “Quantity Surveying”, S. Chand, Limited, 3rd Edition 1987.
[4]	Chakraborti M. “Estimating,Costing and Specification in Civil Engineering”,24th Edition,Chakraborti M
[5]	G.H.Birdie, “Estimating and Costing (Civil Engineering)”, 7th Edition 2015, Dhanpatrai

	Publishing
[6]	Rangwala, “Elements of Estimating and Costing”, 8th Edition,Charotar Publishing House
Reference Books:	
[1]	PWD Hand Book and Red Book.
[2]	PWD District Schedule of Rates (DSR) – Latest.
[3]	IS 1200 (Part1-Part 28) Method of measurement of building and civil engineering works.

List of Laboratory Assignments/Practicals

1. Working out Detailed Quantities for
   i) A Two storied R.C.C. framed building based on prevailing DSR rates for Pune District.
   ii) Estimation of quantities of steel reinforcement for an R.C.C. frame structure in (i) above.
   iii) Detailed Estimate of Residential Drainage and Water Supply Project

2. Preparation of Estimate using Computer Software - Detailed estimate of any two of the following.
   i) One column, column footing, beam and slab panel.
   ii) Quantities of form work.
   iii) Pipe culvert and slab culvert.
   iv) Earthwork (for a road , Railway, Canal or a small dam)

3. Writing detail specifications of any two items of work - For the items of works in (1) above

4. Analysis of Rates - For the two Items of Works in (1) above based on the prevailing market rates of various items and labour involved.

5. Valuation reports - For the residential buildings

6. Preparation of draft of tender notice - For the work for which detailed estimate is prepared.

7. Report on large project management a) PMC b)BOT
   Note: A Laboratory Record based on the laboratory work would be submitted for the term-work. Oral Examination would be based on the term work and theory covered in the class under the course Quantity Surveying and Valuation. Course Teacher for the Laboratory would decide the breakup of Oral Examination. An Objective Multiple-Choice Test may be conducted as a part of the Oral.

Environmental Engineering						
Course Code					**Examination Scheme**	
Teaching Scheme	3-0-2-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	4		**Laboratory**	CIE: 60	ESE: 40	--

Course Outcomes: Students will be able to:

1. Demonstrate a firm understanding of water quality, quantity and supply system.
2. Visualize water and wastewater quality parameters and their characteristics.
3. Understand relevant water and wastewater treatment processes, their design criteria and applicability.
4. Make decisions regarding the treatment plant site selection, operation and maintenance and the need of advanced treatment.
5. Analyze the causes and consequences of water pollution.

UNIT 1: Water Supply Engineering **[8 Hrs]**

Characteristics of water, physical, chemical and biological standards. Water quality standards as per IS10500: 2012, U.S.EPA and WHO. Quantity of water, rate of water consumption for various purposes, factors affecting, fire demand, Sources of water and their yield, population forecast, Principles of water treatment processes, Theory operation and design of aeration system, Solids separation: coagulation and flocculation theory, zeta potential and its significance, mean velocity gradient, "G" and power consumption, common coagulants, coagulant aids, principle of sedimentation, Design of settling tanks and clariflocculator, tube settlers.

UNIT 2: Filtration and Disinfection **[8 Hrs]**

Filtration theory and mechanism, slow sand filters, rapid gravity filters, under drainage system, operational troubles in filtration, backwashing of filters, design of filters, filter materials and multimedia filters, disinfection methods, factors affecting disinfection, types of disinfectants, theory and application of chlorination, breakpoint chlorination, ozone treatment, ultraviolet disinfection, water distribution system.

UNIT 3: Sewage and Primary Treatment **[8 Hrs]**

Sewage quantity, collection and conveyance of sewage, sources of sewage, variations in sewage flow, design of circular sanitary sewers, sewer materials and sewer appurtenances, characteristics of sewage including physical, chemical and biological characteristics, sampling and analysis of sewage for pH, suspended solids, total solids, COD, BOD, TOC, chlorides, nitrates, ammonical nitrogen and sulphates, process flow diagram for sewage treatment, self purification of natural streams, effluent discharge standards as per BIS 2490, oxygen sag curve, Streeter-Phelps equation, theory and design of screen chamber, grit chamber and primary sedimentation tank.

UNIT 4: Secondary (Biological) Treatment **[8 Hrs]**

Theory and design of biological treatment units, biological principles, important microorganisms in wastewater treatment and their importance, bacterial growth, general growth pattern, growth in terms of bacterial numbers and bacterial mass, kinetics, activated sludge process including types of ASP, design of ASP, sludge volume index, sludge bulking and control, trickling filter including biological principle, different filter media and their characteristics, design of standard rate and high rate filters using NRC formula, single stage and two stage filters, recirculation, ventilation, operational problems and control measures.

UNIT 5: Anaerobic Treatment **[8 Hrs]**

Theory and design of anaerobic treatment units, septic tanks, suitable conditions and situations for septic tanks, biological principles, method of treatment and disposal of septic tank effluent, design of septic tank along with upflow filters and soak pit, anaerobic digester including principle of anaerobic digestion, stages of digestion, factors governing anaerobic digestion, methods of sludge treatment and disposal, advantages and disadvantages, upflow anaerobic sludge blanket (UASB) reactor, principle, advantages and disadvantages.

UNIT6: Low Cost Treatment Methods **[8 Hrs]**

Low-cost wastewater treatment methods, oxidation ponds including bacteria and algae symbiosis, design of oxidation ponds as per CPHEEO, advantages and disadvantages of oxidation ponds, aerated lagoons including principle, aeration methods, advantages and disadvantages.

Self-Study:

Introduction and theory of phytoremediation technology for wastewater treatment, introduction and theory of root zone treatment system.

Laboratory Experiments:

1. To determine pH and electrical conductivity of the water sample
2. To determine nitrate contents in water
3. To determine fluoride content in water
4. To determine hardness and alkalinity in water sample
5. To determine sulphate concentration in water
6. To determine dissolved oxygen
7. To determine BOD
8. To determine the SVI
9. To determine the solids

Textbooks:

[1]	Elements of Water Supply and Wastewater Disposal – G.M. Fair, J.C. Geyer
[2]	Water and Wastewater Technology – M.J. Hammer

Reference Books:

[1]	CPHEEO Manual on Water Supply and Treatment
[2]	Manual on Sewerage and Sewage Treatment (Govt. of India)
[3]	Environmental Engineering – Peavy & Row
[4]	Wastewater Engineering – Metcalf & Eddy
[5]	Water Supply and Wastewater Engineering – B.S.N. Raju
[6]	National Building Code-India

Introduction to Earthquake Engineering						
Course Code			**Examination Scheme**			
Teaching Scheme	3-0-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	3		**Laboratory**	--	--	--

Course Outcomes: Students will be able to:

1. Explain basic terminology in seismology, seismicity and will be able to perform simple calculations on recorded earthquake ground motions.
2. Apply basics of structural dynamics in the analysis of structures subjected to earthquake induced vibrations (up to 2 Degrees of freedom).
3. Explain Earthquake resistant features of masonry and RC buildings.
4. Analyse different structural members of RC building considering Earthquake induced forces as per relevant IS codal provisions.
5. Design different structural members of RC building considering Earthquake induced forces as per relevant IS codal provisions.

Unit 1: Seismology **[7 Hrs]**

Introduction: Theory of plate tectonics, seismic waves, earthquake size: magnitude and intensity, local site effects, Indian seismicity, seismic zoning map of India, history of past earthquakes in world and India.

Unit 2: Vibration Theory: Single and Two Degrees of Freedom Systems **[7 Hrs]**

Dynamic Equation of equilibrium, Concept of shear building Free and Forced Vibrations with and without damping, earthquake ground motion, Concept of response spectra and design spectra.

Unit 3: Structural Form and Response **[7 Hrs]**

Effect of Structural Irregularities on seismic performance of RC buildings, Vertical irregularity and plan configuration problems, Seismo-resistant building architecture – lateral load resistant systems, building configuration, building characteristics.

Unit 4: Determination of design lateral loads Seismic design philosophy **[7 Hrs]**

Determination of design lateral loads Seismic design philosophy, Evaluation of seismic forces as per IS 1893:2016, Equivalent static lateral force method, response spectrum methods, lateral load analysis of building, Torsion provisions.

Unit 5: Ductility Considerations in Earthquake-Resistant Design of RC Buildings **[7 Hrs]**

Introduction- Impact of Ductility- Requirements for Ductility- Assessment of Ductility- Factors affecting Ductility- Ductile detailing considerations as per IS 13920:2016. Behaviour of beams, columns, and joints in RC buildings during earthquakes.

Self-Study (SS): Features of Earthquake Resistant Masonry Structure **[6 Hrs]**

Un-reinforced Masonry, Earthquake resistant features of masonry: bands and vertical reinforcement (IS 4326, IS13827, IS 13828).

Textbooks:

[1] Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of structures", Prentice Hall of India Pvt. Ltd. 2006.

[2] S. K. Duggal, "Earthquake Resistant Design of structures", Oxford University Press, 2013.

Reference Books:

[1]	Manohar Sharad, and Suhasini Madhekar, "Seismic design of RC buildings", Springer Transactions in Civil and Environmental Engineering ,2015.
[2]	T. Paulay and M.J.N. Priestly, “Seismic Design of Reinforced Concrete and Masonry Building”, John Wiley & Sons, 1992.
Indian Standards:	
[1]	IS 1893 (Part 1): 2016 Reaffirmed in 2021, Criteria for Earthquake Resistant Design of Structures - Part 1: General Provisions and Buildings, Bureau of Indian Standards, New Delhi. India.
[2]	IS 13920: 2016 Reaffirmed in 2021, Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces - Code of Practice (First Revision), Bureau of Indian Standards, New Delhi.

Advanced Foundation Engineering						
Course Code			**Examination Scheme**			
Teaching Scheme	3		**Theory**	TA: 20	MSE: 30	ESE: 60
Credits	3		**Laboratory**	-	-	--

Course Outcomes: Students will be able to:

6. Assess bearing capacity and settlement of raft foundation.
7. Design foundation for retaining wall.
8. Determine dynamic soil properties of soil and design machine foundation.
9. Assess bearing capacity of shallow foundation on rock and pile foundation on rock.
10. Design different ground improvement technique, foundations on expansive soil.

Unit 1 : Raft Foundation	**[6 Hrs]**
Allowable pressure in raft, Modulus of subgrade reaction, rigid beam analysis, piled raft design.	
Unit 2 : Foundation For Retaining Wall	**[7 Hrs]**
Allowable Bearing pressure below base slab of retaining wall subjected to gravity, seismic and traffic loads, global stability analysis.	
Unit 3 : Machine Foundation	**[7 Hrs]**
Machine vibration, free vibration and force vibration, determination of soil properties for dynamic analysis, design of machine foundation.	
Unit 4 : Ground Improvement	**[7 Hrs]**
Design of prefabricated Vertical Drains (PVD), and Stone columns, remedial measures for liquefaction, Case studies.	
Unit 5 : Design of Foundations on Rock	**[7 Hrs]**
Identification of types of rock, bearing capacity of shallow foundation on rock, pile foundation on rock.	
Unit 6 : Foundations on Expansive Soil	**[7 Hrs]**
Identification of expansive soil, design of foundations on expansive soil.	
Self-Study (SS): Contribution of Indian Mathematicians	

1. Bearing capacity and settlement of the shallow foundations according to various types of loading conditions.
2. Case studies on different ground improvement techniques.
3. Various IS codes IS 2974-1,2,3 on machine foundation

Textbooks:

[1]	B. M. Das, Principles of foundation engineering, Cengage Learning (Thompson)
[2]	Gopal Ranjan and Rao, Basic and Applied Soil Mechanics, New Age International Publishers
[3]	Dr. K. R. Arora, Soil Mechanics and foundation Engineering, Standard Publishers Distributors.

Reference Books:

[1]	Muni Budhu, Soil Mechanics and Foundations, John Wiley and Sons Inc
[2]	J. E. Bowles, Foundation Analysis and Design, McGraw Hill International.
[3]	N. V. Nayak, Foundation Design Manual, Dhanpat Rai Publication.
[4]	Kaniraj S. R., Design aids in soil mechanics and foundation engineering, Tata McGraw Hill Publishing Company Ltd.
[5]	M. J. Tomlinson, Foundation Design and Construction, ELBS Publication.

Building Information Management						
Course Code			**Examination Scheme**			
Teaching Scheme	3-0-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	3		**Laboratory**	--	--	--

Course Outcomes: Students will be able to:

1. Explain BIM concepts, standards, and maturity levels.
2. Analyse BIM processes, workflows, and collaboration.
3. Apply BIM in architecture, structure, and MEP design.
4. Evaluate BIM for planning, scheduling, cost, and sustainability.
5. Assess BIM use in facility management and emerging trends

Unit 1: BIM Fundamentals **[8 Hrs]**

Definition and scope of BIM, history and evolution of BIM, Difference between CAD and BIM models., BIM maturity levels and their significance., Key terms and concepts, National and international BIM standards, Benefits of BIM for stakeholders (owners, contractors, designers, facility managers), Risks and challenges in BIM implementation., Current global and Indian state of BIM adoption

Unit 2: BIM Processes and Workflows **[8 Hrs]**

BIM lifecycle, project delivery methods using BIM, roles and responsibilities in BIM projects, information exchange and data standards (IFC, COBie), collaboration strategies, common data environment (CDE), Level of Development (LOD), BIM Execution Plan (BEP).

Unit 3: BIM for Design Disciplines **[8 Hrs]**

Application of BIM in architecture, structural engineering, and MEP systems, HVAC systems, interdisciplinary coordination, clash detection principles, Integrated Process Design (IPD), and case studies on BIM-aided design decision making.

Unit 4: BIM for Construction Management **[9 Hrs]**

BIM in project planning and scheduling (4D BIM), Linking BIM models with project schedules, Cost estimation and management using BIM (5D BIM), Earned value analysis with BIM, Risk management using BIM simulations, Sustainability and energy analysis (6D BIM)

Unit 5: BIM for Facility and Asset Management **[9 Hrs]**

BIM in operations and maintenance phase, Facility Management (FM) strategies using BIM, Data requirements for FM and asset management, Linking BIM with IoT and smart building technologies, Life-cycle cost optimisation and predictive maintenance, BIM for renovation, retrofitting, and disaster resilience, Integration with digital twins for real-time monitoring.

Self-Study (SS):

Virtual reality (VR) and augmented reality (AR) in BIM, digital twins, 3D printing integration, prefabrication and modular construction, robotic construction, artificial intelligence in BIM applications, and the future roadmap of BIM.

Textbooks:

[1]	Brad Hardin and Dave McCool, BIM and Construction Management: Proven Tools, Methods, and Workflows, Wiley, 2nd Edition.
[2]	Eastman, C. M. (2008). BIM handbook: a guide to building information modelling for owners, managers, designers, engineers, and contractors. Wiley.

Reference Books:	
[1]	Willem Kymmell, *Building Information Modelling*, McGraw-Hill Construction, New York, 2008.
[2]	BS 1192:2007, A2:2016 Collaborative production of AEC information, Code of practice.
[3]	PAS 1192-2: Specification for information management for the capital/delivery phase of construction projects using Building Information Modelling.
[4]	AEC (UK) BIM Technology Protocol, Version 2.1.1, 2015.
[5]	Marcus Kim, Lance Kirby, Eddy Krygiel, *Mastering Autodesk Revit for Architecture*, Wiley.
[6]	AEC(UK) BIM Protocol for Autodesk Revit, version 2.0, 2012.
[7]	Sham Tickoo, Exploring Autodesk Revit 2017 For Structure 2017.
[8]	Sham Tickoo, Exploring Autodesk Revit 2017 for MEP 2017. Brad Hardin, Dave

Railway and Metro Construction						
Course Code			**Examination Scheme**			
Teaching Scheme	3-0-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	3		**Laboratory**	-	-	--

Course Outcomes: Students will be able to:

1. Demonstrate different terminologies of track elements in railway and metros.
2. Analyze track geometry including curves, gradients, turnouts, and crossings.
3. Select as per suitability rolling stock, track elements, fittings, and different types of sleepers.
4. Assess integrated operation of metro system.
5. Demonstrate functions of different components of railway and metro'

Unit 1: Introduction to Railway Engineering and Track Structure **[6 Hrs]**

Origin of Railways, Definition/uniqueness of railways, gauge of railway track, over view of railway systems of different countries, Basic track structure Formation, unconventional railways, atmospheric railway, mountain railways, rack railways etc. Basic track structure – Formation, Maintenance and renewal of track – (in brief) manual and mechanical maintenance and renewal.

Unit 2: Railway Track Geometry **[7 Hrs]**

Turnouts and Crossings – Components constituting turnouts and crossings, Diamond crossings; Slip points, operation of turnouts mechanical & electrical, locking of turnouts, Curved Track – classification of curves, measurement of radius, movement of vehicle on curves, speed on curves, check rails, gauge widening on curves. Gradients / Vertical Curves.

Unit 3: Rolling Stock **[7 Hrs]**

Passenger carrying vehicles (Coaches), development of coaches, 4 wheeled coaches, 6 wheeled coaches, bogie coaches, categories of coaches, Pullman coaches, special coaches in very brief, Goods carrying vehicles, Introduction of maintenance manuals of various types of rolling stock.

Unit 4: Rail Wheel Interaction and Track Components **[7 Hrs]**

Rail-wheel Interaction, Track elements, Flat Bottom Rail, Bull Head Rail, Cast Iron Chair, Rail Screws, Base Plate, Insulating Pad, Modified Loose Jaw, Fish Plated Joint, Insulated Joint Sleepers - Wooden, Steel Trough, Cast Iron Pot, Twin Block and Mono Block Pre-Stressed Concrete Sleepers.

Unit 5: Metro Rail Systems **[6 Hrs]**

Origin of Metro Rail System, Overview of World Metro Systems, Metro Planning and Selection, Metro Construction Metro Track, Introduction of metro act, Report of Ministry of Urban Development on standardization of metro system.

Unit 6: Metro Operations and Management **[7 Hrs]**

Metro Operations, Metro Depots, Metro Maintenance, Metro Station Management, Passenger Information System.

Self-Study (SS) **[6 Hrs]**

1. High-speed rail systems and bullet trains
2. Railway signaling and interlocking (introductory)
3. Case studies of Indian metro systems (Delhi, Mumbai, Pune)
4. Sustainable and green metro infrastructure

Textbooks:

[1]	Saxena, S.C. and Arora, S.P., A Textbook of Railway Engineering, Dhanpat Rai Publications
[2]	Satish Chandra and Agarwal, M. M., Railway Engineering, Oxford University Press
[3]	Balachander Subramanian, Design, Planning, and Construction of Major Metro Rail Projects, Amazon Digital Services LLC - Kdp

Reference Books:

[1]	Mundrey, J.S. – Railway Track Engineering, McGraw Hill Education
[2]	Kerr, A.D. – Fundamentals of Railway Track Engineering, Simmons-Boardman
[3]	M. M. Agrawal, S. Chandra and K. K. Miglani, Metro Rail in India for Urban Mobility: Planning, Design, Construction, Maintenance and Recent Developments, Prabha & Co.
[4]	Indian Railways, Permanent Way Manual (IRPWM)
[5]	Ministry of Housing and Urban Affairs, Metro Rail Policy & Standards

Prestressed Concrete Structures						
Course Code			**Examination Scheme**			
Teaching Scheme	3-0-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	3		**Laboratory**	--	--	--

Course Outcomes: Students will be able to:

1. Apply the basic concepts of prestressed concrete fundamentals, including pre- and post-tensioning processes, losses and deflections in PSC sections.
2. Analyze prestressed concrete flexural members.
3. Design end blocks for basic prestressed concrete members.
4. Design basic prestressed concrete beams / girders.
5. Analyze statically indeterminate beams up to one degree.
6. Analyze simple prestressed composite sections.

Unit 1: Introduction to Prestressed Concrete **[8 Hrs]**

Types of prestressing, systems and devices, materials, losses in prestress, Applications of relevant IS codes and standard.

Unit 2: Analysis of Flexural Members **[7 Hrs]**

Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, calculations for deflections of PSC sections, code provisions.

Unit 3: Anchorage Zones **[7 Hrs]**

Transmission of prestress in pretensioned members; Anchorage zone stresses for post-tensioned members, End Block design as per IS: 1343.

Unit 4: Elementary Analysis and Design of Beams / Girders **[12 Hrs]**

Design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions.
Analysis of two span continuous beams / girders, choice of cable profile, linear transformation and concordancy.

Unit 5: Simple Composite Sections **[6 Hrs]**

Analysis of basic Composite construction with precast PSC beams and cast in-situ RC slab.

Unit 6: Self-Study **[6 Hrs]**

Post-Tensioned Slabs, Use of any commercial software for analysis and design of PSC beams / girders. Site Visit to nearby Prestressed/Post-tensioned concrete structures and site visit report based on this shall be considered as one of the suggested mechanisms for TA.

Textbooks:

[1]	Prestressed Concrete, Krishnaraju N., Tata McGraw Hill Publications
[2]	Prestressed Concrete, Pandit and Gupta, CBS Publishers

Reference Books:

[1]	Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House
[2]	Limit State Design of Prestressed Concrete, Guyan Y., Applied Science Publishers
[3]	Prestressed Concrete, Dayaratnam, Medtech Publishers
[4]	Fundamentals of Prestressed Concrete Sinha N.C. & Roy, S. Chand & Company
[5]	Prestressed Concrete, Rajagopalan N, Narosa Publishing House
[6]	IS 1343: 2012, Code of Practice for Prestressed Concrete, BIS
[7]	All latest relevant Indian Standards published by BIS, India and Indian Road Congress, India.

Design of Hydraulic Structures						
Course Code			**Examination Scheme**			
Teaching Scheme	3-0-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	3		**Laboratory**	--	--	--

Course Outcomes: Students will be able to:

1. Demonstrate different terminologies related to hydraulic structures.
2. Select suitable hydraulic structure in a particular situation.
3. Compute the trial section of gravity dam, earthen dam, spillways, weirs, barrages and apply stability checks.
4. Assess hydropower potential and river training works.
5. Select and design suitable canal, piped distribution network and stable channel in alluviums

Unit 1: Dam **[6 Hrs]**

Dam, types of dam, selection of dam, various components of gravity dam, gravity dam details: joints, water-seals and galleries. Elements of earthen dam, basic design consideration, design of section, filters, rock toe, pitching, causes of failures, piping and its prevention, Field test during construction of gravity and earthen dam.

Unit 2: Canal Irrigation and Piped Distribution Network **[7 Hrs]**

Types of canal, canal alignment, losses in irrigation channel, various types of canal lining, economics of lining, design of lined channels, piped irrigation network, advantages, disadvantages, application of piped irrigation network, data required for piped irrigation network, hydraulics of pipe flow, design standards of pipe irrigation network, piped irrigation network design.

Unit 3: Spillway, Gates, and Diversion Head Works **[6 Hrs]**

Spillway capacity, different types of spillway, their principles of design and construction, energy dissipation below overflow spillway, types and uses, gates.
Diversion head works, selection of sites, layout of the work types of weirs and barrages, safety against piping and uplift, Bligh, Lane, and Khosala's Theories, design of weirs on permeable foundations.

Unit 4: Sediment Transport Theory and Canal Masonry Works **[7 Hrs]**

Design of stable channels in alluvium, the regime method, cross-section of irrigation channels. Cross drainage works, necessity types and selection, comparative merits and demerits, principles of design of various types of cross drainage work, canal falls and its types.

Unit 5: River Training Work and Hydro Power **[7 Hrs]**

Hydraulics of alluvial rivers, meandering, aggradations and degradation, river training, necessity, river training works and bank protection. General features of Hydro-power, Principal components of a hydropower station: Intakes and Trash racks, Water conductor system, Tunnels, Surge tanks, Penstocks, Anchor blocks, general layouts of different types, Assessment of power potential.

Self-Study:

Writing report on a case study of "Major dam / Cross Drainage Work/Hydraulic Structure"

Textbooks:

[1]	Asawa G.L. ,Irrigation and Water Resources Engineering, New Age International (P) Ltd. Publishers, 2006 Modi, P.N., Irrigation, Water Resource and Water Power Engineering, Standard Book House, Delhi, 2008.
[2]	Garg, S. K., Irrigation Engineering and Hydraulic Structures, Vol. I and II, Khanna Publishers Delhi, Latest Edition
[3]	Modi, P.N., Irrigation, Water Resource and Water Power Engineering, Standard Book House, Delhi, 2008.

Reference Books:

[1]	River Behaviour, Management and Training, CBIP Vol-I, 1989

[2]	Varshney R. S., Concrete Dams, Oxford and IBH Publishing Co.
[3]	Goldin, A. L. and Rasskazor, L. N., Design of Earth Dams, CRC Press
[4]	Guidelines for Planning and Design of Piped Irrigation Network, Ministry of Water Resources, Government of India, July 2017
[5]	Khatsuria, R. M., Hydraulics of Spillways and Energy Dissipators, Marcel Dekker Publishing, New York.

Construction Technology & Machinery						
Course Code			**Examination Scheme**			
Teaching Scheme	3-0-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	3		**Laboratory**	--	--	--

Course Outcomes: Students will be able to:

1. Explain construction techniques used in roads, bridges, tunnels, and high-rise structures.
2. Select appropriate construction equipment for different project requirements and site conditions.
3. Analyze the productivity and performance of construction equipment.
4. Evaluate construction methods based on safety, quality, sustainability, and cost.
5. Integrate construction techniques with equipment planning for effective project execution.

Unit 1: Road Construction Techniques **[6 Hrs]**

Rigid pavement construction techniques; flexible pavement construction; overlay construction; pavement rehabilitation methods; service life improvement strategies; quality control measures; performance monitoring of pavements.

Unit 2: Bridges and Underground Construction **[7 Hrs]**

Types of bridges: arch, suspension, cable-stayed, and segmental. Construction of substructures: foundations, piers, abutments. Superstructure construction: decks, girders. Bridge launching techniques: incremental launching, balanced cantilever.

Tunnelling methods in soft ground and rock; NATM; TBM; cut-and-cover method; tunnel linings; safety and ventilation systems.

Unit 3: High-rise and Specialized Construction Techniques **[7 Hrs]**

High-rise construction systems; advanced formwork techniques; pile foundations; diaphragm walls; grouting and dewatering techniques; slip-form construction; underwater concreting; construction of dams; demolition techniques (mechanical and controlled blasting).

Unit 4: Construction Equipment and Machinery **[6 Hrs]**

Classification and selection of construction equipment; earthmoving equipment; compaction equipment; material handling equipment (cranes, conveyors, batching plants); concrete and road construction equipment; drilling and blasting equipment.

Unit 5: Equipment Management, Productivity and Economics **[7 Hrs]**

Equipment planning and management; owning and operating costs; depreciation methods; replacement analysis; equipment productivity; performance evaluation; selection criteria based on economic and technical factors; case studies.

Self-Study (SS):

Automation in construction equipment; Artificial Intelligence (AI); Internet of Things (IoT); sustainable construction practices; digital construction technologies; safety and ergonomics; case studies of mega infrastructure projects.

Textbooks:

[1]	R.L. Peurifoy & C.J. Schexnayder, *Construction Planning, Equipment and Methods*, McGraw-Hill.
[2]	Bhopinder Singh, *Construction Equipment Management*, Pearson Education.
[3]	Chudley R. & Greeno R., *Building Construction Handbook*, Elsevier.
[4]	Sharma S.C. & Bansal S.K., *Construction Machinery and Equipment Management*, Khanna Publishers.

Reference Books:	
[1]	Frank Harris & Ronald McCaffer, *Modern Construction Management*.
[2]	S.W. Nunnally, *Construction Methods and Management*.
[3]	Jagman Singh, *Heavy Construction Planning*.
[4]	Mahesh Varma, *Construction Equipment and its Applications*.
[5]	Christian John A., *Construction Management, Machines and Methods*.

Finite Element Method						
Course Code			**Examination Scheme**			
Teaching Scheme	3-0-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	3		**Laboratory**	CIE: --	ESE: --	--

Course Outcomes: Students will be able to:

1. Apply energy and variational methods to formulate structural equilibrium equations.
2. Analyse axial bar and truss systems using one-dimensional element formulations.
3. Solve beam and frame problems by integrating flexural and torsional stiffness.
4. Implement 2D iso-parametric mapping and numerical integration for plane stress/strain.
5. Develop 3D solid element models for complex, large-scale structural systems.

Unit 1: Introduction and Energy Methods **[6 Hrs]**

Overview of FEM history, steps, and advantages. Review of elasticity, including stress–strain relations, strain–displacement relations, and equilibrium equations. Mathematical modelling using Rayleigh-Ritz, Virtual Work, and Minimum Potential Energy methods.

Unit 2: One-Dimensional Analysis (Axial) **[6 Hrs]**

Formulation of linear spring and axial bar elements. Derivation of shape functions, stiffness matrices, and load vectors using displacement formulations. Global matrix assembly, boundary condition application, and analysis of plane trusses.

Unit 3: One-Dimensional Analysis (Beams and Frames) **[7 Hrs]**

Development of beam element stiffness matrices and load vectors based on flexural theory. Analysis of beam elements with axial and flexural effects and extension to plane frames and grids. Inclusion of torsion effects in grid structures. Practical modelling of continuous beams and rigid-jointed structures.

Unit 4: Two-Dimensional Iso-parametric Formulation **[7 Hrs]**

Analysis of triangular and rectangular continuum elements. Implementation of isoparametric mapping with Lagrange and Serendipity functions. Numerical integration using Gaussian Quadrature for plane stress, plane strain, and axi-symmetric structural problems. Convergence criteria, compatibility and completeness requirements, and patch test. Constraint handling using the Penalty method and the Lagrange Multiplier method.

Unit 5: Three-Dimensional Elements and Constraint Equations **[7 Hrs]**

Formulation of three-dimensional solid elements, including tetrahedron and brick types. Stress–strain relations and strain–displacement formulation in three dimensions. Modelling and analysis of three-dimensional structural problems and large-scale systems.

Self-Study **[6 Hrs]**

Practical software implementation of finite element analysis including preprocessing (geometry creation, meshing), solution procedures, and post-processing. Modeling and analysis of structural and continuum problems using FEM software tools. Interpretation of results including stress, strain, and deformation patterns. Validation of numerical results, error estimation, and convergence assessment. Development of simple FEM models for engineering applications and critical evaluation of modeling assumptions.

Textbooks and Reference Books:

[1]	J.N. Reddy, Introduction to the Finite Element Method, 2nd Ed., McGraw-Hill, New York, 2005.
[2]	C.S. Krishnamoorthy, Finite Element Analysis: Theory and Programming, Tata McGraw Hill, New Delhi, 1987.
[3]	O.C. Zienkiewicz, R.L. Taylor and J.Z. Zhu, Finite Element Method: Its Basis and Fundamentals, 6th Ed., Elsevier Butterworth Heinemann, Oxford, 2005.
[4]	Finite Element Method with Applications in Engineering by Y. M. Desai, T. I. Eldho and A. H. Shah, Pearson, 2011.
[5]	Zienkiewicz, O. C. & Taylor, R. L., “Finite Element Method”, Vol-I, II & III; Elsevier, 2000.
[6]	Bathe, K.J., “Finite Element Procedures”, Pringor; 2nd Edition, 2002.
[7]	Cook, R. D., “Concepts and Applications of Finite Element Analysis”, John Willey & Sons; NY, 1995.

Research Methodology						
Course Code			**Examination Scheme**			
Teaching Scheme	2-0-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	2		**Laboratory**	--	--	--

Course Outcomes: Students will be able to:

1. Analyse research problems and choose appropriate methodologies.
2. Apply research methods, data collection, and analysis techniques.
3. Conduct literature reviews and identify research gaps.
4. Demonstrate research ethics and effective technical communication.
5. Develop and present research proposals and projects.

UNIT 1: Introduction to Research Methodology **[6 Hrs]**

Meaning and definition of research, types of research, research problem identification, sources of research problems, characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research, formulation of research questions and hypotheses, research design, qualitative and quantitative research approaches, overview of interdisciplinary research.

UNIT 2: Literature Review and Research Planning **[6 Hrs]**

Importance of literature review, sources of literature including journals, conference papers, reports and online databases, effective literature survey techniques, critical analysis of literature, identification of research gaps, referencing styles, use of citation tools, formulation of research methodology, selection of research methods, planning of experiments or studies, introduction to Design of Experiments (DOE) and Taguchi method, preparation of research plan and timeline.

UNIT 3: Data Collection and Analysis **[6 Hrs]**

Methods of data collection including primary and secondary data, surveys, questionnaires, interviews and observations, sampling techniques, data processing and validation, statistical tools for data analysis, graphical representation of data, interpretation of results, error analysis, use of software tools for data analysis, drawing meaningful conclusions from experimental or simulated results.

UNIT 4: Research Ethics and Technical Communication **[6 Hrs]**

Research ethics and integrity, plagiarism and its avoidance, ethical issues in data collection and reporting, authorship and publication ethics, structure of technical reports, writing research papers, thesis and dissertations, effective technical writing skills, use of tables, figures and references, preparation of presentations, communication of research findings, peer review process.

UNIT 5: Research Proposal and Project Development **[6 Hrs]**

Components of a research proposal, problem statement, objectives, methodology, expected outcomes, budgeting and scheduling, format of research proposal, preparation of synopsis, project execution strategies, prototype development, testing and validation, result analysis and redesign, presentation of research work before review committee, report submission and documentation.

Self-Study (SS): **[6 Hrs]**

Advanced research tools and techniques, use of software for reference management (Mendeley, Zotero), basics of machine learning and data-driven research, simulation tools in engineering research, systematic review and meta-analysis, case studies of successful engineering research projects, research publication in high-impact journals, emerging trends in multidisciplinary research.

Textbooks:

[1] C.R. Kothari, Research Methodology: Methods and Techniques, New Age International Publishers

[2] R. Panneerselvam, *Research Methodology*, PHI Learning

Reference Books:

[1] John W. Creswell, *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*, Sage Publications

[2] Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, *The Craft of Research*, University of Chicago Press

[3] Thomas R. H. Havens, *Technical Writing and Professional Communication*, McGraw Hill

[4] Mark Saunders, Philip Lewis, Adrian Thornhill, *Research Methods for Business Students*, Pearson

[5] Shashi K. Gupta, Praneet Rangi, *Research Methodology: Methods, Tools and Techniques*, Kalyani Publishers.

Internship – II						
Course Code			**Examination Scheme**			
Teaching Scheme	0-0-0-0		**Theory**	-	-	-
Credits	1		**Laboratory**	-	CIE: 60	ESE: 40

Course Outcomes: Students will be able to:

1. Demonstrate practical knowledge in their field of study.
2. Exhibit improved professional and interpersonal skills.
3. Relate academic concepts to industry practices.
4. Prepare for advanced internships and career opportunities.

Objective:

1. To expose students to professional practices and organizational culture.
2. To apply theoretical knowledge to practical problems.
3. To develop communication, teamwork, and problem-solving skills.
4. To encourage independent learning and professional responsibility.

Duration:

1. Conducted during the summer vacation after the completion of the second year.
2. Minimum duration: 4–6 weeks.

Deliverables:

1. Internship Report: A detailed document outlining the work undertaken, methodologies applied, outcomes achieved, and reflections on learning.
2. Presentation: A formal presentation summarizing the internship experience, highlighting key contributions, challenges faced, and skills acquired.

Evaluation Weightage (suggested):

Report (50%): Assessed on clarity, depth of analysis, technical content, and overall presentation of the document including the certificate of internship to be attached in report.

Presentation (50%): Evaluated on communication skills, organization of content, ability to answer questions, and demonstration of learning outcomes.

Project – III						
Course Code			**Examination Scheme**			
Teaching Scheme	0-0-10-2		**Theory**	-	-	-
Credits	05		**Laboratory**	-	MSE: 60	ESE: 40

Course Outcomes: Students will be able to:

1. Formulate innovative solutions to complex civil engineering problems, considering sustainability and societal impact.
2. Integrate multidisciplinary knowledge to design, analyse, and evaluate engineering systems or structures.
3. Apply research methodologies, experimental techniques, and advanced tools to validate project outcomes.
4. Exhibit professional ethics, responsibility, and awareness of environmental and economic factors in engineering practice.
5. Communicate project deliverables clearly to diverse audiences using professional documentation and presentations.
6. Demonstrate readiness for industry or higher studies through independent problem-solving and critical thinking.

Objective: Culmination of project with final results, conclusions, and professional dissemination.

Content for Evaluation:
Final Results & Validation

- Comprehensive outcomes, comparison with objectives.
- Innovation & Contribution
- Novelty, practical applicability, or industry relevance.
- Documentation
- Complete project report with references, appendices, drawings.
- Presentation & Defense
- Oral defense before panel, clarity of communication.
- Publication/Dissemination
- Conference paper, journal submission, or poster presentation.
- Professional Skills
- Ethical considerations, budgeting, sustainability aspects.

Evaluation Weightage (suggested):

- Work Done, Final results & innovation – 40%
- Report & documentation – 30%
- Presentation & defense – 30%

Semester – VIII

Internship – III						
Course Code			**Examination Scheme**			
Teaching Scheme	0-0-0-0		**Theory**	-	-	-
Credits	3		**Laboratory**	-	CIE: 60	ESE: 40

Course Outcomes: Students will be able to:

1. Demonstrate practical knowledge in their field of study.
2. Exhibit improved professional and interpersonal skills.
3. Relate academic concepts to industry practices.
4. Prepare for advanced internships and career opportunities.

Objective:

1. To expose students to professional practices and organizational culture.
2. To apply theoretical knowledge to practical problems.
3. To develop communication, teamwork, and problem-solving skills.
4. To encourage independent learning and professional responsibility.

Duration:

1. Conducted during the summer vacation after the completion of the second year.
2. Minimum duration: 12-16 Weeks

Deliverables:

1. Internship Report: A detailed document outlining the work undertaken, methodologies applied, outcomes achieved, and reflections on learning.
2. Presentation: A formal presentation summarizing the internship experience, highlighting key contributions, challenges faced, and skills acquired.

Evaluation Weightage (suggested):

Report (50%): Assessed on clarity, depth of analysis, technical content, and overall presentation of the document including the certificate of internship to be attached in report.

Presentation (50%): Evaluated on communication skills, organization of content, ability to answer questions, and demonstration of learning outcomes.