Department of Civil Engineering

Course Outcomes (CO)

COURSE PATTERN 2019 SE CIVIL

SE Civil SEM-III

Course Code	Course Name	COs	Course Outcomes
201001	Building Technology and Architectural Planning	1	Identify types of building and basic requirements of building components.
		2	Make use of Architectural Principles and Building byelaws for building construction.
		3	Plan effectively various types of Residential Building forms according to their utility, functions with reference to National Building Code.
		4	Plan effectively various types of Public Buildings according to their utility functions with reference to National Building Code.
		5	Make use of Principles of Planning in Town Planning, Different Villages and Safety aspects.
		6	Understand different services and safety aspects
201002	Mechanics of Structures	1	Understand concept of stress-strain and determine different types of stress, strain in determinate, indeterminate homogeneous and composite structures.
		2	Calculate shear force and bending moment in determinate beams for different loading conditions and illustrate shear force and bending moment diagram.
		3	Explain the concept of shear and bending stresses in beams and demonstrate shear and bending stress distribution diagram.
		4	Use theory of torsion to determine the stresses in circular shaft and understand concept of Principal stresses and strains.
		5	Analyze axially loaded and eccentrically loaded column.

		6	Determine the slopes and deflection of determinate beams and trusses.
201003	**Fluid Mechanics**	**1**	Understand the use of Fluid Properties, concept of Fluid statics, basic equation of Hydrostatics, measurement of fluid pressure, buoyancy & floatation and its application for solving practical problems.
		2	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 problems of fluid flow
		3	Understand the concept of Dimensional analysis using Buckingham's π theorem, Similarity & Model Laws and boundary layer theory and apply it for solving practical problems of fluid flow.
		4	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.
		5	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.
		6	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.
207001	**Engineering Mathematics III**	**1**	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.
		2	Solve System of linear equations using direct & iterative numerical techniques and develop solutions for ordinary differential equations using single step & multistep methods applied to hydraulics, geotechnics and structural systems.
		3	Apply Statistical methods like correlation, regression and probability theory in data analysis and predictions in civil engineering.

		4	Perform Vector differentiation &integration, analyze the vector fields and apply to fluid flow problems.
		5	Solve Partial differential equations such as wave equation, one and two dimensional heat flow equations.
207003	**Engineering Geology**	**1**	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.
		2	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.
		3	Recognize effect of plate tectonics, structural geology and their significance and utility in civil engineering activities.
		4	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.
		5	Assess the Importance of geological nature of the site, precautions and treatments to improve the site conditions for dams, reservoirs, and tunnels.
		6	Explain geological hazards and importance of ground water and uses of common building stones.
	Audit Course I Awareness to Civil Engineering Practices	**1**	Describe functioning/working of different types of industries/sectors in Civil Engineering.
		2	Describe drawings and documents required and used in different Civil Engineering works.

		3	Understand the importance of Code of Ethics to be practiced by a Civil Engineer and also
		4	Understand different health and safety practices on the site.
	Road Safety Management Audit Course I	**1**	Summarize the existing road transport scenario of our country
		2	Explain the method of road accident investigation
		3	Describe the regulatory provisions needed for road safety
		4	Identify the safety issues for a road and make use of IRC's road safety manual for

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SE Civil SEM-IV

Course Code	Course Name	COs	Course Outcomes
201008	Geotechnical Engineering	1	Identify and classify the soil based on the index properties and its formation process
		2	Explain permeability and seepage analysis of soil by construction of flow net.
		3	Illustrate the effect of compaction on soil and understand the basics of stress distribution.
		4	Express shear strength of soil and its measurement under various drainage conditions.
		5	Evaluate the earth pressure due to backfill on retaining structures by using different theories.
		6	Analysis of stability of slopes for different types of soils.
201009	Surveying	1	Define and Explain basics of plane surveying and differentiate the instruments used for it.
		2	Express proficiency in handling surveying equipment and analyse the surveying data from these equipment.
		3	Describe different methods of surveying and find relative positions of points on the surface of earth.
		4	Execute curve setting for civil engineering projects such as roads, railways etc.
		5	Articulate advancements in surveying such as space based positioning systems
		6	Differentiate map and aerial photographs, also interpret aerial photographs.
201010	Concrete Technology	1	Able to select the various ingredients of concrete and its suitable proportion to achieved desired strength.
		2	Able to check the properties of concrete in fresh and hardened state.
		3	Get acquainted to concreting equipments, techniques and different types of special concrete.

		4	Able to predict deteriorations in concrete and get acquainted to various repairing methods and techniques.
201011	**Structural Analysis**	**1**	Understand the basic concept of static and kinematic indeterminacy and analysis of indeterminate beams.
		2	Analyze redundant trusses and able to perform approximate analysis of multi-story multi-bay frames.
		3	Implement application of the slope deflection method to beams and portal frames.
		4	Analyze beams and portal frames using moment distribution method.
		5	Determine response of beams and portal frames using structure approach of stiffness matrix method.
		6	Apply the concepts of plastic analysis in the analysis of steel structures.
201012	**Project Management**	**1**	Describe project life cycle and the domains of Project Management.
		2	Explain networking methods and their applications in planning and management
		3	Categorize the materials as per their annual usage and also Calculate production rate of construction equipment
		4	Demonstrates resource allocation techniques and apply it for manpower planning.
		5	Understand economical terms and different laws associated with project management
		6	Apply the methods of project selection and recommend the best economical project.
201017	**Project Based Learning**	**1**	Identify the community/ practical/ societal needs and convert the idea into a product/ process/ service.
		2	Analyse and design the physical/ mathematical/ ICT model in order to solve identified problem/project.
		3	Create, work in team and applying the solution in practical way to specific problem.

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TE Civil SEM-V

Course Code	Course Name	COs	Course Outcomes
301001	Hydrology and Water Resource Engineering	1	Understand government organizations, apply & analyze precipitation & its abstractions.
		2	Understand, apply & analyze runoff, runoff hydrographs and gauging of streams.
		3	Understand, apply & analyze floods, hydrologic routing & Q-GIS software in hydrology.
		4	Understand, apply & analyze reservoir planning, capacity of reservoir & reservoir economics.
		5	Understand water logging & water management, apply & analyze ground water hydrology
		6	Understand irrigation, piped distribution network and canal revenue, apply and analyze crop water requirement.
301002	Water Supply Engineering	1	Define identify, describe reliability of water sources, estimate water requirement for various sectors
		2	Ascertain and interpret water treatment method required to be adopted with respect to source and raw water characteristics
		3	Design various components of water treatment plant and distribution system.
		4	Understand and compare contemporary issues and advanced treatment operations and process available in the market, including packaged water treatment plants.
		5	Design elevated service reservoir capacity and understand the rainwater harvesting.
		6	Understand the requirement of water treatment plant for infrastructure and Government scheme.
301003	Design of Steel Structures	1	Demonstrate knowledge about the types of steel structures, steel code provisions and design of the adequate steel section subjected to tensile force.
		2	Determine the adequate steel section subjected to compression load and design of built up columns along with lacing and battening.

		3	Design eccentrically loaded column for section strength and column bases for axial load and uniaxial bending.
		4	Design of laterally restrained and unrestrained beam with and without flange plate using rolled steel section.
		5	Analyze the industrial truss for dead, live and wind load and design of gantry girder for moving load.
		6	Understand the role of components of welded plate girder and design cross section for welded plate girder including stiffeners and its connections.
301004	**Engineering Economics and Financial Management**	**1**	Understand basics of construction economics.
		2	Develop an understanding of financial management in civil engineering projects.
		3	Prepare and analyze the contract account.
		4	Decide on right source of fund for construction projects.
		5	Understand working capital and its estimation for civil engineering projects.
		6	Illustrate the importance of tax planning & understand role of financial regulatory bodies
301005 a	**Elective I: Advanced Fluid Mechanics and Hydraulic Machines**	**1**	To study flow over notches and weirs; and the concept of hydraulic jump and losses
		2	To state the importance of ideal fluid flow analysis.
		3	To study laminar flow between parallel plates.
		4	To study unsteady flow through orifice and the concept of water hammer in pipe flow
		5	To study impact of free jet on stationary and moving flat and curved vanes
		6	To study Pelton wheel, Francis turbine and centrifugal pump from view point of their working principle, work done, efficiency and performance characteristics.

301005 b	**Elective I: Research Methodology and IPR**	**1**	Understand a research problem for civil engineering domain.
		2	Analyze the available literature for given research problem and illustrate different techniques of literature survey thereby gap identification.
		3	Recognize the importance of data collection and investigate the statistical and reliability methods of preliminary data analysis.
		4	Explain the important concept of interpretation and develop technical writing and presentation skills.
		5	Comprehend the various forms of the intellectual property, its relevance and business impact in the changing global business environment.
		6	Realize the importance of patents, trademark and copyright and follow research ethics.
301005 c	**Elective I: Construction Management**	**1**	Understand the overview of construction sector.
		2	Illustrate construction scheduling, work study and work measurement.
		3	Acquaint various labor laws and financial aspects of construction projects.
		4	Explain elements of risk management and value engineering.
		5	State material and human resource management techniques in construction.
		6	Understand basics of artificial intelligence techniques in civil engineering.
301005 d	**Elective I: Advanced Concrete Technology**	**1**	Understand the chemistry of cement and its effect on properties of concrete
		2	Apply the knowledge of supplementary cementitious materials to produce sustainable concretes
		3	Understand the mechanism of working of admixtures and their effect on properties of concrete
		4	Evaluate the characteristic properties of fiber reinforced concrete
		5	Understand the durability properties of concrete
		6	Interpret the properties of concrete through advance testing methods

301005 e	**Elective I: Matrix Methods of Structural Analysis**	**1**	To understand the structural behavior of bars and trusses and analyze it by using flexibility method of analysis.
		2	To understand the structural behavior of beams and plane frames and analyze it by using flexibility method of analysis.
		3	To analyze bars, springs and truss by member approach of stiffness matrix method.
		4	To analyze beams by member approach of stiffness matrix method and to develop transformation matrix and global/structure stiffness matrix for plane frame and thereby analyze it by member approach of stiffness matrix method.
		5	To develop transformation matrix and global/structure stiffness matrix for grid and analyze the grid by structure and member approach of stiffness matrix method.
		6	To develop the member stiffness matrix of space truss and space frame and develop the flow chart /algorithm to write the program for analysis of skeletal structures with reference to computer application.
301005 f	**Elective I: Advanced Mechanics of Structures**	**1**	Apply moment area and conjugate method to find slope and deflection.
		2	Evaluate stresses and strain in thin and thick cylinder.
		3	Analyze the beam and trusses by influence line diagram.
		4	Analyze the beam for moving load by influence line diagram.
		5	Understand and analyze beam curved in plan and elevation.
		6	Analyze three and two hinged arches for axial thrust, shear and moment.
301006	**Seminar**	**1**	Appraise the current civil engineering research / techniques / developments / interdisciplinary areas.
		2	Review and organize literature survey utilizing technical resources, journals etc.
		3	Evaluate and draw conclusions related to technical content studied.
		4	Demonstrate the ability to perform critical writing by preparing a technical report.
		5	Develop technical writing and presentation skills.

301011 a	**Audit Course I: Professional Ethics and Etiquettes**	**1**	Understand the basic perception of profession, professional ethics, various moral issues and uses of ethical theories
		2	Understand various social issues, industrial standards, code o ethics and role of professional ethics in engineering field.
		3	Follow ethics as an engineering professional and adopt good standards and norms of engineering practice.
		4	Apply ethical principles to resolve situations that arise in their professional lives
301011 b	**Audit Course I: Sustainable Energy Systems**	**1**	To demonstrate an overview of the main sources of renewable energy.
		2	To understand benefits of renewable and sustainable energy systems.

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TE Civil SEM-VI

Course Code	Course Name	COs	Course Outcomes
301012	Waste Water Engineering	1	Recall sanitation infrastructure, quantification and characterization of wastewater, natural purification of streams
		2	Design preliminary and primary unit operations in waste water treatment plant
		3	Understand theory and mechanism of aerobic biological treatment system and to design activated sludge process
		4	Understand and design suspended and attached growth wastewater treatment systems
		5	Explain and apply concept of contaminant removal by anaerobic, tertiary and emerging wastewater treatment systems
		6	Compare various sludge management systems and explain the potential of recycle and reuse of wastewater treatment
301013	Design of Reinforced Concrete Structures	1	Apply relevant IS provisions to ensure safety and serviceability of structures, understand the design philosophies and behavior of materials: steel & concrete.
		2	Recognize mode of failure as per LSM and evaluate moment of resistance for singly, doubly rectangular, and flanged sections.
		3	Design & detailing of rectangular one way and two-way slab with different boundary conditions
		4	Design & detailing of dog legged and open well staircase
		5	Design & detailing of singly/doubly rectangular/flanged beams for flexure, shear, bond and torsion.
		6	Design & detailing of short columns subjected to axial load, uni-axial/bi-axial bending and their footings.
301014	Remote Sensing and Geographic Information System	1	Articulate fundamentals and principles of RS techniques.
		2	Demonstrate the knowledge of remote sensing and sensor characteristics.
		3	Distinguish working of various spaces-based positioning systems.

		4	Analyze the RS data and image processing to utilize in civil engineering
		5	Explain fundamentals and applications of RS and GIS
		6	Acquire skills of data processing and its applications using GIS
301015 a:	**Elective II: Advanced Engineering Geology with Rock Mechanics**	**1**	Illustrate seismic zones, plate tectonics and civil engineering significance of major rock formations of India with their characteristics.
		2	Explain soil profile, geo-hydrological characters of various rock formations and necessity of geological studies in water conservation.
		3	Apply knowledge of geology in Infrastructural, Urban development and demonstrate importance of national wealth.
		4	Validate the suitability of rocks based on mechanical properties, R.Q.D. and geophysical exploration.
		5	Explore subsurface Geology for civil engineering projects to suggest foundation treatments for various geological defects and channel erosion.
		6	Illustrate the suitability of proposed alignments for tunnels and bridges on the basis of Geological investigations.
301015 b	**Elective II: Soft Computing Techniques**	**1**	Understand AI techniques, soft computing techniques and basic concepts Artificial Neural Network
		2	Understand components of ANN, training algorithms and implement the back propagation algorithm
		3	Design the feed forward back propagation neural network.
		4	Understand types of neural networks and their applications
		5	Understand working of genetic algorithm, support vector regressions, model tree and random forest along with their applications
		6	Develop models for time series applications using support vector regressions, model tree and random forest.
301015 c	**Elective II: Advanced Surveying**	**1**	Recognize the concept of triangulation for fixing the ground control points.
		2	Differentiate most probable values for different measurement and adjust those in a given figure.

		3	Summarize the concepts of astronomical and hydrographic surveying.
		4	Demonstrate the use of aerial photographs for mapping.
		5	Analyze use of modern surveying instruments in the field.
		6	Execute GPS and the associated software for different applications in civil engineering.
301015 d	**Elective II: Advanced Geotechnical Engineering**	**1**	Classify the soil and understand the soil structure and role of water in clay.
		2	Calculate lateral pressure on retaining structures and carry out design the retaining structures.
		3	Interpret the results of triaxial tests under different drainage conditions.
		4	Draw the stress paths for different conditions.
		5	Select and implement soil stabilization techniques based on field conditions.
		6	Explain different ground improvement techniques.
301015 e	**Elective II: Architecture and Town Planning**	**1**	Apply the principles of architectural planning and landscaping for improving quality of life
		2	Understand the confronting issues of the area and apply the acts.
		3	Evaluate and defend the proposals.
		4	Appraise the existing condition and to develop the area for betterment.
301015 f	**Elective II: Solid Waste Management**	**1**	Outline solid waste management systems with respect to its generation rate (quantity), sampling, characteristics and regulatory/legal requirements.
		2	Explain and suggest relevant method of storage, collection and transportation of solid waste for the given site condition with justification.
		3	Develop understanding of technological applications for processing and material recovery from solid waste with its economics and design composting system for organic waste.
		4	Describe the fundamental and technological aspects of waste to energy systems from solid waste and to design anaerobic

			digester and incineration system.
		5	Outline the design, operation, and maintenance of sanitary landfill and management of legacy waste.
		6	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.
301016	**Internship**	**1**	To develop professional competence through industry internship
		2	To apply academic knowledge in a personal and professional environment
		3	To build the professional network and expose students to future employees
		4	Apply professional and societal ethics in their day to day life
		5	To become a responsible professional having social, economic and administrative considerations
		6	To become a responsible professional having social, economic and administrative considerations
301021 a	**Audit Course II: Leadership and Personality Development**	**1**	Enhanced holistic development of students and improve their employability skills
301021 b	**Audit Course II: Industrial Safety**	**1**	Analyze the safety problem with its solution

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BE Civil SEM-VII

Course Code	Course Name	COs	Course Outcomes
401001	Foundation Engineering	1	Perform subsurface investigations for foundations using different methods.
		2	Estimate the bearing capacity of shallow foundations.
		3	Calculate immediate and primary consolidation settlement of shallow foundations.
		4	Decide the capacity of a pile and pile group.
		5	Understand the steps in geotechnical design of shallow foundations and well foundations.
		6	Analyze problems related to expansive soil and overcome them using design principles, construction techniques in black cotton soil.
401002	Transportation Engineering	1	Understand principles and practices of transportation planning.
		2	Demonstrate knowledge of traffic studies, analysis and their interpretation.
		3	Design Geometric Elements of road pavement.
		4	Evaluate properties of highway materials as a part of road pavement.
		5	Appraise different types of pavements and their design.
		6	Understand the fundamentals of Bridge Engineering and Railway Engineering
401003 a	Elective III: Coastal Engineering	1	Understand basic of ocean waves including wave generation, classification, propagation, wave theories, wave diffraction, wave refection and wave breaking.
		2	Understand and apply short term and long-term wave analysis.
		3	Understand basic characteristics of tides, tide producing forces, dynamic theory of tides.

		4	(Littoral drift) and estimation of wave induced sediment quantity.
		5	Understand the coastal structures and shore protection methods.
		6	Understand coastal zone management activities, issues related to integrated coastal zone management and regulation of coastal zone.
401 003 b	**Elective III: Advanced Design of Concrete Structures**	**1**	Understand yield line theory and apply it to analyze and design slabs of different shapes having different edge conditions.
		2	Understand the concepts of ductile detailing
		3	Analyze and design of flat slab.
		4	Analyze and design of retaining walls.
		5	Analyze and design of liquid retaining structures.
		6	Analyze and design of RC frames and shear walls.
401 003 c	**Elective III: Integrated Water Resources Planning and Management**	**1**	Understand concerned organizations, IWRP & M objectives, principles, challenges, application & analysis of IWRP&M approaches & principles in a case study.
		2	Understand PIM, WDS, WALMI, agriculture in the concept of integrated water resources, apply and analyse water requirements for food production
		3	Understand assessment of surface and ground water quality, EIA, CPCB regulations, application & analysis of effluent quality standards as per CPCB
		4	Understand water economics and funding, application & analysis of planning for a sustainable water future
		5	Understand legal regulatory settings of IWRP & M, application & analysis of inter-basin water transfers and IWRP & M
		6	Understand flood control & power generation for IWRP & M, application QIGIS for analysis of a basin for IWRP & M
401 003 d	**Elective III: Finite Element Method**	**1**	To understand the basics of solid mechanics prior to learn finite element analysis.
		2	Solve simple Engineering problems using 1D, 2D and 3D elements
		3	Write shape functions of 1D, 2D and 3D elements

		4	Determine the stresses in three dimensional finite elements using isoparametric formulation.
		5	Analyze the truss and beam elements using stiffness matrix and finite element procedure.
		6	Evaluate the forces and stresses in rigid jointed portal frame and grid elements using stiffness matrix and finite element procedure.
401003 e	**Elective: Data Analytics**	**1**	Understand the basic concepts of Statistics and its analysis and applications
		2	Solve the problems related to probability and various probability distributions.
		3	Apply the concept of sampling and distribution and interpret problems using correlation
		4	Analyze and test of hypothesis
		5	Examine and prepare the data and use develop regression
		6	Understand and Apply machine learning algorithms for Regression, Classification and Clustering
401003 f	**Elective III: Operation Research**	**1**	Ccorrelate applications of Operations Research in Civil Engineering field
		2	Solve the problems related to stochastic programming
		3	Optimize transportation and assignment problems
		4	Optimize linear problems
		5	Optimize non-linear problems
		6	Suggest solution for the problems related to dynamic models, games theory and replacement of items
401 004 a	**Elective IV: Air Pollution and Control**	**1**	Recall air pollution, legislation and regulations.
		2	Evaluate air pollutant concentrations as a function of meteorology.
		3	Interpret sampling results with prescribed standards.
		4	Assess emission inventory and air quality models.

		5	Compare the air pollution control equipments.
		6	Infer indoor air pollution and its mitigation.
401 004 b	**Elective IV: Advanced Design of Steel Structures**	**1**	Understand the behavior and design of members subjected to combined forces
		2	Design moment resisting connection
		3	Design component / structure using cold form light gauge section
		4	Design members of truss and scaffolding using tubular section
		5	Design castellated beam
		6	Analyze and design components of industrial structure such as Portal frame and gable frame
401 004 c	**Elective IV: Statistical Analysis and Computational Methods**	**1**	Understand the basic concepts of Statistics and perform statistical data analysis
		2	Understand the concept of probability and fit Binomial, or Poisson or Normal distribution to the given data
		3	Understand concept of sampling and perform chi-square test, z test, Student T test
		4	Perform hypothesis test
		5	Carry out correlation and regression analysis for the given data
		6	Calculate variance and perform K-S test for goodness of fit
401 004 d	**Elective IV: Airport and Bridge Engineering**	**1**	Understand the fundamental of airport.
		2	Understand and design the runway and taxiway and drainage systems.
		3	Understand the BIM, AR and VR in airport planning and pavement design.
		4	Plan the lighting and marking of airport and heliport.
		5	Estimate various components of bridge and loads on bridges.

		6	Study and design of bridge structures.
401004 e	**Elective IV: Design of Prestressed Concrete Structures**	**1**	Know the prestressed members.
		2	Determining the stresses and various losses in prestressed concrete members.
		3	Design the prestressed concrete structures
		4	Design the prestressed concrete slab
		5	Design the prestressed concrete flat slab
		6	Analysis and design the prestressed continuous beams
401004 f	**Elective IV: Formwork and Plumbing Engineering**	**1**	Select appropriate material and type of formwork
		2	Analyze the formwork for various loadings.
		3	Illustrate the design aspects of formwork under various requirements.
		4	Understand requirement of plumbing in a building.
		5	Understand plumbing hydraulics and its components in plumbing system.
		6	Illustrate the design aspects as per the requirement of Indian Standards.
401 005	**Project Stage I**	**1**	Appraise the current Civil Engineering research/techniques/developments/interdisciplinary areas.
		2	Review and organize literature survey utilizing technical resources, journals etc.
		3	Evaluate and draw conclusions related to technical content studied.
		4	Demonstrate the ability to perform critical writing by preparing a technical report.
		5	Develop technical writing and presentation skills.
401 009	**Computer Programming**	**1**	To understand the basics of python programming.

	in Civil Engineering	**2**	To develop Python programs for civil engineering problems
401010	**Audit Course I a Stress Management by Yoga**	**1**	Develop an understanding of workplace codes, professionalism at workplace
		2	Learn the workplace ethics
		3	Develop an understanding of Business ethics, workplace privacy and ethics
		4	Learn teamwork at workplace

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BE Civil SEM-VIII

Course Code	Course Name	COs	Course Outcomes
401011	Dams and Hydraulics Structures	1	Understand types of dams and instrumentation working
		2	Execute stability analysis of Gravity Dam
		3	Understand types of spillways & Design of Ogee spillway
		4	Illustrate the failures and analyze stability of earthen dam
		5	Design Canals and understand the canal structures
		6	Analysis of the Diversion headwork and Cross Drainage work
401012	Quantity Surveying, Contracts and Tenders	1	Understand concept of estimates and prepare approximate estimate for various for Civil Engineering works.
		2	Describe tendering process, construction contracts, and aspects of Arbitration and prepare tender documents.

		3	Prepare detailed estimate of various items of work by different methods and calculate quantity of steel from Bar bending schedule.
		4	Apply engineering knowledge to prepare estimate for roads, culverts, and water tank (Elevated storage tank)
		5	Apply concepts of specification to draft brief specification, detailed specification and prepare detailed rate analysis report.
		6	Evaluate depreciation and valuation of property on the basis of present condition, specifications and market trend
401 013 a	**Elective V: Earthquake Engineering**	**1**	Define the concepts of earthquakes, seismology and vibrations.
		2	Model physical structures and develop equations of motion.
		3	Solve the equations of motion for SDOF systems.
		4	Solve the equations of motion for MDOF systems.
		5	Perform static seismic analysis for buildings.
		6	Perform dynamic seismic analysis for buildings.

401013 b	**Elective V: Structural Design of Bridges**	**1**	Identify loads on bridges and selection of type of bridge for the site condition as per Indian standards.
		2	Design the reinforced concrete deck slab, culvert slab and T beam deck slab for highway bridges.
		3	Analysis and design of reinforced concrete and post tension prestressed concrete girders.
		4	Classify the types of rail bridges and design the plate girder steel bridges
		5	Analyse and design the steel trussed bridges.
		6	Study different types of bearing and thereby design the bearings for reinforced concrete highway bridges.
401013 c	**Elective V: Irrigation and Drainage**	**1**	Summarize types of irrigation methods.
		2	Estimate evapotranspiration and crop-water requirement.
		3	Understand component parts and their design considerations of lift irrigation system.
		4	Design drip and sprinkler irrigation systems.

		5	Understand basics of salt affected soils and estimate leaching requirement.
		6	Design surface and subsurface drainage systems.
401013 d	**Elective V: Design of Precast and Composite Structures**	**1**	Achieve knowledge of design and development of problem solving skills.
		2	Explore the concept of precast construction.
		3	Learn the principles and design of precast structures
		4	Understand the need, advantages and limitations of composite material.
		5	Apply basic mechanical principles in analysis of composite structures like beams, columns, floors, shear connectors.
		6	Understand and apply various provisions as per Indian standards in design of structural components using composite materials.
401013 e	**Elective V: Hydropower Engineering**	**1**	Understand the classification of power resources & trends in energy use patterns.
		2	Identify the components of hydro power plant.

		3	Analyze the load assessment for turbines.
		4	Prepare the layout of power house based on the various structures need for it.
		5	Design the turbines and surge tanks.
		6	Understand the laws and regulatory aspects of hydroelectric power.
401013 f	**Elective V: Structural Audit and Retrofitting of Structures**	**1**	Identify causes of deterioration in RC and steel structures.
		2	Explore entire process of structural audit.
		3	Explore necessity and methods of structural health monitoring.
		4	Explain method of retrofitting for RC, steel and historical structures.
		5	Design retrofitting using FRP for RC column.
		6	Design retrofitting using FRP for RC beams.

401014 a	**Elective VI: TQM and MIS**	**1**	Recognize quality and contribution of quality gurus for evaluation of best practices
		2	Relate the functioning and application of TQM & Six Sigma in the domain of construction sector
		3	Recommend ISO 9001 principles in preparation of quality manual to construction business
		4	Apply management control & certification systems for construction industry
		5	Choose TQM process implementation and various quality awards for construction sector
		6	Propose MIS for allied fields in construction sector
401014 b	**Elective VI: Advanced Transportation Engineering**	**1**	Analyze travel demand model and forecasting.
		2	Evaluate relative importance of various modes and their capacities.
		3	Design facilities required for non-motorized transportation and pedestrians.
		4	Estimate basic characteristics of traffic stream and signal design.

		5	Design flexible pavements.
		6	Design rigid pavements and overlays.
4010 14 c	**Elective VI: Geo-Synthetic Engineering**	**1**	Explain types of Geo-synthetic material and its application in construction industry
		2	Define physical and engineering properties of geo-synthetics material
		3	Describe function of geo-synthetics material and its application in geo environment engineering
		4	Analyse effect of geo-synthetics in design of flexible pavements
		5	Design the reinforced soil retaining structures
		6	Explain mechanism of soil reinforcement to improve bearing capacity of soil
401 014 d	**Elective VI: Structural Design of Foundations**	**1**	Judge suitable type of shallow foundation based on the available soil category.
		2	Decide suitable type of pile foundation for different soil stratum and evaluation of group capacity by formulation.

		3	Design Raft foundations.
		4	Design well and caissons Foundations.
		5	Design different types of Machine foundations.
		6	Design Retaining Structures.
401014 e	**Elective VI: Green Structures and Smart Cities**	**1**	Students should be able to describe the importance of energy and minimization by altering the building materials.
		2	Students should be able to understand the importance green construction and green rating system
		3	Students should be able to introduce the applications of energy conservation and efficiency practices in buildings.
		4	Students should be able to understand phases and approval involved in smart city project.
		5	Students should be able to assess the national and global experience of smart cities.
		6	Students should be able to understand the importance of sustainable development and current protocol of sustainable development goals.

401014 f	**Elective VI: Rural Water Supply Engineering**	**1**	Understand issues related to rural water supply with respect to source, water related issues in rural areas.
		2	Understand role of various government departments and importance of participatory approach.
		3	Understand various types of rural water supply scheme and infrastructure requirements therein.
		4	Understand interdisciplinary requirements in RWS including Software
		5	Understand Automation requirements for a Water Supply Project
		6	Understand Documentation and O and M issues related Water Supply Project including Leak Detection.
401 015	**Project Stage II**	**1**	Appraise the current Civil Engineering research/techniques/developments/interdisciplinary areas.
		2	Review and organize literature survey utilizing technical resources, journals etc.
		3	Review and organize literature survey utilizing technical resources, journals etc.
		4	Demonstrate the ability to perform critical writing by preparing a technical report.
		5	Develop technical writing and presentation skills.

401019	**Audit Course II a: Social Responsibility**	**1**	Develop understanding of social responsibility
		2	Learn the International framework for Social Responsibility
		3	Know the drivers of social responsibility in India
		4	Identify the key stakeholders of social responsibility
	Audit Course II b: Human Rights	**1**	Gather Knowledge about Human rights and Human rights Movement
		2	Develop understanding of Human rights and Indian Constitution
		3	Discuss Human Rights of the Different Sections and contemporary issues
		4	Discuss International scenario towards human rights with reference to engineering Industry