



**ZEAL EDUCATION SOCIETY'S  
ZEAL COLLEGE OF ENGINEERING AND RESEARCH  
NARHE | PUNE -41 | INDIA**



**Department of Civil Engineering**

**Courses and Course Outcomes- 2019 Pattern**

**C201 –Building Technology and Architectural Planning**

CO201.1	Identify the types of buildings and the basic requirements of building components.
CO201.2	Make use of Architectural Principles and Building byelaws for building construction.
CO201.3	Plan effectively various types of Residential Building forms according to their utility, functions with reference to National Building Code.
CO201.4	Plan effectively various types of Public Buildings according to their utility functions with reference to National Building Code.
CO201.5	Make use of Principles of Planning in Town Planning, Different Villages and Safety aspects.
CO201.6	Understand different services and safety aspects

**C202 – Mechanics of structure**

CO202.1	Understand concept of stress-strain and determine different types of stress, strain in determinate, indeterminate homogeneous and composite structures.
CO202.2	Calculate shear force and bending moment in determinate beams for different loading conditions and illustrate shear force and bending moment diagram.
CO202.3	Explain the concept of shear and bending stresses in beams and demonstrate shear and bending stress distribution diagram.
CO202.4	Use theory of torsion to determine the stresses in circular shaft and understand concept of Principal stresses and strains.
CO202.5	Analyze axially loaded and eccentrically loaded column.
CO202.6	Determine the slopes and deflection of determinate beams and trusses.



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**C203 – Fluid Mechanics**

<b>CO203.1</b>	<b>Understand the use of Fluid Properties, concept of Fluid statics, basic equation of Hydrostatics, measurement of fluid pressure, buoyancy &amp; floatation and its application for solving practical problems.</b>
<b>CO203.2</b>	<b>Understand the concept of fluid kinematics with reference to Continuity equation and fluid dynamics with reference to Modified Bernoulli's equation and its application to practical nproblems of fluid flow</b>
<b>CO203.3</b>	<b>Understand the concept of Dimensional analysis using Buckingham's <math>\pi</math> theorem, Similarity &amp; Model Laws and boundary layer theory and apply it for solving practical problems of fluid flow.</b>
<b>CO203.4</b>	<b>Understand the concept of laminar and turbulent flow and flow through pipes and its application to determine major and minor losses and analyze pipe network using Hardy Cross method.</b>
<b>CO203.5</b>	<b>Understand the concept of open channel flow, uniform flow and depth-Energy relationships in open channel flow and make the use of Chezy's and Manning's formulae for uniform flow computation and design of most economical channel section.</b>
<b>CO203.6</b>	<b>Understand the concept of gradually varied flow in open channel and fluid flow around submerged objects, compute GVF profile and calculate drag and lift force on fully submerged body.</b>

**C204– Engineering Mathematics III**

<b>CO204.1</b>	<b>Solve Higher order linear differential equations and its applications to modelling and analysing Civil engineering problems such as bending of beams, whirling of shafts and mass spring systems.</b>
<b>CO204.2</b>	<b>Solve System of linear equations using direct &amp; iterative numerical techniques and develop solutions for ordinary differential equations using single step &amp; multistep methods applied to hydraulics, geotechnics and structural systems.</b>
<b>CO204.3</b>	<b>Apply Statistical methods like correlation, regression and probability theory in data analysis and predictions in civil engineering.</b>
<b>CO204.4</b>	<b>Perform Vector differentiation &amp; integration, analyze the vector fields and apply to fluid flow problems.</b>
<b>CO204.5</b>	<b>Solve Partial differential equations such as wave equation, one and two dimensional heat flow equations.</b>



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**C205– Engineering Geology**

<b>CO205.1</b>	<b>Explain about the basic concepts of engineering geology, various rocks, and minerals both in lab and on the fields and their inherent characteristics and their uses in civil engineering constructions.</b>
<b>CO205.2</b>	<b>Exploring the importance of mass wasting processes and various tectonic processes that hampers the design of civil engineering projects and its implications on environment and sustainability.</b>
<b>CO205.3</b>	<b>Recognize effect of plate tectonics, structural geology and their significance and utility in civil engineering activities.</b>
<b>CO205.4</b>	<b>Incorporate the various methods of survey, to evaluate and interpret geological nature of the rocks present at the foundations of the dams, percolation tanks, tunnels and to infer site / alignment/ level free from geological defects.</b>
<b>CO205.5</b>	<b>Assess the Importance of geological nature of the site, precautions and treatments to improve the site conditions for dams, reservoirs, and tunnels.</b>
<b>CO205.6</b>	<b>Explain geological hazards and importance of ground water and uses of common building stones.</b>

**C206– Building Technology and Architectural Planning Lab**

<b>CO206.1</b>	<b>Identify types of building and basic requirements of building construction and masonry.</b>
<b>CO206.2</b>	<b>Make use of Architectural Principles and Building byelaws for building construction.</b>
<b>CO206.3</b>	<b>Identify and select various building components according to their requirement.</b>
<b>CO206.4</b>	<b>Plan effectively various types of Residential Building and green building according to their utility, functions with reference to National Building Code.</b>

**C207– Mechanics of structure Lab**

<b>CO207.1</b>	<b>Examine tensile, shear, torsion and impact strength of metals</b>
<b>CO207.2</b>	<b>Evaluate the compressive and flexural strength of timber</b>
<b>CO201.3</b>	<b>Recommend the suitable bricks and tiles.</b>
<b>CO207.4</b>	<b>Construct influence line diagrams for determinate beams</b>
<b>CO207.5</b>	<b>Compare the cost of structural materials.</b>



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**C208– Fluid Mechanics Lab**

CO208.1	Study of uniform flow formulae, velocity distribution, and calibration of notches in open channel
CO208.2	Measurement of Viscosity and surface tension of given fluid
CO208.3	Verification of Bernoulli's theorem, Calibration of Venturimeter /Orifice meter
CO208.4	Determination of Darcy-Weisbach friction factor (f) and minor losses in a given pipe
CO208.5	Experiment with flow around a circular Cylinder/Aerofoil
CO208.6	Construct flow net by Electrical Analogy for flow below weir.

**C209– Engineering Geology Lab**

CO209.1	Explain common rocks, minerals, their use, significance, and application in civil engineering
CO209.2	Construct sections from contoured geological maps, interpretation of it and giving solutions of engineering geological problems in civil engineering.
CO209.3	Interpret the core drilling data to apply in civil engineering.
CO209.4	Recognize geological features in field, their significance in civil engineering and study of suitable software.

**C210– Awareness to civil Engineering Practices**

CO210.1	Describe functioning/working of different types of industries/sectors in Civil Engineering.
CO210.2	Describe drawings and documents required and used in different Civil Engineering works.
CO210.3	Understand the importance of Code of Ethics to be practiced by a Civil Engineer and also understand the duties and responsibilities as a Civil Engineer.
CO210.4	Understand different health and safety practices on the site.

**C211– Geotechnical Engineering**

CO211.1	Identify and classify the soil based on the index properties and its formation process
CO211.2	Explain permeability and seepage analysis of soil by construction of flow net.
CO211.3	Illustrate the effect of compaction on soil and understand the basics of stress distribution.
CO211.4	Express shear strength of soil and its measurement under various drainage conditions.
CO211.5	Evaluate the earth pressure due to backfill on retaining structures by using different theories.



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<b>CO211.6</b>	<b>Analysis of stability of slopes for different types of soils.</b>
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**C212– Survey**

<b>CO212.1</b>	<b>Define and Explain basics of plane surveying and differentiate the instruments used for it.</b>
<b>CO212.2</b>	<b>Express proficiency in handling surveying equipment and analyse the surveying data from these equipment.</b>
<b>CO212.3</b>	<b>Describe different methods of surveying and find relative positions of points on the surface of earth.</b>
<b>CO212.4</b>	<b>Execute curve setting for civil engineering projects such as roads, railways etc.</b>
<b>CO212.5</b>	<b>Articulate advancements in surveying such as space based positioning systems</b>
<b>CO212.6</b>	<b>Differentiate map and aerial photographs, also interpret aerial photographs.</b>

**C213– Concrete Technology**

<b>CO213.1</b>	<b>Identify the ingredients of concrete and its suitable proportion to achieve desired results</b>
<b>CO213.2</b>	<b>Compare the properties of concrete in fresh state</b>
<b>CO213.3</b>	<b>Demonstrate the properties of concrete in a hardened state</b>
<b>CO213.4</b>	<b>Design the concrete mix as per relevant codes</b>
<b>CO213.5</b>	<b>Distinguish concreting equipments, techniques and types of special concrete</b>
<b>CO213.6</b>	<b>Determine repairing methods and techniques after examining deteriorations in concrete</b>

**C214– Structural Analysis**

<b>CO214.1</b>	<b>Understand the basic concept of static and kinematic indeterminacy and analysis of indeterminate beams.</b>
<b>CO214.2</b>	<b>Analyze redundant trusses and able to perform approximate analysis of multi-story multi-bay frames.</b>
<b>CO214.3</b>	<b>Implement application of the slope deflection method to beams and portal frames.</b>
<b>CO214.4</b>	<b>Analyze beams and portal frames using moment distribution method.</b>
<b>CO214.5</b>	<b>Determine response of beams and portal frames using structure approach of stiffness matrix method.</b>
<b>CO214.6</b>	<b>Apply the concepts of plastic analysis in the analysis of steel structures.</b>



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**C215– Project Management**

CO215.1	Describe project life cycle and the domains of Project Management.
CO215.2	Explain networking methods and their applications in planning and management
CO215.3	Categorize the materials as per their annual usage and also Calculate production rate of construction equipment
CO215.4	Demonstrates resource allocation techniques and apply it for manpower planning.
CO215.5	Understand economical terms and different laws associated with project management
CO215.6	Apply the methods of project selection and recommend the best economical project.

**C216– Geotechnical Engineering-Lab**

CO216.1	Examine index properties of soil using Water content test, Pycnometer test, Sieve analysis test, Consistency limits test, and Field density test.
CO216.2	Analyse permeability of soil using Constant head and Variable head permeability test
CO216.3	Evaluate the Optimized Moisture Content and Maximum Dry Density
CO216.4	Determine shear strength of soil using direct shear test, unconfined compression test, Vane Shear test
CO216.5	Evaluate the earth pressure using Rebhann's and Cullman's graphical method, Differential free swell test.

**C217– Survey - Lab**

CO217.1	Experiment the magnetic bearing, plane table survey and, simple and differential levelling.
CO217.2	Make use of the theodolite for angular measurement, tacheometry, setting out curve and building
CO217.3	Use the nautical sextant, instruments used in hydrographic surveying and special functions available in total station.
CO217.4	Summarize city survey, and spatial database creation using GIS software.
CO217.5	Explain finding out the scale of photograph and air base distance.
CO217.6	Compile the data of total station and/or theodolite traversing, road project data to obtain sections and contouring data to create contour map.

**C218– Concrete Technology - Lab**

CO218.1	Check the suitability of cement to be used for the concrete construction.
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CO218.2	Check the suitability of fine and coarse aggregate to be used for the concrete construction.
CO218.3	Select the various ingredients of concrete and its suitable proportion to achieved desired strength
CO218.4	Check the properties of concrete in fresh and hardened state

**C219– Project Based Learning**

CO219.1	Identify the community/ practical/ societal needs
CO219.2	Apply the physical/ mathematical/ ICT model in order to solve identified problem/project to convert the idea into a product/ process/service.
CO219.3	Prepare a report and present/demonstrate in a team.

**C220– Disaster Management**

CO220.1	Learn basic conceptual understanding of disasters.
CO220.2	Understand approaches of Disaster Management
CO220.3	Acquire skills to respond to disaster

**C301– Hydrology and Water Resource Engineering**

CO301.1	Understand government organizations, apply & analyze precipitation & its abstractions.
CO301.2	Understand, apply & analyze runoff, runoff hydrographs and gauging of streams.
CO301.3	Understand, apply & analyze floods, hydrologic routing & Q-GIS software in hydrology.
CO301.4	Understand, apply & analyze reservoir planning, capacity of reservoir & reservoir economics.
CO301.5	Understand water logging & water management, apply & analyze ground water hydrology
CO301.6	Understand irrigation, piped distribution network and canal revenue, apply and analyze crop water requirement.

**C302– Water Supply Engineering**

CO302.1	Define identify, describe reliability of water sources, estimate water requirement for various sectors
CO302.2	Ascertain and interpret water treatment method required to be adopted with respect to source and raw water characteristics
CO302.3	Design various components of water treatment plant and distribution system.
CO302.4	Understand and compare contemporary issues and advanced treatment operations and process available in the market, including packaged water treatment plants.



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<b>CO302.5</b>	<b>Design elevated service reservoir capacity and understand the rainwater harvesting.</b>
<b>CO302.6</b>	<b>Understand the requirement of water treatment plant for infrastructure and Government scheme.</b>

**C303– Design of Steel Structures**

<b>CO303.1</b>	<b>Demonstrate knowledge about the types of steel structures, steel code provisions and design of the adequate steel section subjected to tensile force.</b>
<b>CO303.2</b>	<b>Determine the adequate steel section subjected to compression load and design of built up columns along with lacing and battening.</b>
<b>CO303.3</b>	<b>Design eccentrically loaded column for section strength and column bases for axial load and uniaxial bending.</b>
<b>CO303.4</b>	<b>Design of laterally restrained and unrestrained beam with and without flange plate using rolled steel section.</b>
<b>CO303.5</b>	<b>Analyze the industrial truss for dead, live and wind load and design of gantry girder for moving load</b>
<b>CO303.6</b>	<b>Understand the role of components of welded plate girder and design cross section for welded plate girder including stiffeners and its connections.</b>

**C304– Engineering Economics and Financial Management**

<b>CO304.1</b>	<b>Understand basics of construction economics.</b>
<b>CO304.2</b>	<b>Develop an understanding of financial management in civil engineering projects.</b>
<b>CO304.3</b>	<b>Prepare and analyze the contract account.</b>
<b>CO304.4</b>	<b>Decide on right source of fund for construction projects.</b>
<b>CO304.5</b>	<b>Understand working capital and its estimation for civil engineering projects.</b>
<b>CO304.6</b>	<b>Illustrate the importance of tax planning &amp; understand role of financial regulatory bodies</b>

**C305– Construction Management**

<b>CO305.1</b>	<b>Understand the overview of construction sector.</b>
<b>CO305.2</b>	<b>Illustrate construction scheduling, work study and work measurement.</b>
<b>CO305.3</b>	<b>Acquaint various labor laws and financial aspects of construction projects.</b>
<b>CO305.4</b>	<b>Explain elements of risk management and value engineering.</b>
<b>CO305.5</b>	<b>State material and human resource management techniques in construction.</b>
	<b>Understand basics of artificial intelligence techniques in civil engineering.</b>





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**C306– Seminar**

<b>CO306.1</b>	<b>Appraise the current civil engineering research / techniques / developments / interdisciplinary areas.</b>
<b>CO306.2</b>	<b>Review and organize literature survey utilizing technical resources, journals etc.</b>
<b>CO306.3</b>	<b>Evaluate and draw conclusions related to technical content studied.</b>
<b>CO306.4</b>	<b>Demonstrate the ability to perform critical writing by preparing a technical report.</b>
<b>CO306.5</b>	<b>Develop technical writing and presentation skills.</b>

**C307– Hydrology and Water Resource Engineering Lab**

<b>CO307.1</b>	<b>Determine average annual precipitation and yield using topo sheet</b>
<b>CO307.2</b>	<b>Analyse rainfall data and frequency</b>
<b>CO307.3</b>	<b>Demonstrate software used in water resources system</b>
<b>CO307.4</b>	<b>Determine peak flood discharge of basin and storage capacity of a reservoir</b>
<b>CO307.5</b>	<b>Explain the components of hydrological cycle on field</b>

**C308– Water Supply Engineering Lab**

<b>CO308.1</b>	<b>Determine the physical, chemical, and biological characteristics of water sample.</b>
<b>CO308.2</b>	<b>Design the water distribution network.</b>
<b>CO308.3</b>	<b>Illustrate the working of water treatment units.</b>
<b>CO308.4</b>	<b>Explain water intake structure.</b>
<b>CO308.5</b>	<b>Design water treatment plant</b>

**C309– Design of Steel Structures Lab**

<b>CO309.1</b>	<b>Design and detailing of Tension member as per IS 800-2007</b>
<b>CO309.2</b>	<b>Design and detailing of compression member as per IS 800-2007</b>
<b>CO309.3</b>	<b>Design and detailing of slab base and gusseted base</b>
<b>CO309.4</b>	<b>Design and detailing of laterally supported and unsupported flexural members</b>
<b>CO309.5</b>	<b>Design and detailing of welded plate girder</b>
<b>CO309.6</b>	<b>Design and detailing of truss</b>



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**C310– Construction Management Lab**

<b>CO310.1</b>	<b>Illustrate construction scheduling, work study and work Break Down Structure</b>
<b>CO310.2</b>	<b>Interpret Financial statement of construction Project</b>
<b>CO310.3</b>	<b>Summarize Risk Management with help of case study</b>
<b>CO310.4</b>	<b>Apply Economic order Quantity for material management.</b>
<b>CO310.5</b>	<b>Explain Artificial Intelligence Techniques in civil Engineering</b>

**C311– Sustainable Energy Systems**

<b>CO311.1</b>	<b>Illustrate construction scheduling, work study and work Break Down Structure</b>
<b>CO311.2</b>	<b>Interpret Financial statement of construction Project</b>

**C312– Waste Water Engineering**

<b>CO312.1</b>	<b>Recall sanitation infrastructure, quantification and characterization of wastewater, natural purification of streams</b>
<b>CO312.2</b>	<b>Design preliminary and primary unit operations in waste water treatment plant</b>
<b>CO312.3</b>	<b>Understand theory and mechanism of aerobic biological treatment system and to design activated sludge process</b>
<b>CO312.4</b>	<b>Understand and design suspended and attached growth wastewater treatment systems</b>
<b>CO312.5</b>	<b>Explain and apply concept of contaminant removal by anaerobic, tertiary and emerging wastewater treatment systems</b>
<b>CO312.6</b>	<b>Compare various sludge management systems and explain the potential of recycle and reuse of wastewater treatment</b>

**C313– Design of Reinforced Concrete Structures**

<b>CO313.1</b>	<b>Apply relevant IS provisions to ensure safety and serviceability of structures, understand the design philosophies and behavior of materials: steel &amp; concrete.</b>
<b>CO313.2</b>	<b>Recognize mode of failure as per LSM and evaluate moment of resistance for singly, doubly rectangular, and flanged sections.</b>
<b>CO313.3</b>	<b>Design &amp; detailing of rectangular one way and two-way slab with different boundary conditions</b>
<b>CO313.4</b>	<b>Design &amp; detailing of dog legged and open well staircase</b>



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<b>CO313.5</b>	<b>Design &amp; detailing of singly/doubly rectangular/flanged beams for flexure, shear, bond and torsion.</b>
<b>CO313.6</b>	<b>Design &amp; detailing of short columns subjected to axial load, uni-axial/bi-axial bending and their footings.</b>

**C314– Remote Sensing and Geographic Information System**

<b>CO314.1</b>	<b>Articulate fundamentals and principles of RS techniques.</b>
<b>CO314.2</b>	<b>Demonstrate the knowledge of remote sensing and sensor characteristics.</b>
<b>CO314.3</b>	<b>Distinguish working of various spaces-based positioning systems.</b>
<b>CO314.4</b>	<b>Analyze the RS data and image processing to utilize in civil engineering</b>
<b>CO314.5</b>	<b>Explain fundamentals and applications of RS and GIS</b>
<b>CO314.6</b>	<b>Acquire skills of data processing and its applications using GIS</b>

**C315e– Architecture and Town Planning**

<b>CO315e.1</b>	<b>Apply the principles of architectural planning and landscaping for improving quality of life</b>
<b>CO315e.2</b>	<b>Understand the confronting issues of the area and apply the acts.</b>
<b>CO315e.3</b>	<b>Evaluate and defend the proposals.</b>
<b>CO315e.4</b>	<b>Appraise the existing condition and to develop the area for betterment.</b>

**C315f– Solid Waste Management**

<b>CO315f.1</b>	<b>Outline solid waste management systems with respect to its generation rate (quantity), sampling, characteristics and regulatory/legal requirements.</b>
<b>CO315f.2</b>	<b>Explain and suggest relevant method of storage, collection and transportation of solid waste for the given site condition with justification.</b>
<b>CO315f.3</b>	<b>Develop understanding of technological applications for processing and material recovery from solid waste with its economics and design composting system for organic waste.</b>
<b>CO315f.4</b>	<b>Describe the fundamental and technological aspects of waste to energy systems from solid waste and to design anaerobic digester and incineration system.</b>



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<b>CO315f.5</b>	<b>Outline the design, operation, and maintenance of sanitary landfill and management of legacy waste.</b>
<b>CO315f.6</b>	<b>Explain the functional element for management of special waste and suggest the relevant method of reuse and recycling for the given type of waste in the given situation.</b>

**C316– Internship**

<b>CO316.1</b>	<b>To develop professional competence through industry internship</b>
<b>CO316.2</b>	<b>To apply academic knowledge in a personal and professional environment</b>
<b>CO316.3</b>	<b>To build the professional network and expose students to future employees</b>
<b>CO316.4</b>	<b>Apply professional and societal ethics in their day to day life</b>
<b>CO316.5</b>	<b>To become a responsible professional having social, economic and administrative considerations</b>
<b>CO316.6</b>	<b>To make own career goals and personal aspirations</b>

**C317– Waste Water Engineering Lab**

<b>CO317.1</b>	<b>Determine the physical, chemical, and biological characteristics of wastewater sample.</b>
<b>CO317.2</b>	<b>Illustrate the working of sewage treatment units.</b>
<b>CO317.3</b>	<b>Design sewage treatment plant</b>
<b>CO317.4</b>	<b>Explain sewer materials, choice of materials, testing of sewer pipes, sewer appurtenances.</b>
<b>CO317.5</b>	<b>Determine the physical, chemical, and biological characteristics of wastewater sample.</b>
<b>CO317.6</b>	<b>Illustrate the working of sewage treatment units.</b>

**C318– Design of Reinforced Concrete Structures Lab**

<b>CO318.1</b>	<b>Design of slab as per 456-2000 and detailing as per SP 34- 1987</b>
<b>CO318.2</b>	<b>Design of beam as per 456-2000 and detailing as per SP 34- 1987</b>
<b>CO318.3</b>	<b>Design of column as per 456-2000 and detailing as per SP 34- 1987</b>
<b>CO318.4</b>	<b>Design of footing as per 456-2000 and detailing as per SP 34- 1987</b>



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**C319– Remote Sensing and GIS Lab**

<b>CO319.1</b>	<b>Summaries the fundamental tools and steps to import and export data in GIS software.</b>
<b>CO319.2</b>	<b>Generate thematic maps using GIS software.</b>
<b>CO319.3</b>	<b>Interpret the data from the aerial photographs and satellite images.</b>
<b>CO319.4</b>	<b>Apply RS &amp; GIS techniques for development of smart cities, land use classification and DEM for geomorphological features.</b>

**C320e– Architecture and Town Planning Lab**

<b>CO320e.1</b>	<b>Describe the process involved in study and analysis of development plan, neighborhood planning.</b>
<b>CO320e.2</b>	<b>Apply the knowledge of history of Indian architecture and case study in relation with Town Planning aspects inclusive of infrastructure, disaster management.</b>
<b>CO320e.3</b>	<b>Demonstrate knowledge of urban renewal schemes and town planning schemes.</b>
<b>CO320e.4</b>	<b>Express Knowledge of URDPFI OR AMRUT guidelines, special townships and rural planning strategies.</b>
<b>CO320e.5</b>	<b>Compare techniques for sustainable architecture</b>

**C320f– Solid Waste Management Lab**

<b>CO320f.1</b>	<b>Demonstrate the process involved in municipal solid waste management process.</b>
<b>CO320f.2</b>	<b>Identify the impacts and problems of improper management of municipal solid waste.</b>
<b>CO320f.3</b>	<b>Characterize and quantify municipal solid waste</b>
<b>CO320f.4</b>	<b>Optimize the route network for municipal solid waste collection.</b>
<b>CO320f.5</b>	<b>Design a composting system, an anaerobic digester and a sanitary landfill system</b>
<b>CO320f.6</b>	<b>Compare various cutting edge technologies for solid waste management</b>

**C321– Leadership and Personality Development**

<b>CO321.1</b>	<b>Enhanced holistic development of students and improve their employability skills</b>
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**C401– Solid Waste Management Lab**

<b>CO401.1</b>	<b>Perform subsurface investigations for foundations using different methods.</b>
<b>CO401.2</b>	<b>Estimate the bearing capacity of shallow foundations.</b>
<b>CO401.3</b>	<b>Calculate immediate and primary consolidation settlement of shallow foundations.</b>
<b>CO401.4</b>	<b>Decide the capacity of a pile and pile group.</b>
<b>CO401.5</b>	<b>Understand the steps in geotechnical design of shallow foundations and well foundations.</b>
<b>CO401.6</b>	<b>Analyze problems related to expansive soil and overcome them using design principles, construction techniques in black cotton soil.</b>

**C402– Transportation Engineering**

<b>CO402.1</b>	<b>Understand principles and practices of transportation planning.</b>
<b>CO402.2</b>	<b>Demonstrate knowledge of traffic studies, analysis and their interpretation.</b>
<b>CO402.3</b>	<b>Design Geometric Elements of road pavement.</b>
<b>CO402.4</b>	<b>Evaluate properties of highway materials as a part of road pavement.</b>
<b>CO402.5</b>	<b>Appraise different types of pavements and their design</b>
<b>CO402.6</b>	<b>Understand the fundamentals of Bridge Engineering and Railway Engineering</b>

**C403c– Integrated Water Resources Planning and Management**

<b>CO403.1</b>	<b>Understand concerned organizations, IWRP &amp; M objectives, principles, challenges, application &amp; analysis of IWRP&amp;M approaches &amp; principles in a case study.</b>
<b>CO403.2</b>	<b>Understand PIM, WDS, WALMI, agriculture in the concept of integrated water resources, apply and analyse water requirements for food production</b>



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<b>CO403.3</b>	<b>Understand assessment of surface and ground water quality, EIA, CPCB regulations, application &amp; analysis of effluent quality standards as per CPCB</b>
<b>CO403.4</b>	<b>Understand water economics and funding, application &amp; analysis of planning for a sustainable water future</b>
<b>CO403.5</b>	<b>Understand legal regulatory settings of IWRP &amp; M, application &amp; analysis of inter-basin water transfers and IWRP &amp; M</b>
<b>CO403.6</b>	<b>Understand flood control &amp; power generation for IWRP &amp; M, application QGIS for analysis of a basin for IWRP &amp; M</b>

**C404a– Air Pollution and Control**

<b>CO404a.1</b>	<b>Recall air pollution, legislation and regulations.</b>
<b>CO404a.2</b>	<b>Evaluate air pollutant concentrations as a function of meteorology.</b>
<b>CO404a.3</b>	<b>Interpret sampling results with prescribed standards.</b>
<b>CO404a.4</b>	<b>Assess emission inventory and air quality models.</b>
<b>CO404a.5</b>	<b>Compare the air pollution control equipments.</b>
<b>CO404a.6</b>	<b>Infer indoor air pollution and its mitigation.</b>

**C404d– Air Pollution and Control**

<b>CO404d.1</b>	<b>Understand the fundamental of airport.</b>
<b>CO404d.2</b>	<b>Understand and design the runway and taxiway and drainage systems.</b>
<b>CO404d.3</b>	<b>Understand the BIM, AR and VR in airport planning and pavement design.</b>
<b>CO404d.4</b>	<b>Plan the lighting and marking of airport and heliport.</b>
<b>CO404d.5</b>	<b>Estimate various components of bridge and loads on bridges.</b>
<b>CO404d.6</b>	<b>Study and design of bridge structures.</b>

**C405– Project Stage I**

<b>CO405.1</b>	<b>Appraise the current Civil Engineering research/ techniques/ developments/ interdisciplinary areas.</b>
<b>CO405.2</b>	<b>Review and organize literature survey utilizing technical resources, journals etc.</b>



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<b>CO405.3</b>	<b>Evaluate and draw conclusions related to technical content studied.</b>
<b>CO405.4</b>	<b>Demonstrate the ability to perform critical writing by preparing a technical report.</b>
<b>CO405.5</b>	<b>Develop technical writing and presentation skills.</b>

**C406– Transportation Engineering Lab**

<b>CO406.1</b>	<b>Evaluate the suitability of road aggregates in highway construction.</b>
<b>CO406.2</b>	<b>Evaluate properties of bitumen to be used for highway construction.</b>
<b>CO406.3</b>	<b>Design and evaluate stability of bitumen and aggregate mix.</b>
<b>CO406.4</b>	<b>Express Knowledge of preparation of bitumen and aggregate mix</b>
<b>CO406.5</b>	<b>Make use of knowledge on construction process of different pavement layers</b>
<b>CO406.6</b>	<b>Express Knowledge of non-Destructive Evaluation of Pavements</b>

**C407– Integrated Water Resources Planning & Management lab**

<b>CO407.1</b>	<b>Identify components and approaches of IWRP &amp; M</b>
<b>CO407.2</b>	<b>Make use of knowledge on national water policy, participatory irrigation management and water distribution societies</b>
<b>CO407.3</b>	<b>Evaluate compliance of effluent quality standards as per CPCB</b>
<b>CO407.4</b>	<b>Interpret knowledge on economics in IWRP &amp; M and decision making</b>
<b>CO407.5</b>	<b>Apply knowledge on water laws (National, State &amp; Local) and on global water partnership.</b>
<b>CO407.6</b>	<b>Apply soft computing tool for flood forecasting and QGIS for IWRM</b>

**C408a– Air Pollution and Control Lab**

<b>CO408a.1</b>	<b>Analyze particulate matter concentration using various monitoring equipment</b>
<b>CO408a.2</b>	<b>Measure Stack Emissions</b>
<b>CO408a.3</b>	<b>Assess Indoor Air Quality</b>
<b>CO408a.4</b>	<b>Adopt suitable air pollution control device</b>
<b>CO408a.5</b>	<b>Demonstrate the air quality issues and state of the art technological inventions.</b>
<b>CO408a.6</b>	<b>Use cutting edge technologies related to air pollution and control</b>

**C408d– Airport and Bridge Engineering Lab**

<b>CO408d.1</b>	<b>Design runway of an airport</b>
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<b>CO408d.2</b>	<b>Design pipe culvert and box culvert.</b>
<b>CO408d.3</b>	<b>Apply the knowledge on airport planning and design.</b>
<b>CO408d.4</b>	<b>Apply the knowledge on site selection of bridges.</b>
<b>CO408d.5</b>	<b>Demonstrate the knowledge on use of cutting edge technologies in bridge and airport engineering.</b>

**C409– Computer Programming in Civil Engineering**

<b>CO409.1</b>	<b>Understand basics of Python Programming</b>
<b>CO409.2</b>	<b>Write Python codes for variety of problems in civil Engineering</b>

**C409– Communication Etiquette in Workplaces**

<b>CO409.1</b>	<b>Develop an understanding of workplace codes, professionalism at workplace</b>
<b>CO409.2</b>	<b>Learn the workplace ethics</b>
<b>CO409.3</b>	<b>Develop an understanding of Business ethics, workplace privacy and ethics</b>
<b>CO409.4</b>	<b>Learn teamwork at workplace</b>
<b>CO409.5</b>	
<b>CO409.6</b>	

**C410– Communication Etiquette in Workplaces**

<b>CO410.1</b>	<b>Understand types of dams and instrumentation working</b>
<b>CO410.2</b>	<b>Execute stability analysis of Gravity Dam</b>
<b>CO410.3</b>	<b>Understand types of spillways &amp; Design of Ogee spillway</b>
<b>CO410.4</b>	<b>Illustrate the failures and analyze stability of earthen dam</b>
<b>CO410.5</b>	<b>Design Canals and understand the canal structures</b>
<b>CO410.6</b>	<b>Analysis of the Diversion headwork and Cross Drainage work</b>

**C411– Dams and Hydraulics Structures**

<b>CO411.1</b>	<b>Understand types of dams and instrumentation working</b>
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<b>CO411.2</b>	<b>Execute stability analysis of Gravity Dam</b>
<b>CO411.3</b>	<b>Understand types of spillways &amp; Design of Ogee spillway</b>
<b>CO411.4</b>	<b>Illustrate the failures and analyze stability of earthen dam</b>
<b>CO411.5</b>	<b>Design Canals and understand the canal structures</b>
<b>CO411.6</b>	<b>Analysis of the Diversion headwork and Cross Drainage work</b>

**C412– Quantity Surveying, Contracts and Tenders**

<b>CO412.1</b>	<b>Understand concept of estimates and prepare approximate estimate for various for Civil Engineering works.</b>
<b>CO412.2</b>	<b>Describe tendering process, construction contracts, and aspects of Arbitration and prepare tender documents.</b>
<b>CO412.3</b>	<b>Prepare detailed estimate of various items of work by different methods and calculate quantity of steel from Bar bending schedule.</b>
<b>CO412.4</b>	<b>Apply engineering knowledge to prepare estimate for roads, culverts, and water tank (Elevated storage tank)</b>
<b>CO412.5</b>	<b>Apply concepts of specification to draft brief specification, detailed specification and prepare detailed rate analysis report.</b>
<b>CO412.6</b>	<b>Evaluate depreciation and valuation of property on the basis of present condition, specifications and market trend.</b>

**C413c– Quantity Surveying, Contracts and Tenders**

<b>CO413.1</b>	<b>Summarize types of irrigation methods.</b>
<b>CO413.2</b>	<b>Estimate evapotranspiration and crop-water requirement.</b>
<b>CO413.3</b>	<b>Understand component parts and their design considerations of lift irrigation system.</b>
<b>CO413.4</b>	<b>Design drip and sprinkler irrigation systems.</b>
<b>CO413.5</b>	<b>Understand basics of salt affected soils and estimate leaching requirement.</b>
<b>CO413.6</b>	<b>Design surface and subsurface drainage systems.</b>



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**C414a– TQM and MIS**

<b>CO414.1</b>	<b>Recognize quality and contribution of quality gurus for evaluation of best practices</b>
<b>CO414.2</b>	<b>Relate the functioning and application of TQM &amp; Six Sigma in the domain of construction sector</b>
<b>CO414.3</b>	<b>Recommend ISO 9001 principles in preparation of quality manual to construction business</b>
<b>CO414.4</b>	<b>Apply management control &amp; certification systems for construction industry</b>
<b>CO414.5</b>	<b>Choose TQM process implementation and various quality awards for construction sector</b>
<b>CO414.6</b>	<b>Propose MIS for allied fields in construction sector</b>

**C415– Project Stage II**

<b>CO415.1</b>	<b>Appraise the current Civil Engineering research /techniques /developments / interdisciplinary areas.</b>
<b>CO415.2</b>	<b>Review and organize literature survey utilizing technical resources, journals etc.</b>
<b>CO415.3</b>	<b>Evaluate and draw conclusions related to technical content studied.</b>
<b>CO415.4</b>	<b>Demonstrate the ability to perform critical writing by preparing a technical report.</b>
<b>CO415.5</b>	<b>Develop technical writing and presentation skills.</b>
<b>CO415.6</b>	

**C416– Dams and Hydraulics Structures Lab**

<b>CO416.1</b>	<b>Demonstrate the knowledge on types and/or failure of dams</b>
<b>CO416.2</b>	<b>Analyze the stability of gravity dam and zoned earthen dam</b>
<b>CO416.3</b>	<b>Design the spillway profile</b>
<b>CO416.4</b>	<b>Design energy dissipation device below the spillway</b>
<b>CO416.5</b>	<b>Analyze weirs on permeable foundations</b>
<b>CO416.6</b>	<b>Design lined canal</b>

**C417 Quantity Surveying, Contracts and Tenders Lab**

<b>CO417.1</b>	<b>Develop estimates of various for Civil Engineering works.</b>
<b>CO417.2</b>	<b>Prepare detailed quantity estimate of various items of work by different methods</b>



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<b>CO417.3</b>	<b>Develop construction contracts and prepare tender documents.</b>
<b>CO417.4</b>	<b>Develop brief specification, detailed specification and prepare detailed rate analysis report.</b>
<b>CO417.5</b>	<b>Evaluate depreciation and valuation of property on the basis of present condition, specifications and market trend.</b>
<b>CO417.6</b>	<b>Make use of software/excel spreadsheet for quantity estimation, Bar bending schedule and detailed estimate of civil engineering works.</b>

**C418 Irrigation and Drainage Lab**

<b>CO418.1</b>	<b>Demonstrate the knowledge on types of irrigation methods and application of artificial intelligence techniques in irrigation and drainage.</b>
<b>CO418.2</b>	<b>Apply the knowledge on estimation of evapotranspiration</b>
<b>CO418.3</b>	<b>Compare and adopt suitable irrigation system</b>
<b>CO418.4</b>	<b>Design surface and sub-surface drainage system</b>
<b>CO418.5</b>	<b>Determine crop water requirement using CropWat software</b>

**C419 Irrigation and Drainage Lab**

<b>CO418.1</b>	<b>Develop understanding of social responsibility</b>
<b>CO418.2</b>	<b>Learn the International framework for Social Responsibility</b>
<b>CO418.3</b>	<b>Know the drivers of social responsibility in India</b>
<b>CO418.4</b>	<b>Identify the key stakeholders of social responsibility</b>