



Sri Shridevi Charitable Trust (R.)

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(Approved by AICTE, New Delhi, Recognised by Govt. of Karnataka and Affiliated to Visvesvaraya Technological University, Belagavi)

ESTD: 2002



COURSE CONTENT AND OUTCOMES OF CIVIL ENGINEERING (Effective from Academic year 2018-19)

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

STRENGTH OF MATERIALS

Course Code	18CV32	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:2:0)	SEE Marks	60
Credits	04	Exam Hours	03

Course Learning Objectives: This course will enable students

1. To understand the basic concepts of the stresses and strains for different materials and strength of structural elements.
2. To know the development of internal forces and resistance mechanism for one dimensional and two-dimensional structural elements.
3. To analyse and understand different internal forces and stresses induced due to representative loads on structural elements.
4. To determine slope and deflections of beams.
5. To evaluate the behaviour of torsion members, columns and struts.

Module-1

Simple Stresses and Strain: Introduction, Definition and concept and of stress and strain. Hooke's law, Stress-Strain diagrams for ferrous and non-ferrous materials, factor of safety, Elongation of tapering bars of circular and rectangular cross sections, Elongation due to self-weight. Saint Venant's principle, Compound bars, Temperature stresses, Compound section subjected to temperature stresses, state of simple shear, Elastic constants and their relationship.

Module-2

Compound Stresses: Introduction, state of stress at a point, General two dimensional stress system, Principal stresses and principal planes. Mohr's circle of stresses. Theory of failures: Max. Shear stress theory and Max. principal stress theory.

Thin and Thick Cylinders: Introduction, Thin cylinders subjected to internal pressure; Hoop stresses, Longitudinal stress and change in volume. Thick cylinders subjected to both internal and external pressure; Lamé's equation, radial and hoop stress distribution.

Module-3

Shear Force and Bending Moment in Beams: Introduction to types of beams, supports and loadings. Definition of bending moment and shear force, Sign conventions, relationship between load intensity, bending moment and shear force. Shear force and bending moment diagrams for statically determinate beams subjected to point load, uniformly distributed loads, uniformly varying loads, couple and their combinations.

Module-4

Bending and Shear Stresses in Beams: Introduction, pure bending theory, Assumptions, derivation of bending equation, modulus of rupture, section modulus, flexural rigidity. Expression for transverse shear stress in beams, Bending and shear stress distribution diagrams for circular, rectangular, 'I', and 'T' sections. Shear centre (only concept).

Torsion in Circular Shaft: Introduction, pure torsion, Assumptions, derivation of torsion equation for circular shafts, torsional rigidity and polar modulus Power transmitted by a shaft.

Module-5

Deflection of Beams: Definition of slope, Deflection and curvature, Sign conventions, Derivation of moment-curvature equation. Double integration method and Macaulay's method: Slope and deflection for standard loading cases and for determinate prismatic beams subjected to point loads, UDL, UVL and couple.

Columns and Struts: Introduction, short and long columns. Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory. Rankine-Gordon's formula for columns.

Course outcomes After studying this course, students will be able;

1. To evaluate the basic concepts of the stresses and strains for different materials and strength of structural elements.
2. To evaluate the development of internal forces and resistance mechanism for one dimensional and two dimensional structural elements.
3. To analyse different internal forces and stresses induced due to representative loads on structural elements.
4. To evaluate slope and deflections of beams.
5. To evaluate the behaviour of torsion members, columns and struts.

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

FLUIDS MECHANICS

Course Code	18CV33	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: The objectives of this course is to make students to learn:

1. The Fundamental properties of fluids and its applications.
2. Hydrostatic laws and application to solve practical problem.
3. Principles of Kinematics and Hydrodynamics for practical applications.
4. Basic design of pipes and pipe networks considering flow, pressure and its losses.
5. The basic flow rate measurements.

Module-1

Fluids & Their Properties: Concept of fluid, Systems of units. Properties of fluid; Mass density, Specific weight, Specific gravity, Specific volume, Viscosity, Newton's law of viscosity (theory & problems), Cohesion, Adhesion, Surface tension, Pressure inside a water droplet, soap bubble and liquid jet. Numerical problems, & Capillarity. Capillary rise in a vertical tube and between two plane surfaces (theory & problems). Vapor pressure of liquid, compressibility and bulk modulus, Fluid as a continuum,

Fluid Pressure and Its Measurements: Definition of pressure, Pressure at a point, Pascal's law, Variation of pressure with depth. Types of pressure. Measurement of pressure using simple, differential & inclined manometers (theory & problems). Introduction to Mechanical and electronic pressure measuring devices.

Module-2

Hydrostatic forces on Surfaces: Definition, Total pressure, centre of pressure, total pressure on horizontal, vertical and inclined plane surface, total pressure on curved surfaces, water pressure on gravity dams, Lock gates. Numerical Problems.

Fundamentals of fluid flow (Kinematics): Introduction. Methods of describing fluid motion. Velocity and Total acceleration of a fluid particle. Types of fluid flow, Description of flow pattern. Basic principles of fluid flow, three- dimensional continuity equation in Cartesian coordinate system. Derivation for Rotational and irrotational motion. Potential function, stream function, orthogonality of streamlines and equipotential lines. Numerical problems on Stream function and velocity potential. Introduction to flow net.

Module-3

Fluid Dynamics: Introduction. Forces acting on fluid in motion. Euler's equation of motion along a streamline and Bernoulli's equation. Assumptions and limitations of Bernoulli's equation. Modified Bernoulli's equation. Problems on applications of Bernoulli's equation (with and without losses). Momentum equation problems on pipe bends.

Applications: Introduction. Venturi meter, Orifice meter, Pitot tube. Numerical Problems.

Module-4

Orifice and Mouth piece: Introduction, classification, flow through orifice, hydraulic coefficients and Numerical problems. Mouthpiece, classification, Borda's Mouthpiece (No problems).

Notches and Weirs: Introduction. Classification, discharge over rectangular, triangular, trapezoidal notches, Cippoletti notch, broad crested weirs. Numerical problems. Ventilation of weirs, submerged weirs.

Module-5

Flow through Pipes: Introduction. Major and minor losses in pipe flow. Darcy- Weis bach equation for head loss due to friction in a pipe. Pipes in series, pipes in parallel, equivalent pipe-problems. Minor losses in pipe flow, equation for head loss due to sudden expansion. Numerical problems. Hydraulic gradient line, energy gradient line. Numerical problems, .Pipe Networks, Hardy Cross method (No problems on pipe networks),

Surge Analysis in Pipes: Water hammer in pipes, equations for pressure rise due to gradual valve closure and sudden closure for rigid and elastic pipes. Problems.

Course outcomes: After successful completion of the course, the student will be able to:

1. Possess a sound knowledge of fundamental properties of fluids and fluid Continuum
2. Compute and solve problems on hydrostatics, including practical applications
3. Apply principles of mathematics to represent kinematic concepts related to fluid flow
4. Apply fundamental laws of fluid mechanics and the Bernoulli's principle for practical applications
5. Compute the discharge through pipes and over notches and weirs

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - III			
BUILDING MATERIALS AND CONSTRUCTION			
Course Code	18CV34	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
<p>Course Learning Objectives: This course will develop a student;</p> <ol style="list-style-type: none"> 1. To recognize good construction materials based on properties. 2. To investigate soil properties and design suitable foundation. 3. To understand the types and properties of masonry materials and supervise masonry construction. 4. To gain knowledge of structural components like lintels, arches, staircase and roofs. 5. To understand the finishes in construction like flooring, plastering, painting. 			
Module-1			
<p>Building Materials: Stone as building material; Requirement of good building stones, Dressing of stones, Deterioration and Preservation of stone work. Bricks; Classification, Manufacturing of clay bricks, Requirement of good bricks. Field and laboratory tests on bricks; compressive strength, water absorption, efflorescence, dimension and warpage.</p> <p>Cement Concrete blocks, Autoclaved Aerated Concrete Blocks, Sizes, requirement of good blocks.</p> <p>Timber as construction material.</p> <p>Fine aggregate: Natural and manufactured: Sieve analysis, zoning, specific gravity, bulking, moisture content, deleterious materials.</p> <p>Coarse aggregate: Natural and manufactured: Importance of size, shape and texture. Grading of aggregates, Sieve analysis, specific gravity, Flakiness and elongation index, crushing, impact and abrasion tests.</p>			
Module-2			
<p>Foundation: Preliminary investigation of soil, safe bearing capacity of soil, Function and requirements of good foundation , types of foundation , introduction to spread, combined , strap, mat and pile foundation</p> <p>Masonry: Definition and terms used in masonry. Brick masonry, characteristics and requirements of good brick masonry, Bonds in brick work, Header, Stretcher, English, Flemish bond, Stone masonry, Requirements of good stone masonry, Classification, characteristics of different stone masonry, Joints in stone masonry. Types of walls; load bearing, partition walls, cavity walls.</p>			
Module-3			
<p>Lintels and Arches: Definition, function and classification of lintels, Balconies, chejja and canopy. Arches; Elements and Stability of an Arch.</p> <p>Floors and roofs: Floors; Requirement of good floor, Components of ground floor, Selection of flooring material Procedure for laying of Concrete (VDF), Mosaic, Kota, Slate, Marble, Granite, Tile flooring, Cladding of tiles.</p> <p>Roof: Requirement of good roof, Types of roof, Elements of a pitched roof, Trussed roof, King post Truss, Queen Post Truss, Steel Truss, Different roofing materials, R.C.C. Roof.</p>			
Module-4			
<p>Doors, Windows and Ventilators: Location of doors and windows, technical terms, Materials for doors and windows: PVC, CPVC and Aluminum. Types of Doors and Windows: Paneled, Flush, Collapsible, Rolling shutter, Paneled and glazed Window, Bay Window, French window. Steel windows, Ventilators. Sizes as per IS recommendations.</p> <p>Stairs: Definitions, technical terms and types of stairs: Wood, RCC, Metal. Requirements of good stairs. Geometrical design of RCC doglegged and open-well stairs.</p> <p>Formwork: Introduction to form work, scaffolding, shoring, under pinning.</p>			
Module-5			

Plastering and Pointing: Mortar and its types. Purpose, materials and methods of plastering and pointing: Sand faced plastering, Stucco plastering, lathe plastering, defects in plastering . Water proofing with various thicknesses.

Damp proofing- causes, effects and methods.

Paints- Purpose, types, technical terms, ingredients and defects, Preparation and applications of paints to new and old plastered surfaces, wooden and steel surfaces.

Course outcomes After a successful completion of the course, the student will be able to:

1. Select suitable materials for buildings and adopt suitable construction techniques.
2. Decide suitable type of foundation based on soil parameters
3. Supervise the construction of different building elements based on suitability
4. Exhibit the knowledge of building finishes and form work requirements

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER – III
BASIC SURVEYING

Course Code	18CV35	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to;

1. Understand the basic principles of Surveying
2. Learn Linear and Angular measurements to arrive at solutions to basic surveying problems.
3. Employ conventional surveying data capturing techniques and process the data for computations.
4. Analyze the obtained spatial data to compute areas and volumes and draw contours to represent 3D data on plane figures.

Module-1

Introduction: Definition of surveying, Objectives and importance of surveying. Classification of surveys. Principles of surveying. Units of measurements, Surveying measurements and errors, types of errors, precision and accuracy. Classification of maps, map scale, conventional symbols, topographic maps, map layout, Survey of India Map numbering systems.

Measurement of Horizontal Distances: Measuring tape and types. Measurement using tapes, Taping on level ground and sloping ground. Errors and corrections in tape measurements, ranging of lines, direct and indirect methods of ranging, Electronic distance measurement, basic principle. Booking of tape survey work, Field book, entries, Conventional symbols, Obstacles in tape survey, Numerical problems.

Module-2

Measurement of Directions and Angles: Compass survey: Basic definitions; meridians, bearings, magnetic and True bearings. Prismatic and surveyor's compasses, temporary adjustments, declination. Quadrantal bearings, whole circle bearings, local attraction and related problems

Traversing: Traverse Survey and Computations: Latitudes and departures, rectangular coordinates, Traverse adjustments, Bowditch rule and transit rule, Numerical Problems.

Module-3

Leveling: Basic terms and definitions, Methods of leveling, Dumpy level, auto level, digital and laser levels. Curvature and refraction corrections. Booking and reduction of levels. Differential leveling, profile leveling, fly leveling, check leveling, reciprocal leveling.

Module-4

Plane Table Surveying: Plane table and accessories, Advantages and limitations of plane table survey, Orientation and methods of orientation, Methods of plotting – Radiation, Intersection, Traversing, Resection method, Two point and three point problems, Solution to two point problem by graphical method, Solution to three point problem Bessel's graphical method, Errors in plane table survey.

Module-5

Areas and Volumes: Measurement of area by dividing the area into geometrical figures, area from offsets, mid ordinate rule, trapezoidal and Simpson's one third rule, area from co-ordinates, introduction to planimeter, digital planimeter. Measurement of volumes- trapezoidal and prismatic formula.

Contouring: Contours, Methods of contouring, Interpolation of contours, contour gradient, characteristics of contours and uses.

Course outcomes: After a successful completion of the course, the student will be able to:

1. Posses a sound knowledge of fundamental principles Geodetics
2. Measurement of vertical and horizontal plane, linear and angular dimensions to arrive at solutions to basic surveying problems.
3. Capture geodetic data to process and perform analysis for survey problems]
4. Analyse the obtained spatial data and compute areas and volumes. Represent 3D data on plane figures as contours

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

ENGINEERING GEOLOGY

Course Code	18CV36	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students;

1. To inculcate the importance of earth's interior and application of Geology in civil engineering. Attempts are made to highlight the industrial applications of minerals.
2. To create awareness among Civil engineers regarding the use of rocks as building materials.
3. To provide knowledge on dynamic Geology and its importance in modifying the physical character of rocks which cause rocks suitable or unsuitable in different civil engineering projects such as Dams, bridges, tunnels and highways.
4. To educate the ground water management regarding diversified geological formations, climatologically dissimilarity which are prevailed in the country. To highlight the concept of rain water harvesting.
5. To understand the application of Remote Sensing and GIS, Natural disaster and management and environmental awareness.

Module-1

Introduction: Application of Geology in Civil Engineering Practices, Understanding the earth, internal structure and composition.

Mineralogy: Mineral properties, composition and their use in the manufacture of construction materials – Quartz Group (Glass); Feldspar Group (Ceramic wares and Flooring tiles); Kaolin (Paper, paint and textile); Asbestos (AC sheets); Carbonate Group (Cement); Gypsum (POP, gypsum sheets, cement); Mica Group (Electrical industries); Ore minerals - Iron ores (Steel); Chro mite (Alloy); Bauxite (aluminum); Chalcopryite (copper).

Module-2

Petrology & Geomorphology: Formation, Classification and Engineering Properties of: **Igneous rocks**-Types of Granite, Dolerite, Basalt, Pumice, Granite Porphyry. **Sedimentary Rocks**- Sandstone, Limestone, Shale, Late rite, Conglomerate. **Metamorphic Rocks**- Gneiss, Slate, Muscovite & Biotite schist, Marble, Quartzite. Rock weathering: types and their effects on Civil Engineering Projects. Landforms, Drainage pattern and types. Soil formation and soil profile. The apprehension of Index properties of rocks: Porosity, Density, Permeability, and Durability. Selection of rocks as materials for construction, as a foundation, Decorative, Flooring, and Roofing, Concrete Aggregate, Road Metal, Railway Ballast with examples.

Module-3

Structural Geology & Rock Mechanics: Structural aspects of rocks like Outcrop, Dip and strike, Folds, Faults, Joints, Unconformities and their influence on Engineering Projects/structures like dam, tunnels, slope treatment; ground improvement, recognition of the structures in field and their types/classification. Rock Quality Determination (RQD) & Rock Structure Rating (RSR). Geological site characterization: Dam foundations and rock Foundation treatment for dams and Reservoirs heavy structures by grouting and rock reinforcement. Tunnels: Basic terminology and application, site investigations, Coastlines and their engineering considerations.

Module-4

Hydrogeology: Hydrological cycle, Vertical distribution of groundwater, artesian groundwater in soil and rock. Water Bearing Formations, Aquifer and its types – Aquitard, Aquifuge, and Aquiclude. Porosity, Specific yield and retention, Permeability, Transmissibility and Storage Coefficient. Determination of Quality - SAR, RSC and TH of Groundwater. Groundwater Exploration- Electrical Resistivity and Seismic methods, Artificial Recharge of Groundwater, Rain water harvesting and methods, Seawater intrusion in coastal areas and remedies. Groundwater Pollution. Floods and its control, Cyclone and its effects.

Module-5

Seismology and Geodesy: Earthquake - Causes and Effects, Seismic waves, engineering problems related to Earthquakes, Earthquake intensity, Richter scale, Seismograph, Seismic zones- World and India. Tsunami causes and effects, Volcanic Eruptions. Landslides (Mass movements) causes, types and remedial measures –stability assessment for soil and rock slopes. Study of Topographic maps and Contour maps; Remote Sensing – Concept, Application and its Limitations; Geographic Information System (GIS) and Global Positioning System (GPS) –

Concept and their use resource mapping. Aerial Photography, LANDSAT Imagery – Definition and its use. Impact of Mining, Quarrying and Reservoirs on Environment. Natural Disasters and their mitigation

Course outcomes: After a successful completion of the course, the student will be able to:

1. Apply geological knowledge in different civil engineering practice.
2. Students will acquire knowledge on durability and competence of foundation rocks, and confidence enough to use the best building materials.
3. Civil Engineers are competent enough for the safety, stability, economy and life of the structures that they construct.
4. Able to solve various issues related to ground water exploration, build up dams, bridges, tunnels which are often confronted with ground water problems.
5. Intelligent enough to apply GIS, GPS and remote sensing as a latest tool in different civil engineering construction.

.E.(Common to all Programmes) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER - IV			
COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS (Common to all Programmes) [As per Choice Based Credit System (CBCS) scheme]			
Course Code	18MAT41	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	3	Exam Hours	03
Course Learning Objectives:			
<ul style="list-style-type: none"> To provide an insight into applications of complex variables, conformal mapping and special functions arising in potential theory, quantum mechanics, heat conduction and field theory. To develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, design engineering and microwave engineering. 			
Module-1			
Calculus of complex functions: Review of function of a complex variable, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences. Construction of analytic functions: Milne-Thomson method-Problems.			
Module-2			
Conformal transformations: Introduction. Discussion of transformations: $w = z^2$, $w = e^z$, $w = z + \frac{1}{z}$, $\left(\frac{\bar{z}}{z} \neq 0\right)$. Bilinear transformations- Problems.			
Complex integration: Line integral of a complex function-Cauchy's theorem and Cauchy's integral formula and problems.			
Module-3			
Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions- problems (No derivation for mean and standard deviation)-Illustrative examples.			
Module-4			
Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form- $y = ax + b$, $y = ax^b$ & $y = ax^2 + bx + c$.			
Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation- problems. Regression analysis- lines of regression –problems.			
Module-5			
Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation and covariance.			
Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.			
Course outcomes: At the end of the course the student will be able to:			
<ul style="list-style-type: none"> CO1: Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory. CO2: Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing. CO3: Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field. CO4: Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data. CO5: Construct joint probability distributions and demonstrate the validity of testing the hypothesis. 			

B. E. CIVIL ENGINEERING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV
ANALYSIS OF DETERMINATE STRUCTURES

Course Code	18CV42	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:2:0)	SEE Marks	60
Credits	04	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. To understand different forms of structural systems.
2. To understand concept of ILD and moving loads.
3. To determine slopes and deflections of beams and trusses.
4. To analyse arches and cables.

Module-1

Introduction and Analysis of Plane Trusses: Structural forms, Conditions of equilibrium, Compatibility conditions, Degree of freedom, Linear and non linear analysis, Static and kinematic indeterminacies of structural systems.

Influence Lines: Concepts of influence lines-ILD for reactions, SF and BM for determinate beams-ILD for axial forces in determinate trusses and numerical problems.

Module-2

Moving Loads: Reactions, BM and SF in determinate beams, axial forces in determinate trusses for rolling loads using ILD (Max. values and absolute max. values for beams subjected to multiple loads).

Module-3

Deflection of Beams: Moment area method: Derivation, Mohr's theorems, Sign conventions, Application of moment area method for determinate prismatic beams, Beams of varying section, Use of moment diagram by parts. Conjugate beam method: Real beam and conjugate beam, conjugate beam theorems, Application of conjugate beam method of determinate beams of variable cross sections

Module-4

Energy Principles and Energy Theorems: Principle of virtual displacements, Principle of virtual forces, Strain energy and complimentary energy, Strain energy due to axial force, bending, shear and torsion, Deflection of determinate beams and trusses using total strain energy, Deflection at the point of application of single load, Castiglino's theorems and its application to estimate the deflections of trusses, bent frames, Special applications-Dummy unit load method.

Module-5

Arches and Cable Structures: Three hinged parabolic and circular arches with supports at the same and different levels. Determination of normal thrust, radial shear and bending moment. Analysis of cables under point loads and UDL. Length of cables for supports at same and at different levels- Stiffening trusses for suspension cables.

Course Outcomes: After studying this course, students will be able to:

1. Identify different forms of structural systems.
2. Construct ILD and analyse the beams and trusses subjected to moving loads
3. Understand the energy principles and energy theorems and its applications to determine the deflections of trusses and beams.
4. Determine the stress resultants in arches and cables.

CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER - IV

APPLIED HYDRAULICS

Course Code	18CV43	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: The objectives of this course is to make students to learn:

1. Principles of dimensional analysis to design hydraulic models and Design of various models.
2. Design the open channels of various cross sections including design of economical sections.
3. Energy concepts of fluid in open channel, Energy dissipation, Water surface profiles at different conditions.
4. The working principles of the hydraulic machines for the given data and analyzing the performance of Turbines for various design data.

Module-1

Dimensional analysis: Dimensional analysis and similitude: Dimensional homogeneity, Non Dimensional parameter, Rayleigh methods and Buckingham π theorem, dimensional analysis, choice of variables, examples on various applications. **Model analysis:** Model analysis, similitude, types of similarities, force ratios, similarity laws, model classification, Reynolds model, Froude's model, Euler's Model, Webber's model, Mach model, scale effects, Distorted models. Numerical problems on Reynolds's, and Froude's Model

Buoyancy and Flotation: Buoyancy, Force and Centre of Buoyancy, Meta centre and Meta centric height, Stability of submerged and floating bodies, Determination of Meta centric height, Experimental and theoretical method, Numerical problems.

Module-2

Open Channel Flow Hydraulics: Uniform Flow: Introduction, Classification of flow through channels, Chezy's and Manning's equation for flow through open channel, Most economical channel sections, Uniform flow through Open channels, Numerical Problems. Specific Energy and Specific energy curve, Critical flow and corresponding critical parameters, Numerical Problems

Module-3

Non-Uniform Flow: Hydraulic Jump, Expressions for conjugate depths and Energy loss, Numerical Problems Gradually varied flow, Equation, Back water curve and afflux, Description of water curves or profiles, Mild, steep, critical, horizontal and adverse slope profiles, Numerical problems on identifying the flow profiles

Module-4

Impact of jet on Curved vanes: Introduction, Impulse-Momentum equation. Direct impact of a jet on stationary and moving curved vanes, Introduction to concept of velocity triangles, impact of jet on a series of curved vanes- Problems.

Turbines – Impulse Turbines: Introduction to turbines, General lay out of a hydro- electric plant, Heads and Efficiencies, classification of turbines. Pelton wheel- components, working principle and velocity triangles. Maximum power, efficiency, working proportions – Numerical problems.

Module-5

Reaction Turbines and Pumps: Radial flow reaction turbines: (i) Francis turbine- Descriptions, working proportions and design, Numerical problems. (ii) Kaplan turbine- Descriptions, working proportions and design, Numerical problems. Draft tube theory and unit quantities. (No problems)

Centrifugal pumps: Components and Working of centrifugal pumps, Types of centrifugal pumps, Work done by the impeller, Heads and Efficiencies, Minimum starting speed of centrifugal pump, Numerical problems, Multi-stage pumps.

Course outcomes: After a successful completion of the course, the student will be able to:

1. Apply dimensional analysis to develop mathematical modeling and compute the parametric values in prototype by analyzing the corresponding model parameters
2. Design the open channels of various cross sections including economical channel sections
3. Apply Energy concepts to flow in open channel sections, Calculate Energy dissipation.
4. Compute water surface profiles at different conditions
5. Design turbines for the given data, and to know their operation characteristics under different operating conditions

CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - IV

CONCRETE TECHNOLOGY

Course Code	18CV44	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to:

1. To recognize material characterization of ingredients of concrete and its influence on properties of concrete
2. Proportion ingredients of Concrete to arrive at most desirable mechanical properties of Concrete.
3. Ascertain and measure engineering properties of concrete in fresh and hardened state which meet the requirement of real time structures.

Module-1

Concrete Ingredients Cement – Cement manufacturing process, steps to reduce carbon footprint, chemical composition and their importance, hydration of cement, types of cement. Testing of cement. Fine aggregate: Functions, requirement, Alternatives to River sand, M-sand introduction and manufacturing. Coarse aggregate: Importance of size, shape and texture. Grading and blending of aggregate. Testing on aggregate, requirement. Recycled aggregates Water – qualities of water. Chemical admixtures – plasticizers, accelerators, retarders and air entraining agents. Mineral admixtures – Pozzolan and cementitious materials, Fly ash, GGBS, silica fumes, Metakaolin and rice huskash.

Module-2

Fresh Concrete Workability-factors affecting workability. Measurement of workability–slump, Compaction factor and Vee-Bee Consistometer tests, flow tests. Segregation and bleeding. Process of manufacturing of concrete- Batching, Mixing, Transporting, Placing and Compaction. Curing – Methods of curing – Water curing, membrane curing, steam curing, accelerated curing, self- curing. Good and Bad practices of making and using fresh concrete and Effect of heat of hydration during mass concreting at project sites.

Module-3

Hardened Concrete Factors influencing strength, W/C ratio, gel/space ratio, Maturity concept, Testing of hardened concrete, Creep –factors affecting creep. Shrinkage of concrete – plastic shrinking and drying shrinkage, Factors affecting shrinkage. Definition and significance of durability. Internal and external factors influencing durability, Mechanisms- Sulphate attack – chloride attack, carbonation, freezing and thawing. Corrosion, Durability requirements as per IS-456, In situ testing of concrete- Penetration and pull out test, rebound hammer test, ultrasonic pulse velocity, core extraction – Principal, applications and limitations.

Module-4

Concrete Mix Proportioning

Concept of Mix Design with and without admixtures, variables in proportioning and Exposure conditions, Selection criteria of ingredients used for mix design, Procedure of mix proportioning. Numerical Examples of Mix Proportioning using IS-10262:2019.

Module-5

Special Concretes

RMC- manufacture and requirement as per QCI-RMCPCS, properties, advantages and disadvantages. Self-Compacting concrete- concept, materials, tests, properties, application and typical mix Fiber reinforced concrete - Fibers types, properties, application of FRC. Light weight concrete-material properties and types. Typical light weight concrete mix and applications, materials, requirements, mix proportion and properties of Geo polymer Concrete, High Strength Concrete and High Performance Concrete.

Course outcomes: After studying this course, students will be able to:

1. Relate material characteristics and their influence on microstructure of concrete.
2. Distinguish concrete behavior based on its fresh and hardened properties.
3. Illustrate proportioning of different types of concrete mixes for required fresh and hardened properties using professional codes.
4. Adopt suitable concreting methods to place the concrete based on requirement.
5. Select a suitable type of concrete based on specific application.

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - IV

ADVANCED SURVEYING

Course Code	18CV45	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Objectives: This course will enable students to

1. Apply geometric principles to arrive at solutions to surveying problems.
2. Analyze spatial data using appropriate computational and analytical techniques.
3. Design proper types of curves for deviating type of alignments.
4. Use the concepts of advanced data capturing methods necessary for engineering practice

Module-1

Theodolite Survey and Instrument Adjustment: Theodolite and types, Fundamental axes and parts of Transit theodolite, uses of theodolite, Temporary adjustments of transit theodolite, measurement of horizontal and vertical angles, step by step procedure for obtaining permanent adjustment of Transit theodolite.

Trigonometric Levelling: Trigonometric leveling (heights and distances-single plane and double plane methods).

Module-2

Tacheometry: Basic principle, types of tacheometry, distance equation for horizontal and inclined line of sight in fixed hair method, problems.

Geodetic Surveying: Principle and Classification of triangulation system, Selection of base line and stations, Orders of triangulation, Triangulation figures, Reduction to Centre, Selection and marking of stations.

Module-3

Curve Surveying:

Curves – Necessity – Types, Simple curves, Elements , Designation of curves, Setting out simple curves by linear methods (numerical problems on offsets from long chord & chord produced method), Setting out curves by Rankines deflection angle method (Numerical problems). Compound curves, Elements, Design of compound curves, Setting out of compound curves (numerical problems). Reverse curve between two Parallel straights (numerical problems on Equal radius and unequal radius). Transition curves Characteristics, numerical problems on Length of Transition curve, Vertical curves & Types – (theory).

Module-4

Aerial Photogrammetry

Introduction, Uses, Aerial photographs, Definitions, Scale of vertical and tilted photograph (simple problem) Ground Co-ordinates (simple problems), Relief Displacements (Derivation), Ground control, Procedure of ae survey, overlaps and mosaics, Stereoscopes, Derivation Parallax.

Module-5

Modern Surveying Instruments

Introduction, Electromagnetic spectrum, Electromagnetic distance measurement, Total station, Lidar scanners for topographical survey.

Remote Sensing: Introduction, Principles of energy interaction in atmosphere and earth surface features, Image interpretation techniques, visual interpretation. Digital image processing, Global Positioning system

Geographical Information System: Definition of GIS, Key Components of GIS, Functions of GIS, Spatial data, spatial information system Geospatial analysis, Integration of Remote sensing and GIS and Applications in Civil Engineering(transportation, town planning).

Course outcomes: After a successful completion of the course, the student will be able to:

1. Apply the knowledge of geometric principles to arrive at surveying problems
2. Use modern instruments to obtain geo-spatial data and analyse the same to appropriate engineering problems.
3. Capture geodetic data to process and perform analysis for survey problems with the use of electronic instruments;
4. Design and implement the different types of curves for deviating type of alignments.

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - IV

WATER SUPPLY AND TREATMENT ENGINEERING

Course Code	18CV46	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. Analyze the variation of water demand and to estimate water requirement for a community.
2. Evaluate the sources and conveyance systems for raw and treated water.
3. Study drinking water quality standards and to illustrate qualitative analysis of water.
4. Design physical, chemical and biological treatment methods to ensure safe and potable water Supply.

Module -1

Introduction: Need for protected water supply. Demand of Water: Types of water demands -domestic demand, industrial, institutional and commercial, public use, fire demand estimation, factors affecting per capita demand, Variations in demand of water, Peak factor.

Design period and factors governing design period. Methods of population forecasting and numerical problems

Module -2

Water Treatment: Objectives, Unit flow diagrams – significance of each unit: Sources and Characteristics of surface and subsurface sources and Suitability. Sampling : Objectives, methods and preservation techniques. Drinking water quality standards as per BIS. Effect of water quality parameters.

Intake structures – types. Factors to be considered in selection of site for intake structures. Aeration process, limitations, types and two film theory.

Module -3

Sedimentation -theory, settling tanks, types and design. Coagulation and flocculation, Clariflocculators (circular and rectangular). theory, types of coagulants, coagulant feeding devices. Jar test apparatus and estimation of coagulants.

Filtration: mechanism, theory of filtration, types of filters: slow sand, rapid sand and pressure filters. Operation, cleaning. Operational problems in filters. Design of slow and rapid sand filter without under drainage system

Module -4

Disinfection: Theory of disinfection. Methods of disinfection with merits and demerits. Chlorination: Break point chlorination and determination of chlorine demand. Estimation of quantity bleaching powder.

Miscellaneous treatment Process: Softening: Lime soda and Zeolite process. Estimation of Hardness. Fluoridation and De-fluoridation, Nalagonda Technique. RO and Nano filtration process with merits and demerits.

Module -5

Collection and Conveyance of water: Types of pumps with working principles and numerical Problems. Design of the economical diameter for the rising main.

Pipe appurtenances, Valves, Fire hydrants and different Pipe materials with their advantages and disadvantages. Factors affecting selection of pipe material.

Distribution system: Methods: Gravity, Pumping and Combined gravity and pumping system. Types of Distribution system. Service reservoirs and their capacity determination plant units and distribution system with population forecasting for the given city.

Course Outcomes: After studying this course, students will be able to:

1. Estimate average and peak water demand for a community.
2. Evaluate available sources of water, quantitatively and qualitatively and make appropriate choice for a community.
3. Evaluate water quality and environmental significance of various parameters and plan suitable treatment system.
4. Design a comprehensive water treatment and distribution system to purify and distribute water to the required quality standards.

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - V			
CONSTRUCTION MANAGEMENT AND ENTREPRENEURSHIP			
Course Code	18CV51	CIE Marks	40
Teaching Hours/Week(L:T:P)	(2:2:0)	SEE Marks	60
Credits	03	Exam Hours	03
<p>Course Learning Objectives: This course will enable students to</p> <ol style="list-style-type: none"> 1. Understand the concept of planning, scheduling, cost and quality control, safety during construction, organization and use of project information necessary for construction project. 2. Inculcate Human values to grow as responsible human beings with proper personality. 3. Keep up ethical conduct and discharge professional duties. 			
Module -1			
<p>Management: Characteristics of management, functions of management, importance and purpose of planning process, types of plans.</p> <p>Construction Project Formulation: Introduction to construction management, project organization, management functions, management styles.</p> <p>Construction Planning and Scheduling: Introduction, types of project plans, work breakdown structure, Grant Chart, preparation of network diagram- event and activity based and its critical path-critical path method, PERT method, concept of activity on arrow and activity on node.</p>			
Module -2			
<p>Resource Management: Basic concepts of resource management, class of labour, Wages & statutory requirement, Labour Production rate or Productivity, Factors affecting labour output or productivity.</p> <p>Construction Equipments: classification of construction equipment, estimation of productivity for: excavator, dozer, compactors, graders and dumpers. Estimation of ownership cost, operational and maintenance cost of construction equipments. Selection of construction equipment and basic concept on equipment maintenance</p> <p>Materials: material management functions, inventory management.</p>			
Module -3			
<p>Construction Quality , safety and Human Values:</p> <p>Construction quality process, inspection, quality control and quality assurance, cost of quality, ISO standards. Introduction to concept of Total Quality Management</p> <p>HSE: Introduction to concepts of HSE as applicable to Construction. Importance of safety in construction , Safety measures to be taken during Excavation , Explosives , drilling and blasting , hot bituminous works , scaffolds / platforms / ladder , form work and equipment operation. Storage of materials. Safety through legislation, safety campaign. Insurances.</p> <p>Ethics : Morals, values and ethics, integrity, trustworthiness , work ethics, need of engineering ethics, Professional Duties, Professional and Individual Rights, Confidential and Proprietary Information, Conflict of Interest Confidentiality, Gifts and Bribes, Price Fixing, Whistle Blowing.</p>			
Module -4			
<p>Introduction to engineering economy: Principles of engineering economics, concept on Micro and macro analysis, problem solving and decision making.</p> <p>Interest and time value of money: concept of simple and compound interest, interest formula for: single payment, equal payment and uniform gradient series. Nominal and effective interest rates, deferred annuities, capitalized cost.</p> <p>Comparison of alternatives: Present worth, annual equivalent, capitalized and rate of return methods, Minimum Cost analysis and break even analysis.</p>			
Module -5			

Entrepreneurship: Evolution of the concept, functions of an entrepreneur, concepts of entrepreneurship, stages in entrepreneurial process, different sources of finance for entrepreneur, central and state level financial institutions.

Micro, Small & Medium Enterprises (MSME): definition, characteristics, objectives, scope, role of MSME in economic development, advantages of MSME, Introduction to different schemes: TECKSOK, KIADB, KSSIDC, DIC, Single Window Agency: SISI, NSIC, SIDBI, KSFC.

Business Planning Process: Business planning process, marketing plan, financial plan, project report and feasibility study, guidelines for preparation of model project report for starting a new venture. Introduction to international entrepreneurship opportunities, entry into international business, exporting, direct foreign investment, venture capital.

Course Outcomes: After studying this course, students will be able to:

1. Prepare a project plan based on requirements and prepare schedule of a project by understanding the activities and their sequence.
2. Understand labour output, equipment efficiency to allocate resources required for an activity / project to achieve desired quality and safety.
3. Analyze the economics of alternatives and evaluate benefits and profits of a construction activity based on monetary value and time value.
4. Establish as an ethical entrepreneur and establish an enterprise utilizing the provisions offered by the federal agencies.

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - V			
ANALYSIS OF INDETERMINATE STRUCTURES			
Course Code	18CV52	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:2:0)	SEE Marks	60
Credits	04	Exam Hours	03
Course Learning Objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. Apply knowledge of mathematics and engineering in calculating slope, deflection, bending moment and shear force using slope deflection, moment distribution method and Kani's method. 2. Identify, formulate and solve problems in structural analysis. 3. Analyze structural system and interpret data. 4. use the techniques, such as stiffness and flexibility methods to solve engineering problems 5. communicate effectively in design of structural elements 			
Module-1			
Slope Deflection Method: Introduction, sign convention, development of slope deflection equation, analysis of continuous beams including settlements, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy ≤ 3 .			
Module-2			
Moment Distribution Method: Introduction, Definition of terms, Development of method, Analysis of continuous beams with support yielding, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy ≤ 3 .			
Module-3			
Kani's Method: Introduction, Concept, Relationships between bending moment and deformations, Analysis of continuous beams with and without settlements, Analysis of frames with and without sway.			
Module-4			
Matrix Method of Analysis (Flexibility Method) : Introduction, Axes and coordinates, Flexibility matrix, Analysis of continuous beams and plane trusses using system approach, Analysis of simple orthogonal rigid frames using system approach with static indeterminacy ≤ 3 .			
Module-5			
Matrix Method of Analysis (Stiffness Method): Introduction, Stiffness matrix, Analysis of continuous beams and plane trusses using system approach, Analysis of simple orthogonal rigid frames using system approach with kinematic indeterminacy ≤ 3 .			
Course Outcomes: After studying this course, students will be able to;			
<ol style="list-style-type: none"> 1. Determine the moment in indeterminate beams and frames having variable moment of inertia and subsidence using slope deflection method 2. Determine the moment in indeterminate beams and frames of no sway and sway using moment distribution method. 3. Construct the bending moment diagram for beams and frames by Kani's method. 4. Construct the bending moment diagram for beams and frames using flexibility method 5. Analyze the beams and indeterminate frames by system stiffness method. 			

E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - V

DESIGN OF RC STRUCTURAL ELEMENTS

Course Code	18CV53	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:2:0)	SEE Marks	60
Credits	04	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. Identify, formulate and solve engineering problems of RC elements subjected to different kinds of loading.
2. Follow a procedural knowledge in designing various structural RC elements.
3. Impart the usage of codes for strength, serviceability and durability.
4. Provide knowledge in analysis and design of RC elements.

Module-1

Introduction to working stress and limit State Design: Introduction to working stress method, Difference between Working stress and Limit State Method of design, Modular Ratio and Factor of Safety and evaluation of design constants for working stress method.

Philosophy and principle of limit state design with assumptions. Partial Safety factors, Characteristic load and strength. Stress block parameters, concept of balanced section, under reinforced and over reinforced section.

Limiting deflection, short term deflection, long term deflection, Calculation of deflection of singly reinforced beam only. Cracking in reinforced concrete members, calculation of crack width of singly reinforced beam. Side face reinforcement, slender limits of beams for stability.

Module-2

Limit State Analysis of Beams:

Analysis of singly reinforced, doubly reinforced and flanged beams for flexure and shear.

Module-3

Limit State Design of Beams: Design of singly and doubly reinforced beams, Design of flanged beams, design for combined bending, shear and torsion as per IS-456.

Module-4

Limit State Design of Slabs and Stairs: Introduction to one way and two way slabs, Design of cantilever, simply supported and one way continuous slab. Design of two way slabs for different boundary conditions. Design of dog legged and open well staircases. Importance of bond, anchorage length and lap length.

Module-5

Limit State Design of Columns and Footings: Analysis and design of short axially loaded RC column. Design of columns with uniaxial and biaxial moments, Design concepts of the footings. Design of Rectangular and square column footings with axial load and also for axial load & moment.

Course outcomes: After studying this course, students will be able to:

1. Understand the design philosophy and principles.
2. Solve engineering problems of RC elements subjected to flexure, shear and torsion.
3. Demonstrate the procedural knowledge in designs of RC structural elements such as slabs, columns and footings.
4. Owns professional and ethical responsibility.

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - V			
BASIC GEOTECHNICAL ENGINEERING			
Course Code	18CV54	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. Appreciate basic concepts of soil mechanics as an integral part in the knowledge of civil engineering. 2. Comprehend basic engineering and mechanical properties of different types of soil. 3. Become broadly familiar with geotechnical engineering problems such as, flow of water through soil medium and terminologies associated with geotechnical engineering. 4. Assess the improvement in mechanical behaviour by densification of soil deposits using compaction. 5. Model and measure strength-deformation characteristics of soils. 			
Module-1			
<p>Introduction: Origin and formation of soil, Regional soil deposits in India, Phase Diagram, phase relationships, definitions and their interrelationships.</p> <p>Determination of Index properties: Specific gravity, water content, in-situ density, relative density, particle size analysis (sieve and Hydrometer analysis)</p> <p>Atterberg's Limits, consistency indices. Activity of clay, Field identification tests, Plasticity chart, BIS soil classification (IS: 1498-1970).</p>			
Module-2			
<p>Soil Structure and Clay Mineralogy Single grained, honey combed, flocculent and dispersed structures, Valence bonds, Soil-Water system, Electrical diffuse double layer, adsorbed water, base-exchange capacity, Isomorphous substitution. Common clay minerals in soil and their structures- Kaolinite, Illite and Montmorillonite and their application in Engineering</p> <p>Compaction of Soils: Definition, Principle of compaction, Standard and Modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, Field compaction control-compactive effort & method of compaction, lift thickness and number of passes, Proctor's needle, Compacting equipments and their suitability.</p>			
Module -3			
<p>Flow through Soils: Darcy's law-assumption and validity, coefficient of permeability and its determination (laboratory and field), factors affecting permeability, permeability of stratified soils, Seepage velocity, superficial velocity and coefficient of percolation, Capillary Phenomena.</p> <p>Seepage Analysis: Laplace equation, assumptions, limitation and its derivation. Flow nets-characteristics and applications. Flow nets for sheet piles and below the dam section.</p> <p>Unconfined flow, phreaticline (Casagrande's method-with and without toe filter), flow through dams, design of dam filters.</p> <p>Effective Stress Analysis:</p> <p>Geostatic stresses, Effective stress concept-total stress, effective stress and Neutral stress and impact of the effective stress in construction of structures, quick sand phenomena.</p>			
Module -4			
<p>Shear Strength of Soil: Concept of shear strength, Mohr-Coulomb Failure Criterion, Modified Mohr-Coulomb Criterion Total and effective shear strength parameters, factors affecting shear strength of soils. Thixotrophy and sensitivity, Measurement of shear strength parameters - Direct shear test, unconfined compression test, triaxial compression test and field Vane shear test, Test under different drainage conditions.</p>			
Module-5			
<p>Consolidation of Soil: Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory-assumptions and limitations. Governing differential Equation and solution (No derivation).</p> <p>Consolidation characteristics of soil (C_c, a_v, m_v and C_v). Laboratory one dimensional consolidation test, characteristics of e-log (σ') curve, Pre-consolidation pressure and its determination by Casagrande's method. Over consolidation ratio, normally consolidated, under consolidated and over consolidated soils.</p>			

Determination of consolidation characteristics of soils- compression index and coefficient of consolidation (square root of time fitting method, logarithmic time fitting method). Primary and secondary consolidation.

Course outcomes: On the completion of this course students are expected to attain the following outcomes:

1. Ability to plan and execute geotechnical site investigation program for different civil engineering projects
2. Understanding of stress distribution and resulting settlement beneath the loaded footings on sand and clayey soils
3. Ability to estimate factor of safety against failure of slopes and to compute lateral pressure distribution behind earth retaining structures
4. Ability to determine bearing capacity of soil and achieve proficiency in proportioning shallow isolated and combined footings for uniform bearing pressure
5. Capable of estimating load carrying capacity of single and group of piles

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - V

MUNICIPAL WASTEWATER ENGINEERING

Course Code	18CV55	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to;

1. Understand the various water demands and population forecasting methods.
2. Understand and design different unit operations and unit process involved in wastewater treatment process
3. Understand the concept and design of various physicochemical treatment units
4. Understand the concept and design of various biological treatment units
5. Understand the concept of various advanced waste water and low cost treatment processes for rural areas.

Module-1

Introduction: Need for sanitation, methods of sewage disposal, types of sewerage systems, dry weather flow, wet weather flow, factors affecting dry and wet weather flow on design of sewerage system, estimation of storm water flow, time of concentration flow, numericals.

Sewer appurtenances: Manholes, catch basins, oil and grease traps. P, Q and S traps. Material of sewers, shape of sewers, laying and testing of sewers, ventilation of sewers basic principles of house drainage.

Module-2

Design of sewers: Hydraulic formula to determine velocity and discharge. Self cleansing and non scouring velocity. Design of hydraulic elements for circular sewers for full flow and half flow conditions.

Waste water characteristics: sampling, significance and techniques, physical, chemical and biological characteristics, flow diagram for municipal waste water

Treatment unit operations and process. Estimation of BOD. Reaction kinetics (zero order, 1st order and 2nd order).

Module-3

Treatment of municipal waste water: Screens: types, disposal. Grit chamber, oil and grease removal. primary and secondary settling tanks.

Disposal of effluents: Dilution, self-purification phenomenon, oxygen sag curve, zones of purification, sewage farming, sewage sickness, numerical problems on disposal of effluents. Streeter-Phelps equation.

Module-4

Biological Treatment Process: Suspended growth system - conventional activated sludge process and its modifications. Attached growth system – trickling filter, bio-towers and rotating biological contactors.

Principle of stabilization ponds, oxidation ditch, Sludge digesters (aerobic and anaerobic), Equalization, thickeners and drying beds.

Module-5

Advanced Wastewater Treatment: Need and technologies used. Nitrification and Denitrification Processes, Phosphorous removal. Advanced oxidation processes (AOPs), Electro coagulation.

Rural sanitation: Low cost treatment process: Working principle and design of septic tanks for small community in rural and urban areas, two-pit latrines, eco-toilet and soak pits.

Course outcomes: After studying this course, the students will be able to:

1. Select the appropriate sewer appurtenances and materials in sewer network.
2. Design the sewers network and understand the self purification process in flowing water.
3. Design the various physico-chemical treatment units
4. Design the various biological treatment units
5. Design various AOPs and low cost treatment units.

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - V

HIGHWAY ENGINEERING

Course Code	18CV56	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to;

1. Gain knowledge of different modes of transportation systems, history, development of highways and the organizations associated with research and development of the same in INDIA.
2. Understand Highway planning and development considering the essential criteria's (engineering and financial aspects, regulations and policies, socio economic impact).
3. Get insight to different aspects of geometric elements and train them to design geometric elements of a highway network.
4. Understand pavement and its components, pavement construction activities and its requirements.
5. Gain the skills of evaluating the highway economics by B/C, NPV, IRR methods and also introduce the students to highway financing concepts.

Module -1

Principles of Transportation Engineering: Importance of transportation, Different modes of transportation and comparison, Characteristics of road transport Jayakar committee recommendations, and implementation – Central Road Fund, Indian Roads Congress, Central Road Research Institute.

Highway Development and Planning: Road types and classification, road patterns, planning surveys, master plan – saturation system of road planning, phasing road development in India, problems on best alignment among alternate proposals Salient Features of 3rd and 4th twenty year road development plans and Policies, Present scenario of road development in India (NHDP & PMGSY) and in Karnataka (KSHIP & KRDC) Road development plan - vision 2021.

Highway Alignment and Surveys: Ideal Alignment, Factors affecting the alignment, Engineering surveys- Map study, Reconnaissance, Preliminary and Final location & detailed survey, Reports and drawings for new and re-aligned projects.

Module -2

Highway Geometric Design of horizontal alignment elements: Cross sectional elements–width, surface, camber, Sight distances–SSD, OSD, ISD, HSD, Radius of curve, Transition curve, Design of horizontal and vertical alignment–curves, super-elevation, widening, gradients, summit and valley curves.

Module -3

Pavement Materials: Sub grade soil - desirable properties-HRB soil classification-determination of CBR and modulus of sub grade reaction with Problems Aggregates- Desirable properties and tests, Bituminous materials- Explanation on Tar, bitumen, cutback and emulsion-tests on bituminous material Pavement Design: Pavement types, component parts of flexible and rigid pavements and their functions, ESWL and its determination (Graphical method only)-Examples.

Module -4

Pavement Construction: Design of soil aggregate mixes by Rothfuch's method. Uses and properties of bituminous mixes and cement concrete in pavement construction. Earthwork; cutting and Filling, Preparation of subgrade, Specification and construction of i) Granular Sub base, ii) WBM Base iii) WMM base,iv) Bituminous Macadam v) Dense Bituminous Macadam vi) Bituminous Concrete,vii) Dry Lean Concrete sub base and PQC viii) concrete roads.

Module -5

Highway Drainage: Significance and requirements, Surface drainage system and design-Examples, sub surface drainage system, design of filter materials, Types of cross drainage structures, their choice and location.

Highway Economics: Highway user benefits, VOC using charts only-Examples, Economic analysis - annual cost method-Benefit Cost Ratio method-NPV-IRR methods- Examples, Highway financing-BOT-BOOT concepts.

Course Outcomes: After studying this course, students will be able to:

1. Acquire the capability of proposing a new alignment or re-alignment of existing roads, conduct necessary field investigation for generation of required data.
 2. Evaluate the engineering properties of the materials and suggest the suitability of the same for pavement construction.
 3. Design road geometrics, structural components of pavement and drainage.
 4. Evaluate the highway economics by few select methods and also will have a basic knowledge of various highway financing concepts.
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B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

DESIGN OF STEEL STRUCTURAL ELEMENTS

Course Code	18CV61	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:2:0)	SEE Marks	60
Credits	04	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. Understand advantages and disadvantages of steel structures, steel code provisions, and plastic behaviour of structural steel.
2. Learn Bolted connections and Welded connections.
3. Design of compression members, built-up columns and columns splices.
4. Design of tension members, simple slab base and gusseted base.
5. Design of laterally supported and un-supported steel beams.

Module -1

Introduction: Advantages and Disadvantages of Steel Structures, Limit state method Limit State of Strength, Structural Stability, Serviceability Limit states, Failure Criteria of steel, Design Consideration, Loading and load combinations, IS code provisions, Specification and Section classification.

Plastic Behavior of Structural Steel: Introduction, Plastic theory, Plastic Hinge Concept, Plastic collapse load, load factor, Shape factor, Theorem of plastic collapse, Methods of Plastic analysis, Plastic analysis of Continuous Beams.

Module -2

Bolted Connections: Introduction, Types of Bolts, Behavior of bolted joints, Design of High Strength friction Grip (HSFG) bolts, Design of Simple bolted Connections (Lap and Butt joints) and bracket connections.

Welded Connections: Introduction, Types and properties of welds, Effective areas of welds, Weld Defects, Simple welded joints for truss member and bracket connections, Advantages and Disadvantages of Bolted and Welded Connections.

Module -3

Design of Compression Members: Introduction, Failure modes, Behavior of compression members, Sections used for compression members, Effective length of compression members, Design of compression members and built up Compression members, Design of Laced and Battened Systems.

Module -4

Design of Tension Members: Introduction, Types of Tension members, Slenderness ratio, Modes of Failure, Factors affecting the strength of tension members, Design of Tension members and Lug angles, Splices, Gussets.

Design of Column Bases: Design of Simple Slab Base and Gusseted Base.

Module -5

Design of Beams: Introduction, Beam types, Lateral Stability of beams, factors affecting lateral stability, Behavior of Beams in Bending, Design strength of laterally supported beams in Bending, Design of Laterally unsupported Beams [No Numerical Problems], Shear Strength of Steel Beams.

Beam to Beam Connections, Beam to Column Connection and Column Splices [No Numerical Problems].

Course Outcomes: After studying this course, students will be able to:

1. Possess knowledge of Steel Structures Advantages and Disadvantages of Steel structures, steel code provisions and plastic behaviour of structural steel.
2. Understand the Concept of Bolted and Welded connections.
3. Understand the Concept of Design of compression members, built-up columns and columns splices.
4. Understand the Concept of Design of tension members, simple slab base and gusseted base.
5. Understand the Concept of Design of laterally supported and un-supported steel beams.

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VI			
APPLIED GEOTECHNICAL ENGINEERING			
Course Code	18CV62	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:2:0)	SEE Marks	60
Credits	04	Exam Hours	03
Course Learning Objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. Appreciate basic concepts of soil mechanics as an integral part in the knowledge of Civil Engineering. Also to become familiar with foundation engineering terminology and understand how the principles of Geo-technology are applied in the design of foundations 2. Learn introductory concepts of Geotechnical investigations required for civil engineering projects emphasizing in situ investigations 3. Conceptually learn various theories related to bearing capacity of soil and their application in the design of shallow foundations and estimation of load carrying capacity of pile foundation 4. Estimate internal stresses in the soil mass and application of this knowledge in proportioning of shallow and deep foundation fulfilling settlement criteria 5. Study about assessing stability of slopes and earth pressure on rigid retaining structures 			
Module-1			
Soil Exploration: Introduction, Objectives and Importance, Stages and Methods of exploration- Test pits, Borings, Geophysical methods, stabilization of boreholes, Sampling techniques, Undisturbed, disturbed and representative samples, Geophysical exploration and Bore hole log. Drainage and Dewatering methods, estimation of depth of GWT (Hvorslev's method).			
Module-2			
Stress in Soils: Introduction, Boussinesq's and Westergaard's theory concentrated load, circular and rectangular load, equivalent point load method, pressure distribution diagrams and contact pressure, Newmark's chart. Foundation Settlement: Types of settlements and importance, Computation of immediate and consolidation settlement, permissible differential and total settlements (IS 8009 part 1).			
Module-3			
Lateral Earth Pressure: Active, Passive and earth pressure at rest, Rankine's theory for cohesionless and cohesive soils, Coulomb's theory, Rebhann's and Culmann's graphical construction. Stability of Slopes : Assumptions, infinite and finite slopes, factor of safety, Swedish slip circle method for C and C- ϕ (Method of slices) soils, Felineous method for critical slip circle, use of Taylor's stability charts.			
Module-4			
Bearing Capacity of Shallow Foundation: Types of foundations, Determination of bearing capacity by Terzaghi's and BIS method (IS: 6403), Modes of shear failure, Factors affecting Bearing capacity of soil. Effect of water table and/or eccentricity on bearing capacity of soil, field methods of determining bearing capacity of soil: SPT and plate load test.			
Module-5			
Pile Foundations: Types and classification of piles, single loaded pile capacity in cohesionless and cohesive soils by static and Dynamic formulas, efficiency of Pile group, group capacity of piles in cohesionless and cohesive soils, negative skin friction, pile load tests, Settlement of piles, under reamed piles (only introductory concepts – no derivation).			
Course outcomes: On the completion of this course students are expected to attain the following outcomes;			
<ol style="list-style-type: none"> 1. Ability to plan and execute geotechnical site investigation program for different civil engineering projects 2. Understanding of stress distribution and resulting settlement beneath the loaded footings on sand and clayey soils 3. Ability to estimate factor of safety against failure of slopes and to compute lateral pressure distribution behind earth retaining structures 4. Ability to determine bearing capacity of soil and achieve proficiency in proportioning shallow isolated and combined footings for uniform bearing pressure 5. Capable of estimating load carrying capacity of single and group of piles 			

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VI			
HYDROLOGY AND IRRIGATION ENGINEERING			
Course Code	18CV63	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:2:0)	SEE Marks	60
Credits	04	Exam Hours	03
Course Learning Objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. Understand the concept of hydrology and components of hydrologic cycle such as precipitation, infiltration, evaporation and transpiration. 2. Quantify runoff and use concept of unit hydrograph. 3. Demonstrate different methods of irrigation, methods of application of water and irrigation procedure. 4. Design canals and canal network based on the water requirement of various crops. 5. Determine the reservoir capacity. 			
Module -1			
Hydrology: Introduction, Importance of hydrology, Global distribution of water and Indian water availability, Practical application of hydrology, Hydrologic cycle (Horton's) qualitative and engineering representation.			
Precipitation: Definition, Forms and types of precipitation, measurement of rain fall using Symon's and Syphon type of rain gauges, optimum number of rain gauge stations, consistency of rainfall data (double mass curve method), computation of mean rainfall, estimation of missing data, presentation of precipitation data, moving average curve, mass curve, rainfall hyetographs.			
Module -2			
Losses: Evaporation: Introduction, Process, factors affecting evaporation, measurement using IS class-A Pan, estimation using empirical formulae (Meyer's and Rohwer's equations) Reservoir evaporation and control.			
Evapo-transpiration: Introduction, Consumptive use, AET, PET, Factors affecting, Measurement, Estimation by Blaney-Criddle equation.			
Infiltration: Introduction, factors affecting infiltration capacity, measurement by double ring infiltrometer, Horton's infiltration equation, infiltration indices.			
Module -3			
Runoff: Definition, concept of catchment, factors affecting runoff, rainfall – runoff relationship using regression analysis.			
Hydrographs: Definition, components of hydrograph, base flow separation, unit hydrograph, assumption, application and limitations, derivation from simple storm hydrographs, S curve and its computations, Conversion of UH of different durations.			
Module -4			
Irrigation: Definition. Benefits and ill effects of irrigation. System of irrigation: surface and ground water, flow irrigation, lift irrigation, Bandhara irrigation.			
Water Requirements of Crops: Duty, delta and base period, relationship between them, factors affecting duty of water crops and crop seasons in India, irrigation efficiency, frequency of irrigation.			
Module -5			
Canals: Types of canals. Alignment of canals. Definition of gross command area, cultural command area, intensity of irrigation, time factor, crop factor. Unlined and lined canals. Standard sections. Design of canals by Lacey's and Kennedy's method.			
Reservoirs: Definition, investigation for reservoir site, storage zones determination of storage capacity using mass curves, economical height of dam.			
Course outcomes: After studying this course, students will be able to:			
<ol style="list-style-type: none"> 1. Understand the importance of hydrology and its components. 2. Measure precipitation and analyze the data and analyze the losses in precipitation. 3. Estimate runoff and develop unit hydrographs. 			

4. Find the benefits and ill-effects of irrigation.
5. Find the quantity of irrigation water and frequency of irrigation for various crops.
6. Find the canal capacity, design the canal and compute the reservoir capacity.

B. E. CIVIL ENGINEERING Choice Based Credit System (CBCS) and Outcome Based Education (OBE) SEMESTER - VI			
MATRIX METHOD OF STRUCTURAL ANALYSIS			
Course Code	18CV641	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
<p>Course Learning Objectives: This course will enable students to</p> <ol style="list-style-type: none"> 1. Gain basic knowledge of structural systems and application of concepts of flexibility and stiffness matrices for simple elements. 2. Understand flexibility and stiffness matrices to solve problems in beams, frames and trusses. 3. Gain knowledge of direct stiffness method to solve problems in beams, frames and trusses. 4. Gain knowledge of solving problems involving temperature changes and lack of fit. 			
<p>Module -1</p> <p>Introduction: Structural systems, geometric and material non-linearity, principle of superposition, equilibrium and compatibility conditions, static and kinematic indeterminacy, principle of minimum potential energy and minimum complementary energy, concepts of stiffness and flexibility, flexibility and stiffness matrices of beam and truss elements.</p>			
<p>Module -2</p> <p>Element Flexibility Method: Force transformation matrix, global flexibility matrix, analysis of continuous beams, rigid frames and trusses.</p>			
<p>Module -3</p> <p>Element Stiffness Method: Displacement transformation matrix, global stiffness matrix, analysis of continuous beams, rigid frames and trusses.</p>			
<p>Module -4</p> <p>Effects of Temperature Changes and Lack of Fit: Related numerical problems by flexibility and stiffness method as in Module 2 and Module 3.</p>			
<p>Module -5</p> <p>Direct Stiffness Method: Local and global coordinates systems, principle of contra gradient, global stiffness matrices of beam and truss elements, analysis of continuous beams and trusses.</p>			
<p>Course Outcomes: After studying this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Evaluate the structural systems to application of concepts of flexibility and stiffness matrices for simple problems. 2. Identify, formulate and solve engineering problems with respect to flexibility and stiffness matrices as applied to continuous beams, rigid frames and trusses. 3. Identify, formulate and solve engineering problems by application of concepts of direct stiffness method as applied to continuous beams and trusses. 4. Evaluate secondary stresses. 			

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VI			
SOLID WASTE MANAGEMENT			
Course Code	18CV642	CIE Marks	40
Teaching Hours/Week(L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. Study the present methods of solid waste management system and to analyze their draw backs comparing with statutory rules. 2. Understand different elements of solid waste management from generation of solid waste to disposal. 3. Analyze different processing technologies and to study conversion of municipal solid waste to compost or biogas. 4. Evaluate landfill site and to study the sanitary landfill reactions. 			
Module -1			
Sources: Sources of Solid waste, Types of solid waste, Physical and Chemical composition of municipal solid waste. Generation rate, Numerical Problems.			
Collection: Collection of solid waste- services and systems, equipments, Transportation: Need of transfer operation, transfer station, transport means and methods, route optimization. Solid waste management 2000 rules with, 2016 amendments.			
Module -2			
Processing techniques: Purpose of processing, Volume reduction by incineration, Process description, Mechanical volume reduction (compaction), Mechanical size reduction (shredding), component separation (manual and mechanical methods).			
Module -3			
Composting Aerobic and anaerobic method - process description, process microbiology, design consideration, Mechanical composting, Vermi composting, Numerical Problems.			
Sanitary land filling: Definition, advantages and disadvantages, site selection, methods, reaction occurring in landfill- Gas and Leachate movement, Control of gas and leachate movement, Design of sanitary landfill. Numerical Problems.			
Module -4			
Sources, collection, treatment and disposal:- Biomedical waste,E-waste, construction and demolition waste.			
Module -5			
Incineration -3Ts factor affecting incineration, types of incinerations, Pyrolysis , Energy recovery technique from solid waste management. Hazardous waste.			
Course outcomes: After studying this course, students will be able to:			
<ol style="list-style-type: none"> 1. Analyse existing solid waste management system and to identify their drawbacks. 2. Evaluate different elements of solid waste management system. 3. Suggest suitable scientific methods for solid waste management elements. 4. Design suitable processing system and evaluate disposal sites. 			

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VI			
ALTERNATE BUILDING MATERIALS			
Course Code	18CV643	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: This Course will enable students to:			
<ol style="list-style-type: none"> 1. understand environmental issues due to building materials and the energy consumption in manufacturing building materials 2. study the various masonry blocks, masonry mortar and structural behavior of masonry under compression. 3. Study the alternative building materials in the present context. 4. understand the alternative building technologies which are followed in present construction field. 			
Module -1			
Introduction: Energy in building materials, Environmental issues concerned to building materials, Embodied energy and life-cycle energy, Global warming and construction industry, Green concepts in buildings, Green building ratings – IGBC and LEED manuals – mandatory requirements, Rainwater harvesting & solar passive architecture. Environmental friendly and cost effective building technologies, Requirements for buildings of different climatic regions.			
Module -2			
Elements of Structural Masonry : Elements of Structural Masonry, Masonry materials, requirements of masonry units' characteristics of bricks, stones, clay blocks, concrete blocks, stone boulders, laterite Blocks, Fal- G blocks and Stabilized mud block. Manufacture of stabilized blocks. Structural Masonry Mortars: Mortars, cementations materials, sand, natural & manufactured, types of mortars, classification of mortars as per BIS, characteristics and requirements of mortar, selection of mortar. Uses of masonry, masonry bonding, Compressive strength of masonry elements, Factors affecting compressive strength, Strength of Prisms/wallets and walls, Effect of brick bond on strength, Bond strength of masonry: Flexure and shear, Elastic properties of masonry materials and masonry, Design of masonry compression elements subjected to axial load.			
Module -3			
Alternate Building Materials: Lime, Pozzolana cements, Raw materials, Manufacturing process, Properties and uses. Fibers- metal and synthetic, Properties and applications. Fiber reinforced plastics, Matrix materials, Fibers organic and synthetic, Properties and applications. Building materials from agro and industrial wastes ,Types of agro wastes, Types of industrial and mine wastes, Properties and applications. Masonry blocks using industrial wastes. Construction and demolition wastes.			
Module -4			
Alternate Building Technologies: Use of arches in foundation, alternatives for wall constructions, composite masonry, confined masonry, cavity walls, rammed earth, Ferro cement and ferroconcrete building components, Materials and specifications, Properties, Construction methods, Applications. Top down construction, Mivan Construction Technique. Alternate Roofing Systems: Concepts, Filler slabs, Composite beam panel roofs, Masonry vaults and domes.			
Module -5			

Equipment for Production of Alternate Materials: Machines for manufacture of concrete, Equipments for production of stabilized blocks, Moulds and methods of production of precast elements, Cost concepts in buildings, Cost saving techniques in planning, design and construction, Cost analysis: Case studies using alternatives.

Course Outcomes: After studying this course, students will be able to:

1. Solve the problems of Environmental issues concerned to building materials and cost effective building technologies;
2. Select appropriate type of masonry unit and mortar for civil engineering constructions; also they are able to Design Structural Masonry Elements under Axial Compression.
3. Analyse different alternative building materials which will be suitable for specific climate and in an environmentally sustainable manner. Also capable of suggesting suitable agro and industrial wastes as a building material.
4. Recommend various types of alternative building materials and technologies and design a energy efficient building by considering local climatic condition and building material.

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VI			
GROUND IMPROVEMENT TECHNIQUES			
Course Code	18CV644	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. Understand the fundamental concepts of ground improvement techniques 2. Apply knowledge of mathematics, Science and Geotechnical Engineering to solve problems in the field of modification of ground required for construction of civil engineering structures. 3. Understand the concepts of chemical compaction, grouting and other miscellaneous methods. 4. Impart the knowledge of geo synthetics, vibration, grouting and Injection. 			
Module -1			
Formation and Development of Ground : Introduction, Formation of Rock, soil and soil profile, Soil distribution in India, Alterations of ground after formation, Reclaimed soils, Natural offshore deposits; Ground Improvement Potential – Hazardous ground conditions, poor ground conditions, favourable ground conditions, Alternative Approaches, Geotechnical processes.			
Compaction: Introduction, compaction mechanics, Field procedure, surface compaction, Dynamic Compaction, selection of field compaction procedures, compaction quality control.			
Module -2			
Drainage Methods: Introduction, Seepage, filter requirements, ground water and seepage control, methods of dewatering systems, Design of dewatering system including pipe line effects of dewatering. Drains, different types of drains.			
Pre-compression and Vertical Drains: Importance, Vertical drains, Sand drains, Drainage of slopes, Electro kinetic dewatering, Preloading.			
Module -3			
Chemical Modification-I: Definition, cement stabilization, sandwich technique, admixtures. Hydration – effect of cement stabilization on permeability, Swelling and shrinkage and strength and deformation characteristics. Criteria for cement stabilization. Stabilization using Fly ash.			
Chemical Modification-II: Lime stabilization – suitability, process, criteria for lime stabilization. Other chemicals like chlorides, hydroxides, lignin and hydrofluoric acid. Properties of chemical components, reactions and effects. Bitumen, tar or asphalt in stabilization.			
Module -4			
Vibration Methods: Introduction, Vibro compaction – blasting, vibratory probe, Vibro displacement compaction – displacement piles, vibro flotation, sand compaction piles, stone columns, heavy tamping			
Grouting And Injection: Introduction, Effect of grouting. Chemicals and materials used. Types of grouting. Grouting procedure, Applications of grouting.			
Module -5			
Geosynthetics: Introduction, Geosynthetic types, properties of Geosynthetics – materials and fibre properties, Geometrical aspects, mechanical properties, Hydraulic properties, Durability ; Applications of Geosynthetics - Separation, Filtration and Fluid Transmission, Reinforcement,			
Miscellaneous Methods (Only Concepts & Uses): Soil reinforcement, Thermal methods, Ground improvement by confinement – Crib walls, Gabions and Mattresses, Anchors, Rock bolts and soil nailing. Stone Column, Micro piles.			
Course Outcomes: After studying this course, students will be able to:			
<ol style="list-style-type: none"> 1. Give solutions to solve various problems associated with soil formations having less strength. 2. Use effectively the various methods of ground improvement techniques depending upon the requirements. 3. utilize properly the locally available materials and techniques for ground improvement so that economy in the design of foundations of various civil engineering structures 			

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

RAILWAYS, HARBOUR, TUNNELING AND AIRPORTS

Course Code	18CV645	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. Understand the history and development, role of railways, railway planning and development based on essential criteria's.
2. Learn different types of structural components, engineering properties of the materials, to calculate the material quantities required for construction
3. Understand various aspects of geometrical elements, points and crossings, significance of maintenance of tracks.
4. Design and plan airport layout, design facilities required for runway, taxiway and impart knowledge about visual aids
5. Apply design features of tunnels, harbors, dock and necessary navigational aids; also expose them to various methods of tunneling and tunnel accessories.

Module-1

Railway Planning: Significance of Road, Rail, Air and Water transports – Coordination of all modes to achieve sustainability – Elements of permanent way
– Rails, Sleepers, Ballast, rail fixtures and fastenings, – Track Stress, coning of wheels, creep in rails, defects in rails
– Route alignment surveys, conventional and modern methods- – Soil suitability analysis – Geometric design of railways, gradient, super elevation, widening of gauge on curves- Points and Crossings(Explanation & Sketches of Right and Left hand turnouts only).

Module-2

Railway Construction and Maintenance: Earthwork – Stabilization of track on poor soil, Calculation of Materials required for track laying – Construction and maintenance of tracks – Modern methods of construction & maintenance – Railway stations and yards and passenger amenities- Urban rail – Infrastructure for Metro, Mono and underground railways.

Module-3

Harbour and Tunnel Engineering: Definition of Basic Terms: Planning and Design of Harbours: Requirements, Classification, Location and Design
Principles – Harbour Layout and Terminal Facilities , Coastal Structures, Inland Water Transport – Wave action on Coastal Structures and Coastal Protection Works.
Tunneling: Introduction, size and shape of the tunnel, tunneling methods in soils, tunnel lining, tunnel drainage and ventilation.

Module-4

Airport Planning: Air transport characteristics, airport classification, air port planning: objectives, components, layout characteristics, and socio-economic characteristics of the catchment area, criteria for airport site selection and ICAO stipulations, typical airport layouts, Parking and circulation area.

Module-5

Airport Design: Runway Design: Orientation, Wind Rose Diagram, Runway length, Problems on basic and Actual Length, Geometric design of runways, Configuration and Pavement Design Principles, Elements of Taxiway Design, Airport Zones, Passenger Facilities and Services, Runway and Taxiway Markings and lighting.

Course outcomes: After studying this course, students will be able to:

1. Acquires capability of choosing alignment and also design geometric aspects of railway system, runway and taxiway.
2. Suggest and estimate the material quantity required for laying a railway track and also will be able to determine the hauling capacity of a locomotive.
3. Develop layout plan of airport, harbor, dock and will be able relate the gained knowledge to identify required type of visual and/or navigational aids for the same.
4. Apply the knowledge gained to conduct surveying, understand the tunneling activities.

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VI			
REMOTE SENSING AND GIS			
Course Code	18CV651	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. Understand the basic concepts of remote sensing. 2. Analyze satellite imagery and extract the required units. 3. Extract the GIS data and prepare the thematic maps. 4. Use the thematic maps for various applications. 			
Module-1			
Remote Sensing: Basic concept of Remote sensing, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, and vegetation), Resolution, image registration and Image and False color composite, elements of visual interpretation techniques.			
Module-2			
Remote Sensing Platforms and Sensors: Indian Satellites and Sensors characteristics, Remote Sensing Platforms, Sensors and Properties of Digital Data, Data Formats: Introduction, platforms- IRS, Landsat, SPOT, Cartosat, Ikonos, Envisat etc. sensors, sensor resolutions (spatial, spectral, radiometric and temporal). Basics of digital image processing- introduction to digital data, systematic errors(Scan Skew, Mirror-Scan Velocity, Panoramic Distortion, Platform Velocity, Earth Rotation) and non-systematic [random] errors(Altitude, Attitude), Image enhancements(Gray Level Thresholding, level slicing, contrast stretching),image filtering.			
Module-3			
Geographic Information System: Introduction to GIS; components of a GIS; Geographically Referenced Data, Spatial Data- Attribute data-Joining Spatial and attribute data, GIS Operations: Spatial Data Input – Attribute data Management, Geographic coordinate System, Datum; Map Projections: Types of Map Projections, Projected coordinate Systems. UTM Zones.			
Module-4			
Data Models: Vector data model: Representation of simple features – Topology and its importance; coverage and its data structure, Shape file; Relational Database, Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, and Data conversion.			
Module-5			
Integrated Applications of Remote sensing and GIS: Applications in land use land cover analysis, change detection, water resources, urban planning, environmental planning, Natural resource management and Traffic management. Location Based Services And Its Applications.			
Course outcomes: After studying this course, students will be able to:			
<ol style="list-style-type: none"> 1. Collect data and delineate various elements from the satellite imagery using their spectral signature. 2. Analyze different features of ground information to create raster or vector data. 3. Perform digital classification and create different thematic maps for solving specific problems. 4. Make decision based on the GIS analysis on thematic maps. 			

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VI			
TRAFFIC ENGINEERING			
Course Code	18CV652	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. Understand fundamental knowledge of traffic engineering, scope and its importance. 2. Describe basic techniques for collecting and analyzing traffic data, diagnosing problems, designing appropriate remedial treatment, and assessing its effectiveness. 3. Apply probabilistic and queuing theory techniques for the analysis of traffic flow situations and emphasize the interaction of flow efficiency and traffic safety. 4. Understand and analyse traffic issues including safety, planning, design, operation and control. 5. Apply intelligent transport system and its applications in the present traffic scenario. 			
Module-1			
Traffic Planning and Characteristics: Road Characteristics-Road user characteristics, PIEV theory, Vehicle Performance characteristics, Fundamentals of Traffic Flow, Urban Traffic problems in India, Integrated planning of town, country, regional and all urban infrastructures, Sustainable approach- land use & transport and modal integration.			
Module-2			
Traffic Surveys: Traffic Surveys- Speed, journey time and delay surveys, Vehicles Volume Survey including non-motorized transports, Methods and interpretation, Origin Destination Survey, Methods and presentation, Parking Survey, Accident analyses-Methods, interpretation and presentation, Statistical applications in traffic studies and traffic forecasting, Level of service-Concept, applications and significance.			
Module-3			
Traffic Design and Visual Aids: Intersection Design- channelization, Rotary intersection design, Signal design, Coordination of signals, Grade separation, Traffic signs including VMS and road markings, Significant roles of traffic control personnel, Networking pedestrian facilities & cycle tracks.			
Module-4			
Traffic Safety and Environment: Road accidents, Causes, effect, prevention, and cost, Street lighting, Traffic and environment hazards, Air and Noise Pollution, causes, abatement measures, Promotion and integration of public transportation, Promotion of non-motorized transport.			
Module-5			
Traffic Management: Area Traffic Management System, Traffic System Management (TSM) with IRC standards, Traffic Regulatory Measures, Travel Demand Management (TDM), Direct and indirect methods, Congestion and parking pricing, All segregation methods- Coordination among different agencies, Intelligent Transport System for traffic management, enforcement and education.			
Course outcomes: After studying this course, students will be able to:			
<ol style="list-style-type: none"> 1. Understand the human factors and vehicular factors in traffic engineering design. 2. Conduct different types of traffic surveys and analysis of collected data using statistical concepts. 3. Use an appropriate traffic flow theory and to comprehend the capacity & signalized intersection analysis. 4. Understand the basic knowledge of Intelligent Transportation System. 			

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VI			
OCCUPATIONAL HEALTH AND SAFETY			
Course Code	18CV653	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. Gain an historical, economic, and organizational perspective of occupational safety and health; 2. Investigate current occupational safety and health problems and solutions. 3. Identify the forces that influence occupational safety and health. 4. Demonstrate the knowledge and skills needed to identify work place problems and safe work practice 			
Module-1			
Occupational Hazard and Control Principles: Safety, History and development, National Safety Policy. Occupational safety and Health Act (OSHA), Occupational Health and Safety administration - Laws governing OSHA and right to know. Accident – causation, investigation, investigation plan, Methods of acquiring accident facts, Supervisory role in accident investigation.			
Module-2			
Ergonomics at Work Place: Ergonomics Task analysis, Preventing Ergonomic Hazards, Work space Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs. Hazard cognition and Analysis, Human Error Analysis – Fault Tree Analysis – Emergency Response - Decision for action – purpose and considerations.			
Module-3			
Fire Prevention and Protection: Fire Triangle, Fire Development and its severity, Effect of Enclosures, early detection of Fire, Classification of fire and Fire Extinguishers. Electrical Safety, Product Safety: Technical Requirements of Product safety.			
Module-4			
Health Considerations at Work Place: types of diseases and their spread, Health Emergency. Personal Protective Equipment (PPE) – types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste. Environment management plans (EMP) for safety and sustainability.			
Module-5			
Occupational Health and Safety Considerations: Water and wastewater treatment plants, Handling of chemical and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing industries like cement plants, RMC Plants, precast plants and construction sites. Policies, roles and responsibilities of workers, managers and supervisors.			
Course outcomes: After studying this course, students will be able to:			
<ol style="list-style-type: none"> 1. Identify hazards in the workplace that pose a danger or threat to their safety or health, or that of others. 2. Control unsafe or unhealthy hazards and propose methods to eliminate the hazard. 3. Present a coherent analysis of a potential safety or health hazard both verbally and in writing, citing the occupational Health and Safety Regulations as well as supported legislation. 4. Discuss the role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors. 5. Identify the decisions required to maintain protection of the environment, workplace as well as personal health and safety. 			

B. E. CIVIL ENGINEERING Choice Based Credit System (CBCS) and Outcome Based Education (OBE) SEMESTER - VI			
SUSTAINABILITY CONCEPTS IN CIVIL ENGINEERING			
Course Code	18CV654	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
<p>Course Learning Objectives: This course will enable students to</p> <ol style="list-style-type: none"> 1. Learn about the principles, indicators and general concept of sustainability. 2. Apprehend the local, regional and global impacts of unsustainable designs, products and processes. 3. Student shall be able to apply the sustainability concepts in engineering 4. Know built environment frame work sand their use 5. Understand how building and design is judged and valued by clients and stakeholders and how to implement sustainability. 			
Module-1			
<p>Introduction: Sustainability - Introduction, Need and concept of sustainability, Social-environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Environmental legislations in India - Water Act, Air Act.</p>			
Module-2			
<p>Global Environmental Issue: Resource degradation, Climate change, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print Carbon sequestration – Carbon capture and storage (CCS). Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking.</p>			
Module-3			
<p>Sustainable Design: Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification- GRIHA & IGBC Certification for buildings, Energy efficient building design- Passive solar design technique, Thermal storage, Cooling strategies, high performance insulation. Sustainable cities, Sustainable transport.</p>			
Module-4			
<p>Clean Technology and Energy: Energy sources: Basic concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy. Rainwater harvesting.</p>			
Module-5			
<p>Green Engineering: Green Engineering concepts, Sustainable Urbanization, industrialization and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis.</p>			
<p>Course Outcomes: After studying this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Learn the sustainability concepts; understand the role and responsibility of engineers in sustainable development. 2. Quantify sustainability, and resource availability, Rationalize the sustainability based on scientific merits. 3. Understand and apply sustainability concepts in construction practices, designs, product developments and processes across various engineering disciplines. 4. Make a decision in applying green engineering concepts and become a lifelong advocate of sustainability in society. 			

INTELLIGENT TRANSPORTATION SYSTEMS
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – VI

Subject Code	18CV655	CIE Marks	40
Number of Lecture Hours/Week(L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning objectives: This course will enable students to

Have an awareness and scope of transport issues, such as, traffic safety, public transport, advanced vehicle management and control. Learn how Intelligent transport systems (ITS) involve the application of information technology and telecommunications to control traffic, inform travellers and drivers, operate public transport, automating payments, handle emergencies and incidents, operate commercial fleets and freight exchange, and automate driving and safety.

Module -1

Basic elements of intelligent transportation systems (ITS), focusing on technological, systems and institutional aspects. Benefits of ITS -ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.

Module -2

Advanced traveller information systems; transportation network operations; commercial vehicle operations and intermodal freight.

Module -3

Public transportation applications, ITS and regional strategic transportation planning, including regional architectures.

Module -4

ITS and changing transportation institutions, ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS and sustainable mobility.

Module -5

Travel demand management, electronic toll collection, and ITS and road-pricing. Automated Highway Systems- Vehicles in Platoons –ITS in World – Overview of ITS Implementations in developed countries, ITS in developing countries.

Course outcomes:

After studying this course, students would be able to suggest the appropriate system/s in various functional areas of transportation. Would be able to amalgamate the various systems, plan and implement the applications of ITS. Would have learnt the application of information technology and telecommunication to control traffic and also provide advance information to the travellers, automatic handling of emergencies and to improve safety.

CONSERVATION OF NATURAL RESOURCES

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER – VI

Subject Code	18CV656	CIE Marks	40
Teaching Hours/Week(L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course learning objectives: This course will enable the students to

- Learn types of land forms , soil conservation and sustainable land use planning.
- Apprehend water resources, types, distribution, planning and conservation.
- Know the atmospheric composition of air, pollution and effects on human beings, animals and plants. Air pollution control.
- Apprehend basics of biodiversity and ecosystems.
-

Module -1

Land: Land as a resource, types of lands, conservation of land forms, deforestation, effect of land use changes. Soil health, ecological and economic importance of soil, impact of soil degradation on agriculture and food security, need for soil conservation, sustainable land use planning.

Module -2

Water: Global water resources, Indian water resources, Resources system planning. Water use sectors- domestic, industrial, agriculture. Water deficit and water surplus basins in India, equitable distribution, Inter-basin water transfers, Interlinking of rivers – Himalayan component, peninsular component, issues involved. Ground water, its potential in India, conjunctive use, recharge of ground water. Contamination of ground water, sea water ingress, problems and solutions.

Module -3

Air: Introduction, composition, sources and classification of air pollutants, National Ambient Air quality standards (NAAQS), Air quality index, effects of air pollution on human health. Economic effects of air pollution. Control of air pollution by equipment, smoke and its control. Ozone depletion –impacts, photochemical changes.

Minerals and rocks: Minerals, important rock forming minerals like Quartz, Mica, Feldspar and Amphibole, lithification & metamorphism, weathering: physical, biogeochemical processes, erosion, agents of erosion.

Module -4

Biodiversity: Introduction, Flora and Fauna, Importance of biodiversity, Economic values-medicinal plants, drugs, fisheries biogeochemical cycling. Threat to biodiversity, natural & anthropogenic disturbance, habitat loss. Conservation of biodiversity, National parks, wild life sanctuaries, zoological gardens, gene banks, pollen culture, ecological restoration, social forestry. Ecosystem: Definition, Types: forest, grass land, marine, desert, wetlands, estuarine, lotic, lentic. Abiotic & biotic components of eco system.

Module -5

Global warming: concept, indicators, factors and effects. Global climate change-indicators, health impacts, effect on biodiversity. Introduction to global efforts in conservation of biodiversity.

EIA: Regulations in India, status of EIA in India, list of projects needing environmental clearance under EIA notifications. Case study of hydro power/ thermal power projects.

Course Outcomes(CO):

At the end of the course, students will be able to

1. Apprehend various components of land as a natural resource and land use planning.
2. Know availability and distribution for water resources as applied to India.
3. Analyse the components of air as resource and its pollution.
4. Discuss biodiversity & its role in ecosystem functioning.
5. Critically appreciate the environmental concerns of today.

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VII			
QUANTITY SURVEYING AND CONTRACT MANAGEMENT			
Course Code	18CV71	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: This course will enable students to;			
<ol style="list-style-type: none"> 1. Estimate the quantities of work, develop the bill of quantities and arrive at the Cost of civil engineering Project 2. Understand and apply the concept of Valuation for Properties 3. Understand, Apply and Create the Tender and Contract document. 			
Module -1			
<p>Quantity Estimation for Building: study of various drawing attached with estimates, important terms, units of measurements, abstract, Types of estimates. Estimation of building by Short wall and long wall method - centre line method.</p> <p>Estimate of R.C.C structures including Slab, beam, column, footings.</p>			
Module -2			
<p>Estimate of Steel truss, manhole and septic tanks and slab culvert.</p> <p>Quantity Estimation for Roads: Computation of volume of earthwork fully in banking, cutting, partly cutting and partly Filling by mid-section, trapezoidal and Prismoidal Methods.</p>			
Module -3			
<p>Specification for Civil Engineering Works: Objective of writing specifications essentials in specifications, general and detail specifications of different items of works in buildings and roads.</p> <p>Analysis of Rates : Factors Affecting Cost of Civil Works , Concept of Direct Cost , Indirect Cost and Project Cost</p> <p>Rate analysis and preparation of bills, Data analysis of rates for various items of Works, Sub-structure components, Rate analysis for R.C.C. slabs, columns and beams.</p>			
Module-4			
<p>Contract Management-Tender and its Process: Invitation to tender, Prequalification, administrative approval & Technical sanction. Bid submission and Evaluation process. Contract Formulation: Letter of intent, Award of contract, letter of acceptance and notice to proceed. Features / elements of standard Tender document (source: PWD / CPWD / International Competitive Bidding – NHAI / NHEPC / NPC).</p> <p>Law of Contract as per Indian Contract act 1872, Types of Contract, Joint venture.</p> <p>Contract Forms: FIDIC contract Forms, CPWD, NHAI, NTPC, NHEPC.</p>			
Module -5			
<p>Contract Management-Post award :Basic understanding on definitions, Performance security, Mobilization and equipment advances, Secured Advance, Suspension of work, Time limit for completion, Liquidated damages and bonus, measurement and payment, additions and alterations or variations and deviations, breach of contract, Escalation, settlement of account or final payment, claims, Delay's and Compensation, Disputes & its resolution mechanism, Contract management and administration.</p> <p>Valuation: Definitions of terms used in valuation process, Purpose of valuation, Cost, Estimate, Value and its relationship, Capitalized value. Freehold and lease hold and easement, Sinking fund, depreciation–methods of estimating depreciation, Outgoings, Process and methods of valuation: Rent fixation, valuation for mortgage, valuation of land.</p>			
Course outcomes: After studying this course, students will be able to:			
<ol style="list-style-type: none"> 1. Taking out quantities and work out the cost and preparation of abstract for the estimated cost for various civil engineering works. 2. Prepare detailed and abstract estimates for various road works, structural works and water supply and sanitary works. 3. Prepare the specifications and analyze the rates for various items of work. 4. Assess contract and tender documents for various construction works. 5. Prepare valuation reports of buildings. 			

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VII			
DESIGN OF RCC AND STEEL STRUCTURES			
Course Code	18CV72	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
<p>Course Learning Objectives: This course will enable students to</p> <ol style="list-style-type: none"> 1. Provide basic knowledge in the areas of limit state method and concept of design of RC and Steel structures 2. Identify, formulate and solve engineering problems in RC and Steel Structures 3. Give procedural knowledge to design a system, component or process as per needs and specifications of RC Structures like Retaining wall, Footing, Water tanks, Portal Frames and Steel Structures like Roof Truss, Plate Girder and Gantry Girder. 4. Imbibe the culture of professional and ethical responsibilities by following codal provisions in the analysis, design of RC and Steel Structures. 5. Provide factual knowledge on analysis and design of RC Structural elements, who can participate and succeed in competitive examinations. 			
Module -1			
<p>Footings: Design of rectangular slab, slab-beam type combined footing. Retaining Walls: Design of cantilever Retaining wall and counter fort retaining wall. Water Tanks: Design of circular water tanks resting on ground (Rigid and Flexible base). Design of rectangular water tanks resting on ground. As per IS: 3370 (Part IV). Design of portal frames with fixed and hinged based supports.</p>			
Module -2			
<p>Roof Truss: Design of roof truss for different cases of loading, forces in members to given. Plate Girder: Design of welded plate girder with intermediate stiffener, bearing stiffener and necessary checks Gantry Girder: Design of gantry girder with all necessary checks.</p>			
<p>Course Outcomes: After studying this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Students will acquire the basic knowledge in design of RCC and Steel Structures. 2. Students will have the ability to follow design procedures as per codal provisions and skills to arrive at structurally safe RC and Steel members. 			

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VII

THEORY OF ELASTICITY

Course Code	18CV731	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. This course advances students from the one-dimensional and linear problems conventionally treated in courses of strength of materials in to more general, two and three-dimensional problems.
2. The student will be introduced to rectangular and polar coordinate systems to describe stress and strain of a continuous body.
3. Introduction to the stress-strain relationship, basic principles and mathematical expressions involved in continuum mechanics. Also solution of problems in 2-dimensional linear elasticity.

Module-1

Rigid and deformable bodies, body and surface forces, concept of stress, state of stress at a point, Cartesian stress components, Cauchy's stress formula, stress transformation, principal stresses and principal planes, stress invariants, equations of equilibrium in 2D and 3D (Cartesian coordinates).

Module-2

Types of strain, strain displacement relations, state of strain at a point, strain tensor, strain transformation, strain along a linear element, principal strains, strain invariants, octahedral strains, spherical and deviatoric strains.

Module-3

Generalized Hooke's Law, Stress-strain relationships, Equilibrium equations in terms of displacements and Compatibility equations in terms of stresses, Plane stress and plane strain problems, St. Venant's principle, Principle of superposition, Uniqueness theorem, Airy's stress function, Stress polynomials (Two Dimensional cases only). Equations of equilibrium in polar coordinate, compatibility equation, stress function.

Module-4

Axisymmetric stress distribution - Rotating discs, Lamé's equation for thick cylinder, Effect of circular hole on stress distribution in plates subjected to tension, compression and shear, stress concentration factor.

Module-5

Torsion: Inverse and Semi-inverse methods, stress function, torsion of circular, elliptical, triangular sections.

Course outcomes: After studying this course, students will be able to:

1. Ability to apply knowledge of mechanics and mathematics to model elastic bodies as continuum.
2. Ability to formulate boundary value problems; and calculate stresses and strains.
3. Ability to comprehend constitutive relations for elastic solids and compatibility constraints.
4. Ability to solve two-dimensional problems (plane stress and plane strain) using the concept of stress function.

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VII			
AIR POLLUTION AND CONTROL			
Course Code	18CV732	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. Study the sources and effects of air pollution 2. Learn the meteorological factors influencing air pollution. 3. Analyze air pollutant dispersion models 4. Illustrate particular and gaseous pollution control methods. 			
Module-1			
Introduction: Definition, Sources, classification and characterization of air pollutants. Effects of air pollution on health, vegetation & materials. Types of inversion, photochemical smog.			
Module-2			
Meteorology: Temperature lapse rate & stability, wind velocity & turbulence, plume behavior, measurement of meteorological variables, wind rose diagrams, Plume Rise, estimation of effective stack height and mixing depths.			
Module-3			
Sampling: Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution), Monitoring and analysis of air pollutants (PM _{2.5} , PM ₁₀ , SO _x , NO _x , CO, NH ₃). Development of air quality models-Gaussian dispersion model-Including Numerical problems.			
Module-4			
Control Techniques: Particulate matter and gaseous pollutants- settling chambers, cyclone separators, scrubbers, filters & ESP - Including Numerical problems. Site selection for industrial plant location.			
Module-5			
Air pollution due to automobiles, standards and control methods. Noise pollution- causes, effects and control, noise standards. Environmental issues, global episodes. Environmental laws and acts.			
Course outcomes: After studying this course, students will be able to:			
<ol style="list-style-type: none"> 1. Identify the major sources of air pollution and understand their effects on health and environment. 2. Evaluate the dispersion of air pollutants in the atmosphere and to develop air quality models. 3. Ascertain and evaluate sampling techniques for atmospheric and stack pollutants. 4. Choose and design control techniques for particulate and gaseous emissions. 			

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VII

PAVEMENT MATERIALS AND CONSTRUCTION

Course Code	18CV733	CIE Marks	40
Teaching Hours/Week	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:

1. Expose students to different materials which are used in pavement construction, impart knowledge about the engineering properties required.
2. To train students to perform various types of bituminous mix designs as per the guidelines (MORTH).
3. Student will get knowledge about different highway construction equipment with their suitability and adaptability in various field scenarios.
4. Expose students to construction practice and quality control aspects of embankment, flexible and rigid pavement as per the required specifications (MORTH).
5. To introduce students to possible improvisation in various layers of pavement to increase the structural strength by the use of non basic materials (DLC, polythene sheets).

Module-1

Pavement Materials

Aggregates- Origin, Classification, Requirements, properties and tests on Road aggregates, Concepts of size and gradation- design gradation, maximum aggregate size, aggregate blending by different methods to meet specification.
Bitumen and Tar- Origin, Preparation, Properties and Chemical Constitution of bituminous road binders, Requirements.

Module-2

Bituminous emulsion and Cutbacks- Preparation, Characteristics, uses and test. Adhesion of bitumen binders to road aggregates, Adhesion failure, Mechanism of stripping, tests and methods of improving adhesion.

Module-3

Bituminous mixes: Mechanical properties, dense and open textured mixes, flexibility and brittleness, (No Hveemstabilo meter and Hubbar- field tests) bituminous mixes, Design methods using Rothfutch's method only and specification, Marshall mix design criteria, voids in mineral aggregates, voids in total mix, density, flow, stability, percentage voids filled with bitumen. Problems on above.

Module-4

Equipments in highway construction: Various types of equipments for excavation, grading and compaction- their working principles, advantages and limitations. Special equipment for bituminous and cement concrete pavement and stabilized soil road construction.

Sub grade: Earthwork grading and Construction of embankments and cuts for roads, Preparation of subgrade, quality control tests.

Module-5

Flexible Pavements: Specifications of materials, Construction method and field control checks for various types of flexible pavement layers.

Cement Concrete Pavements: Specifications and method of cement concrete pavement construction (PQC, importance of providing DLC as sub base and polythene thin layer between PQC and sub base). Quality control tests, Construction of various types of joints.

Course outcomes: At the end of the course the student will be able to:

1. Students will be able to evaluate and assess the suitability of any pavement material to be used in various components of pavement by conducting required tests as per IS,IRC specifications
2. Students will be able to formulate the proportions of different sizes of aggregates to suit gradation criteria for various mixes as per MORTH and also design bituminous mixes.
3. Students will be competent to adapt suitable modern technique and equipment for speedy and economic construction.
4. Student will be able to execute the construction of embankment, flexible, rigid pavement and perform required quality control tests at different stages of pavement construction.

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VII

GROUND WATER HYDRAULICS

Course Code	18CV734	IA Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	Exam Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students

1. To characterize the properties of ground water and aquifers.
2. To quantify the ground water flow.
3. To locate occurrence of ground water and augment ground water resources.
4. To synthesize ground water development methods.

Module -1

Introduction: Importance, vertical distribution of subsurface water, occurrence in different types of rocks and soils, definitions-aquifers, aquifuge, aquitard, aquiclude, confined and Unconfined aquifers.

Module -2

Fundamentals of Ground Water Flow: Aquifer parameters, specific yield and specific retention, porosity, storage coefficient, derivation of the expression, Darcy's law, hydraulic conductivity, coefficient of permeability and intrinsic permeability, transmissibility, permeability in isotropic, anisotropic layered soils.

Module -3

Well Hydraulics: Steady Flow, Radial flow in confined and unconfined aquifers, pumping test Unsteady Flow, General equation, derivation; theis method, Cooper and Jacob method, Chow's method, solution of unsteady flow equations, leakyaquifers (only introduction), interference of well, image well theory.

Module -4

Ground Water Exploration: Seismic method, electrical resistivity method, Geo-physical techniques, electrical logging, radioactive logging, induction logging, sonic and fluid logging.

Module -5

Ground Water Development: Types of wells, methods of construction, tube well design, dug wells, pumps for lifting water, working principles, power requirement, Conjunctive use, necessity, techniques and economics.

Ground Water Recharge: Artificial recharge, Rainwater harvesting for ground water recharge.

Course outcomes: After studying this course, students will be able to:

1. Find the characteristics of aquifers.
2. Estimate the quantity of ground water by various methods.
3. Locate the zones of ground water resources.
4. Select particular type of well and augment the ground water storage.

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VII			
MASONRY STRUCTURES			
Course Code	18CV735	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. Understand properties of masonry units, strength and factors affecting strength. 2. Understand design criteria of various types of wall subjected to different load system. 3. Impart the culture of following the codes for strength, serviceability and durability as an ethics. 4. Provide knowledge in analysis and design of masonry elements for the success in competitive examinations. 			
Module-1			
<p>Masonry Units, Materials, types and masonry construction: Bricks, Stone and Block masonry units-strength, modulus of elasticity and water absorption of masonry materials-classification and properties of mortars. Defects and Errors in masonry construction – cracks in masonry, types, reason f o r cracking, methods of avoiding cracks.</p> <p>Strength and Stability: Strength and stability of axially loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of curing, effect of ageing, workmanship. Compressive strength formulae based on elastic theory and empirical formulae.</p>			
Module-2			
<p>Permissible stresses: Types of walls, permissible compressive stress, stress reduction and shape modification factors, increase in permissible stresses for eccentric vertical and lateral load, permissible tensile stress and shear stresses.</p> <p>Design Considerations: Effective height of wall sand columns, openings in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action in lintels. Problems on design considerations for solid walls, cavity walls, wall with pillars.</p>			
Module-3			
Load considerations and design of Masonry subjected to axial loads: Design criteria, design examples of walls under UDL, solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers.			
Module-4			
<p>Design of walls subjected to concentrated axial loads: Solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers, design of wall with openings.</p> <p>Design of walls subjected to eccentric loads: Design criteria – stress distribution under eccentric loads –Problems onec centrally loaded solid walls, cavity walls, walls with piers.</p>			
Module-5			
<p>Design of Laterally and transversely loaded walls: Design criteria, design of solid wall under wind loading, design of shear wall – design of compound walls.</p> <p>Introduction to reinforced brick masonry, lintels and slabs.</p> <p>In-filled frames: Types – modes of failures – design criteria of masonry retaining walls.</p>			
<p>Course outcomes: After studying this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Select suitable material for masonry construction by understanding engineering properties. 2. Compute loads, load combinations and analyze the stresses in masonry. 3. Design masonry under compression (Axial load) for various requirements and conditions. 4. Design masonry under bending (Eccentric, lateral, transverse load) for various requirements and conditions. 5. Assess the behavior of shear wall and reinforced masonry. 			

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VII

EARTHQUAKE ENGINEERING

Course Code	18CV741	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to learn about

1. Fundamentals of engineering seismology
2. Irregularities in building which are detrimental to its earthquake performance
3. Different methods of computation seismic lateral forces for framed and masonry structures
4. Earthquake resistant design requirements for RCC and Masonry structures
5. Relevant clauses of IS codes of practice pertinent to earthquake resistant design of structures

Module -1

Engineering Seismology: Terminologies (Focus, Focal depth, Epicenter, etc.); Causes of Earthquakes; Theory of plate tectonics; Types and characteristics faults; Classification of Earthquakes; Major past earthquakes and their consequences; Types and characteristics of seismic waves; Magnitude and intensity of earthquakes; local site effects; Earthquake ground motion characteristics: Amplitude, frequency and duration; Seismic zoning map of India; (Problems on computation of wave velocities. Location of epicenter, Magnitude of earthquake).

Module -2

Response Spectrum: Basics of structural dynamics; Free and forced vibration of SDOF system; Effect of frequency of input motion and Resonance; Numerical evaluation of response of SDOF system (Linear acceleration method), Earthquake Response spectrum: Definition, construction, Characteristics and application; Elastic design spectrum.

Module -3

Seismic Performance of Buildings and Over View of IS-1893 (Part-1): Types of damages to building observed during past earthquakes; Plan irregularities; mass irregularity; stiffness irregularity; Concept of soft and weak storey; Torsional irregularity and its consequences; configuration problems; continuous load path; Architectural aspects of earthquake resistant buildings; Lateral load resistant systems. Seismic design philosophy; Structural modeling; Code based seismic design methods.

Module -4

Determination of Design Lateral Forces: Equivalent lateral force procedure and dynamic analysis procedure. Step by step procedures for seismic analysis of RC buildings using Equivalent static lateral force method and response spectrum methods (maximum of 4 storeys and without infill walls).

Module -5

Earthquake Resistant Analysis and Design of RC Buildings: Typical failures of RC frame structures, Ductility in Reinforced Concrete, Design of Ductile Reinforced Concrete Beams, Seismic Design of Ductile Reinforced Concrete column, Concept of weak beam-strong column, Detailing of Beam-Column Joints to enhance ductility, Detailing as per IS-13920. Retrofitting of RC buildings

Earthquake Resistant Design of Masonry Buildings: Performance of Unreinforced, Reinforced, Infill Masonry Walls, Box Action, Lintel and sill Bands, elastic properties of structural masonry, lateral load analysis, Recommendations for Improving performance of Masonry Buildings during earthquakes; Retrofitting of Masonry buildings.

- Course outcomes:**
1. Acquire basic knowledge of engineering seismology.
 2. Develop response spectra for a given earthquake time history and its implementation to estimate response of a given structure.
 3. Understanding of causes and types of damages to civil engineering structures during different earthquake scenarios.
 4. Analyze multi-storied structures modeled as shear frames and determine lateral force distribution due to earthquake input motion using IS-1893 procedures.
 5. Comprehend planning and design requirements of earthquake resistant features of RCC and Masonry structures through exposure to different IS-codes of practices.

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VII

DESIGN CONCEPT OF BUILDING SERVICES

Course Code	18CV742	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. Learn the importance of sanitation, domestic water supply, and plumbing and fire services.
2. Understand the concepts of heat, ventilation and air conditioning.
3. Develop technical and practical knowledge in Building Services.

Module -1

Water Supply and its Services.

Water requirements for different types of buildings, simple method of removal of impurities, water saving practices and their potential Service connection from mains, sump and storage tank, types and sizes of pipes, special installation in multistoried buildings. Material, types of fixtures and fitting for a contemporary bathroom– taps –quarter turn, half turn, ceramic, foam flow etc, hot water mixer, hand shower Rainwater harvesting to include roof top harvesting, type of spouts, sizes of rainwater pipes and typical detail of a water harvesting pit.

Module -2

Heat Ventilation and Air Conditioning (HVAC):

Behaviour of heat propagation, thermal insulating materials and their co-efficient of thermal conductivity. General methods of thermal insulation: Thermal insulation of roofs, exposed walls. Ventilation: Definition and necessity, system of ventilation. Principles of air conditioning, Air cooling, Different systems of ducting and distribution, Essentials of air-conditioning system.

Module -3

Electrical and Fire Fighting Services:

Electrical systems, Basics of electricity, single/Three phase supply, protective devices in electrical installation, Earthing for safety, Types of earthing, ISI Specifications. Electrical installations in buildings, Types of wires, Wiring systems and their choice, planning electrical wiring for building, Main and distribution boards, Principles of illumination.

Classification of buildings based on occupancy, causes of fire and spread of fire, Standard fire, Fire fighting, protection and fire resistance, Firefighting equipment and different methods of fighting fire., means of escape, alarms, etc., Combustibility of materials, Structural elements and fire resistance, Fire escape routes and elements, planning and design. Wet risers, dry risers, sprinklers, heat detector, smoke detectors, fire dampers, fire doors, etc. Provisions of NBC.

Module -4

Plumbing and Fire Fighting Layout of Simple Buildings:

Application of above studies in preparing layout and details - Plumbing layout of residential and public buildings, Fire fighting layout, Reflected ceiling plan of smoke detectors / sprinklers, etc.

Module -5

Engineering Services: engineering services in a building as a system, Lifts, escalators, cold and hot water systems, waste water systems and electrical systems.

Pumps and Machineries: Reciprocating, Centrifugal, Deep well, Submersible, Automatic pumps, Sewerage pumps, Compressors, Vacuum pump – their selection, installation and maintenance – Hot water boilers – Classification and types of lifts, lift codes, rules structural provision: escalators, their uses, types and sizes, safety norms to be adopted – Social features required for physically handicapped and elderly, DC/AC motors, Generators,

Building Maintenance: Preventive and protective maintenance, Scheduled and contingency maintenance planning, M.I.S. for building maintenance. Maintenance standards. Economic maintenance decisions.

Course Outcomes: After studying this course, students will be able to:

1. Describe the basics of house plumbing and waste water collection and disposal.
2. Discuss the safety and guidelines with respect to fire safety.
3. Describe the issues with respect to quantity of water, rain water harvesting and roof top harvesting.
4. Understand and implement the requirements of thermal comfort in buildings.

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VII

REINFORCED EARTH STRUCTURES

Course Code	18CV743	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to;

1. Create an understanding of the latest technique such as reinforcing the soil;
2. Analyze the concept of RE so as to ascertain stability of RE structures;
3. Understand the different reinforcing materials that can be used efficiently in soils.
4. Understand design concepts of different RE structures including introductory concepts of Foundations resting on RE soil bed.

Module -1

Basics of Reinforced Earth Construction: Definition, Historical Background, Components, Mechanism and Concept, Advantages and Disadvantage of reinforced earth Construction, Sandwich technique for clayey soil.

Geosynthetics and Their Functions: Historical developments, Recent developments, manufacturing process woven & non-woven, Raw materials – Classification based on materials type – Metallic and Non-metallic, Natural and Man-made, Geosynthetics.

Properties and Tests on Materials Properties – Physical, Chemical, Mechanical, Hydraulic, Endurance and Degradation requirements, Testing & Evaluation of properties.

Module -2

Design of Reinforced Earth Retaining Walls: Concept of Reinforced earth retaining wall, Internal and external stability, Selection of materials, Typical design problems

Soil Nailing Techniques: Concept, Advantages & limitations of soil nailing techniques, comparison of soil nailing with reinforced soil, methods of soil nailing, Construction sequence, Components of system, Design aspects and precautions to be taken.

Module -3

Design of Reinforced Earth Foundations: Modes of failure of foundation, Determination of force induced in reinforcement ties – Location of failure surface, tension failure and pull out resistance, length of tie and its curtailment, Bearing capacity improvement in soft soils, General guidelines.

Module -4

Geosynthetics for Roads and Slopes: Roads - Applications to Temporary and Permanent roads, Role of Geosynthetic in enhancing properties of road, control of mud pumping, Enhancing properties of subgrade, Design requirements Slopes – Causes for slope failure, Improvement of slope stability with Geosynthetic, Drainage requirements, Construction technique. Simple Numerical Stability Checking Problems on Reinforced Slopes.

Module -5

Geosynthetics - filter, drain and landfills: Filter & Drain – Conventional granular filter design criteria, Geosynthetic filter design requirements, Drain and filter properties, Design criteria – soil retention, Geosynthetic permeability, anti clogging, survivability and durability (No Numerical Problems)

Landfills – Typical design of Landfills – Landfill liner & cover, EPA Guidelines, Barrier walls for existing landfills and abandoned dumps (No Numerical Problems).

Course outcomes: After studying this course, students will be able to:

1. identify, formulate reinforced earth techniques that are suitable for different soils and in different structures;
2. understand the laboratory testing concepts of Geo synthetics
3. design RE retaining structures and Soil Nailing concepts
4. Determine the load carrying capacity of Foundations resting on RE soil bed.
5. assess the use of Geo synthetics in drainage requirements and landfill designs

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VII

DESIGN OF HYDRAULIC STRUCTURES

Course Code	18CV744	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

CREDITS –03

Course Learning Objectives: This course will enable students to;

1. Analyze and design gravity dams.
2. Find the cross-section of earth dam and estimate the seepage loss.
3. Design spillways and aprons for diversion works.
4. Design CD works and chose appropriate canal regulation works.

Module -1

Gravity Dams: Introduction, forces acting on dam, cause of failure, design principles, principal and shear stresses. Elementary profile and practical profile of a gravity dam. Drainage galleries, joints in gravity dams.

Module -2

Earth Dams: Introduction, causes of failure of earth dams, preliminary section, Determination of parametric line by Casagrande's method. Estimation of seepage.

Module -3

Spillways: Types, Design of Ogee spillway, Upstream and downstream profiles, Energy dissipation devices.

Diversion Headworks: Design of aprons- Bligh's and Koshla's theory, Simple Problems.

Module -4

Cross Drainage Works: Introduction, Type of C.D works, Design considerations for C.D works. Transition formula design of protection works, Design of only aqueduct.

Module -5

Canal Regulation Works: Introduction, Function of a regulator.

Canal falls: Necessity and types.

Canal outlets: Necessity and types.

Course outcomes: After studying this course, students will be able to:

1. Check the stability of gravity dams and design the dam.
2. Estimate the quantity of seepage through earth dams.
3. Design spillways and aprons for various diversion works.
4. Select particular type of canal regulation work for canal network.

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VII			
URBAN TRANSPORT PLANNING			
Course Code	18CV745	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: This course will enable students to;			
<ol style="list-style-type: none"> 5. Understand and apply basic concepts and methods of urban transportation planning. 6. Apprise about the methods of designing, conducting and administering surveys to provide the data required for transportation planning. 7. Understand the process of developing an organized mathematical modelling approach to solve select urban transportation planning problem. 8. Excel in use of various types of models used for travel forecasting, prediction of future travel patterns. 			
Module -1			
Urban transport planning: Urbanization, urban class groups, transportation problems and identification, impacts of transportation, urban transport system planning process, modeling techniques in planning. Urban mass transportation systems: urban transit problems, travel demand, types of transit systems, public, private, para-transit transport, mass and rapid transit systems, BRTS and Metro rails, capacity, merits and comparison of systems, coordination, types of coordination.			
Module -2			
Data Collection And Inventories: Collection of data – Organisation of surveys and Analysis, Study Area, Zoning, Types and Sources of Data, Road Side Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques, Expansion Factors, Accuracy Checks, Use of Secondary Sources, Economic data – Income – Population – Employment – Vehicle Owner Ship.			
Module -3			
Trip Generation & Distribution: UTPS Approach, Trip Generation Analysis: Zonal Models, Category Analysis, Household Models, Trip Attraction models, Commercial Trip Rates; Trip Distribution by Growth Factor Methods. Problems on above.			
Module -4			
Trip Distribution: Gravity Models, Opportunity Models, Time Function Iteration Models. Travel demand modeling: gravity model, opportunity models, Desire line diagram. Modal split analysis. Problems on above.			
Module -5			
Traffic Assignment: Diversion Curves; Basic Elements of Transport Networks, Coding, Route Properties, Path Building Criteria, Skimming Tree, All-or-Nothing Assignment, Capacity Restraint Techniques, Reallocation of Assigned Volumes, Equilibrium Assignment. Numerical problems on Traffic Assignment. Introduction to land use planning models, land use and transportation interaction.			
Course outcomes: After studying this course, students will be able to:			
<ol style="list-style-type: none"> 5. Design, conduct and administer surveys to provide the data required for transportation planning. 6. Supervise the process of data collection about travel behavior and analyze the data for use in transport planning. 7. Develop and calibrate modal split, trip generation rates for specific types of land use developments. 8. Adopt the steps that are necessary to complete a long-term transportation plan. 			

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VII

FINITE ELEMENT METHOD

Course Code	18CV751	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to;

1. Develop analytical skills.
2. Learn principles of analysis of stress and strain.
3. Develop problem solving skills.
4. Understand the principles of FEM for one and two dimensional problems.

Module -1

Theory of elasticity concepts, Energy principles, Rayleigh - Ritz Method, Galerkin method and finite element method, steps in finite element analysis, displacement approach, stiffness matrix and boundary conditions.

Module -2

Discretisation; finite representation of infinite bodies and discretisation of very large bodies, Natural Coordinates, Shape functions; polynomial, LaGrange and Serendipity , one dimensional formulations; beam and truss with numerical examples.

Module -3

2D formulations; Constant Strain Triangle, Linear Strain Triangle, 4 and 8 noded quadrilateral elements, Numerical Evaluation of Element Stiffness -Computation of Stresses, Static Condensation of nodes, degradation technique, Axisymmetric Element.

Module -4

Isoparametric concepts; isoparametric, sub parametric and super parametric elements, Jacobian transformation matrix, Stiffness Matrix of Isoparametric Elements, Numerical integration by Gaussian quadrature rule for one, two and three dimensional problems.

Module -5

Techniques to solve nonlinearities in structural systems; material, geometric and combined non linearity, incremental and iterative techniques.
 Structure of computer program for FEM analysis, description of different modules, exposure to FEM softwares.

Course outcomes: The student will have the knowledge on advanced methods of analysis of structures.

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VII

NUMERICAL METHODS AND APPLICATIONS

Course Code	18CV752	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course aims at providing the necessary basic concepts of a few numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology

Module -1

Solution of Equations and Eigen value Problems: Solution of algebraic and transcendental equations, Fixed point iteration method, Newton Raphson method, Solution of linear system of equations, Gauss elimination method, Pivoting, Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Matrix Inversion by Gauss Jordan method.

Module -2

Interpolation and Approximation: Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and backward difference formulae.

Module -3

Numerical Differentiation and Integration: Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

Module -4

Initial Value Problems for Ordinary Differential Equations : Single Step methods - Taylor's series method - Euler's method - Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations - Multi step methods - Milne's and Adams-Bash forth predictor corrector methods for solving first order equations.

Module -5

Boundary Value Problems in Ordinary and Partial Differential Equations: Finite difference methods for solving two-point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

Course Outcomes: After studying this course, The students will have a clear perception of the power of numerical techniques, ideas and would be able to demonstrate the applications of these techniques to problems drawn from Industry, management and other engineering fields.

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VII			
ENVIRONMENTAL PROTECTION AND MANAGEMENT			
Course Code	18CV753	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: This course will enable students to gain knowledge in Environmental protection and Management systems			
Module -1			
Environmental Management Standards: Unique Characteristics of Environmental Problems - Systems approach to Corporate environmental management - Classification of Environmental Impact Reduction Efforts - Business Charter for Sustainable Production and Consumption – Tools, Business strategy drivers and Barriers - Evolution of Environmental Stewardship. Environmental Management Principles - National policies on environment, abatement of pollution and conservation of resources - Charter on Corporate responsibility for Environmental protection.			
Module -2			
Environmental Management Objectives: Environmental quality objectives – Rationale of Environmental standards: Concentration and Mass standards, Effluent and stream standards, Emission and ambient standards, Minimum national standards, environmental performance evaluation: Indicators, benchmarking. Pollution control Vs Pollution Prevention - Opportunities and Barriers – Cleaner production and Clean technology, closing the loops, zero discharge technologies.			
Module -3			
Environmental Management System: EMAS, ISO 14000 - EMS as per ISO 14001– benefits and barriers of EMS – Concept of continual improvement and pollution prevention - environmental policy – initial environmental review – environmental aspect and impact analysis – legal and other requirements- objectives and targets – environmental management programs – structure and responsibility – training awareness and competence- communication – documentation and document control – operational control – monitoring and measurement – management review.			
Module -4			
Environmental Audit: Environmental management system audits as per ISO 19011- – Roles and qualifications of auditors - Environmental performance indicators and their evaluation – Non conformance – Corrective and preventive actions -compliance audits – waste audits and waste minimization planning – Environmental statement (form V) - Due diligence audit.			
Module -5			
Applications: Applications of EMS, Waste Audits and Pollution Prevention Control: Textile, Sugar, Pulp & Paper, Electroplating, , Tanning industry. Hazardous Wastes - Classification, characteristics Treatment and Disposal Methods, Transboundary movement, disposal.			
Course outcomes: After studying this course, students will be able to:			
1. Appreciate the elements of Corporate Environmental Management systems complying to international environmental management system standards.			
2. Lead pollution prevention assessment team and implement waste minimization options.			
3. Develop, Implement, maintain and Audit Environmental Management systems for Organizations.			

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VIII

DESIGN OF PRE-STRESSED CONCRETE

Course Code	18CV81	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to learn Design of Pre Stressed Concrete Elements.

Module -1

Introduction and Analysis of Members: Concept of Pre stressing - Types of Pre stressing - Advantages - Limitations - Pre stressing systems - Anchoring devices - Materials - Mechanical Properties of high strength concrete - high strength steel - Stress-Strain curve for High strength concrete.
 Analysis of members at transfer - Stress concept - Comparison of behavior of reinforced concrete – pre stressed concrete - Force concept - Load balancing concept - Kern point - Pressure line.

Module -2

Losses in Pre stress: Loss of Pre stress due to Elastic shortening, Friction, Anchorage slip, Creep of concrete, Shrinkage of concrete and Relaxation of steel - Total Loss.
 Deflection and Crack Width Calculations of Deflection due to gravity loads - Deflection due to prestressing force - Total deflection - Limits of deflection - Limits of span-to-effective depth ratio - Calculation of Crack Width - Limits of crack width.

Module -3

Design of Sections for Flexure: Analysis of members at ultimate strength - Preliminary Design - Final Design for Type I members.

Module -4

Design for Shear: Analysis for shear - Components of shear resistance - Modes of Failure - Limit State of collapse for shear - Design of transverse reinforcement.

Module -5

Different anchorage system and design of end block by latest IS codes.

Course outcomes: After studying this course, students will be able to:

1. Understand the requirement of PSC members for present scenario.
2. Analyse the stresses encountered in PSC element during transfer and at working.
3. Understand the effectiveness of the design of PSC after studying losses
4. Capable of analyzing the PSC element and finding its efficiency.
5. Design PSC beam for different requirements.

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VIII

BRIDGE ENGINEERING

Course Code	18CV821	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to understand the analysis and design of concrete Bridges.

Note: All designs have to be done by Working Stress Method

Module -1

Introduction to bridges, classification, selection of bridge site and preliminary and detailed survey work computation of discharge, linear waterway, economic span, afflux, scour depth.
 Design loads for bridges, introduction to I.R.C. loading standards, Load Distribution Theory, Bridge slabs, Effective width, Introduction to methods as per I.R.C.

Module -2

Design of Slab Bridges: Straight and skew slab bridges.

Module -3

Design of T beam bridges(up to three girder only)
 Proportioning of components, analysis of slab using IRC Class AA tracked vehicle, structural design of slab, analysis of cross girder for dead load & IRC Class AA tracked vehicle, structural design of cross girder, analysis of main girder using Courbon's method, calculation of dead load BM and SF, calculation of live load B M & S F using IRC Class AA Tracked vehicle. Structural design of main girder.

Module -4

Other Bridges:
 Design of Box culvert (Single vent only).
 Design of Pipe culverts.

Module -5

Substructures - Design of Piers and abutments,
 Introduction to Bridge bearings, Hinges and Expansion joints.(No design).

Course outcomes: After studying this course, students will be able to:

1. Understand the load distribution and IRC standards.
2. Design the slab and T beam bridges.
3. Design Box culvert, pipe culvert
4. Use bearings, hinges and expansion joints and
5. Design Piers and abutments.

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VIII

PREFABRICATED STRUCTURES

Course Code	18CV822	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. Understand modular construction, industrialized construction
2. Design prefabricated elements.
3. Understand construction methods.

Module -1

Introduction: Need for prefabrication–Principles–Materials–Modular coordination–Standardization–Systems–Production–Transportation–Erection.

Module -2

Prefabricated Components: Behavior of structural components–Large panel constructions–Construction of roof and floor slabs–Wall panels–Columns–Shear walls.

Module -3

Design Principles: Disuniting of structures–Design of cross section based on efficiency of material used–Problems in design because of joint flexibility–Allowance for joint deformation.

Module -4

Joint In Structural Members: Joints for different structural connections–Dimensions and detailing–Design of expansion joints.

Module -5

Design For Abnormal Loads: Progressive collapse–Code provisions–Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc.,-Importance of avoidance of progressive collapse.

Course Outcomes: After studying this course, students will be able to:

1. Use modular construction, industrialized construction
2. Design prefabricated elements
3. Design some of the prefabricated elements
4. Use the knowledge of the construction methods and prefabricated elements in buildings

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VIII			
ADVANCED FOUNDATION ENGINEERING			
Course Code	18CV823	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. Gain knowledge of about advanced topics of foundation design and analyses, supplementing their comprehensive knowledge acquired in basic foundation engineering course. 2. Develop profound understanding of shallow and deep foundation analyses. 3. Develop understanding of choice of foundation design parameters. 4. Learn about cause and effect of dynamic loads on foundation. 			
Module -1			
General bearing capacity equation – Terzaghi’s, Brinch Hansen’s and Mayerhof’s analyses, bearing capacity of footings according to BIS, eccentrically loaded footing, footing on layered soil, Settlement of shallow Foundations: Immediate, consolidation, & differential settlements. Principles of design of footing, Proportioning of footings for equal settlement.			
Module -2			
Design of combined footings by Rigid method, Combined footings (rectangular & trapezoidal), strap footings. Types of rafts, bearing capacity & settlements of raft foundation, Design of raft foundation – Conventional rigid method, Elastic methods, Coefficient of sub-grade reaction, IS code (IS-2950) procedure.			
Module -3			
Introduction Necessity of pile foundations, Classification, Load bearing capacity of single pile by Static formula, Dynamic formula, Pile load test and Penetration tests. Introduction, Pile groups, group action of piles in sand and clay, group efficiency of piles, settlement of piles, negative skin friction, laterally loaded piles and under reamed piles.			
Module -4			
Well Foundations: Introduction, Different shapes and characteristics of wells. Components of well foundation. Forces acting on well foundation. Sinking of wells. Causes and remedies of tilts and shifts. Drilled Piers & Caissons: Introduction, construction, advantages and disadvantages of drilled piers. Design of open, pneumatic and floating caissons. Advantages and disadvantages of floating caissons.			
Module -5			
Machine Foundations: Introduction, free and forced vibrations, Types of Machine foundations, degrees of freedom of a block foundation, general criteria for design of machine foundation, vibration analysis of a machine foundation, determination of natural frequency, vibration isolation and control.			
Course outcomes: After studying this course, students will be able to:			
<ol style="list-style-type: none"> 1. Estimate the size of isolated and combined foundations to satisfy bearing capacity and settlement criteria. 2. Estimate the load carrying capacity and settlement of single piles and pile groups including laterally loaded piles. 3. Understand the basics of analysis and design principles of well foundation, drilled piers and caissons. 4. Understand basics of analysis and design principles of machine foundations. 			

B. E. CIVIL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - VIII			
REHABILITATION AND RETROFITTING			
Course Code	18CV824	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: This course will enable students to;			
<ol style="list-style-type: none"> 1. Investigate the cause of deterioration of concrete structures. 2. Strategies different repair and rehabilitation of structures. 3. Evaluate the performance of the materials for repair. 			
Module -1			
General: Introduction and Definition for Repair, Retrofitting, Strengthening and rehabilitation. Physical and Chemical Causes of deterioration of concrete structures, Evaluation of structural damages to the concrete structural elements due to earthquake.			
Module -2			
Damage Assessment: Purpose of assessment, Rapid assessment, Investigation of damage, Evaluation of surface and structural cracks, Damage assessment procedure, destructive, non-destructive and semi destructive testing systems.			
Module -3			
Influence on Serviceability and Durability: Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, and cathodic protection.			
Module -4			
Maintenance and Retrofitting Techniques: Definitions: Maintenance, Facts of Maintenance and importance of Maintenance Need for retrofitting, retrofitting of structural members i.e., column and beams by Jacketing technique, Externally bonding(ERB) technique, near surface mounted (NSM) technique, External post-tensioning, Section enlargement and guidelines for seismic rehabilitation of existing building.			
Module -5			
Materials for Repair and Retrofitting: Artificial fiber reinforced polymer like CFRP, GFRP, AFRP and natural fiber like Sisal and Jute. Adhesive like, Epoxy Resin, Special concretes and mortars, concrete chemicals, special elements for accelerated strength gain, Techniques for Repair: Rust eliminators and polymers coating for rebar during repair foamed concrete, mortar and dry pack, vacuum concrete, Guniting and Shot Crete Epoxy injection, Mortar repair for cracks, shoring and underpinning.			
Course outcomes: After studying this course, students will be able to:			
<ol style="list-style-type: none"> 1. Identify the causes for structural (Concrete) deterioration. 2. Assess the type and extent of damage and carry out damage assessment of structures through various types of tests. 3. Recommend maintenance requirements of the buildings and preventive measures against influencing factors. 4. Select suitable material and suggest an appropriate method for repair and rehabilitation. 			

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VIII

PAVEMENT DESIGN

Course Code	18CV825	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. Gain knowledge about the process of collecting data required for design, factors affecting pavement design, and maintenance of pavement.
2. Excel in the path of analysis of stress, strain and deflection in pavement.
3. Understand design concepts of flexible pavement by various methods (CBR, IRC 37-2001, Mcleods, Kansas) and also the same of rigid pavement by IRC 58-2002
4. Understand the various causes leading to failure of pavement and remedies for the same.
5. Develop skills to perform functional and structural evaluation of pavement by suitable methods.

Module -1

Introduction: Desirable characteristics of pavement, Types and components, Difference between Highway pavement and Air field pavement, Design strategies of variables, Functions of sub grade, sub base, Base course, surface course, comparison between Rigid and flexible pavement
Fundamentals of Design of Pavements: Stresses and deflections, Principle, Assumptions and Limitations of Boussinesq's theory, Burmister theory and problems on above.

Module -2

Design Factors: Design wheel load, contact pressure, Design life, Traffic factors, climatic factors, Road geometry, Subgrade strength and drainage, ESWL concept Determination of ESWL by equivalent deflection criteria, Stress criteria, EWL concept, and problems on above.
Flexible pavement Design: Assumptions, Mcleod Method, Kansas method, CBR method, IRC Method (old), CSA method using IRC-37-2001, problems on above.

Module -3

Flexible Pavement Failures, Maintenance and Evaluation: Types of failures, Causes, Remedial/Maintenance measures in flexible pavements, Functional Evaluation by Visual inspection and unevenness measurements, Structural evaluation by Benkleman beam deflection method, Falling weight deflecto meter, GPR method. Design factors for runway pavements, Design methods for Airfield pavement and problems on above.

Module -4

Stresses in Rigid Pavement : Types of stress, Analysis of Stresses, Westergaard's Analysis, Modified Westergaard equations, Critical stresses, Wheel load stresses, Warping stress, Frictional stress, combined stresses (using chart / equations), problems on above.
Design of Rigid Pavement: Design of CC pavement by IRC: 58-2002 for dual and Tandem axle load, Reinforcement in slabs, Design of Dowel bars, Design of Tie bars, Design factors for Runway pavements, Design methods for airfield pavements, problems of the above.

Module -5

Rigid Pavement Failures, Maintenance and Evaluation: Types of failures, causes, remedial/maintenance measures in rigid pavements, Functional evaluation by Visual inspection and unevenness measurements, wheel load and its repetition, properties of sub grade, properties of concrete. External conditions, joints, Reinforcement, Requirements of joints, Types of joints, Expansion joint, contraction joint, warping joint, construction joint, longitudinal joint, Design of joints.

Course outcomes: After studying this course, students will be able to:

1. Systematically generate and compile required data's for design of pavement (Highway & Airfield).
2. Analyze stress, strain and deflection by boussinesq's, bur mister's and westergaard's theory.
3. Design rigid pavement and flexible pavement conforming to IRC58-2002 and IRC37-2001.
4. Evaluate the performance of the pavement and also develops maintenance statement based on site specific requirements.