**UEM JAIPUR**

**DEPARTMENT OF CIVIL ENGINEERING**

**UPDATED SYLLABUS**

**(*Effective from January 2018*)**

**THIRD SEMESTER**

**CEC301  
Auto Cad 2D and Civil 3D**

**Module 1: Introduction:** Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, co-ordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.

**Module 2: Symbols and Sign Conventions:** Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards

**Module 3: Masonry Bonds:** English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall

**Module 4: Building Drawing:** Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity

**Module 5: Pictorial View:** Principles of isometrics and perspective drawing. Perspective view of building. Fundamentals of Building Information Modeling (BIM).

**CEC302  
Engineering Mechanics**

**Module 1:** **Introduction to Engineering Mechanics**: Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy.

**Module 2:** **Friction:** Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

**Module 3**: **Basic Structural Analysis**: Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines.

**Module 4:** **Centroid and Centre of Gravity**: Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

**Module 5:** **Virtual Work and Energy Method**: Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium, Applications of energy method for equilibrium, Stability of equilibrium.

**Module 6:** **Review of particle dynamics**- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton’s 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy.Impulse-momentum (linear, angular); Impact (Direct and oblique).

**Module 7:** **Introduction to Kinetics of Rigid Bodies**: Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D’Alembert’s principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.

**Module 8:** **Mechanical Vibrations**: Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums

**CEC303  
Energy Science and Engineering**

**Module 1: Introduction to Energy Science:** Scientific principles and historical interpretation to place energy use in the context of pressing societal, environmental and climate issues; Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment.

**Module 2: Energy Sources:** Overview of energy systems, sources, transformations, efficiency, and storage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energy storages, high efficiency batteries).

**Module 3: Energy & Environment:** Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How future energy use can be influenced by economic, environmental, trade, and research policy.

**Module 4: Civil Engineering Projects connected with the Energy Sources:** Coal mining technologies, Oil exploration offshore platforms, Underground and under-sea oil pipelines, solar chimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydropower stations above-ground and underground along with associated dams, tunnels, penstocks, etc.; Nuclear reactor containment buildings and associated buildings, design and construction constraints and testing procedures for reactor containment buildings; Spent Nuclear fuel storage and disposal systems

**Module 5: Engineering for Energy conservation:** Concept of Green Building and Green Architecture; Green building concepts (Green building encompasses everything from the choice of building materials to where a building is located, how it is designed and operated); LEED ratings; Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption.

**CEC304  
Engineering Geology**

**Module 1: Introduction**-Branches of geology useful to civil engineering, scope of geological studies in various civil engineering projects. Department dealing with this subject in India and their scope of work- GSI, Granite Dimension Stone Cell, NIRM. Mineralogy-Mineral, Origin and composition. Physical properties of minerals, susceptibility of minerals to alteration, basic of optical mineralogy, SEM, XRD., Rock forming minerals, megascopic identification of common primary & secondary minerals.

**Module 2: Petrology**-Rock forming processes. Specific gravity of rocks. Ternary diagram. Igneous petrology- Volcanic Phenomenon and different materials ejected by volcanoes. Types of volcanic eruption. Concept of Hot spring and Geysers. Characteristics of different types of magma. Division of rock on the basis of depth of formation, and their characteristics. Chemical and Mineralogical Composition. Texture and its types. Various forms of rocks. IUGS Classification of phaneritic and volcanic rock.. Field Classification chart. Structures. Classification of Igneous rocks on the basis of Chemical composition. Detailed study of Acidic Igneous rocks like Granite, Rhyolite or Tuff, Felsite, Pegmatite, Hornfels. Metamorphic Aureole, Kaolinization. Landform as Tors. Engineering aspect to granite. Basic Igneous rocks Like Gabbro, Dolerite, Basalt. Engineering aspect to Basalt. Sedimentary petrology- mode of formation, Mineralogical Composition. Texture and its types, Structures, Gradation of Clastic rocks. Classification of sedimentary rocks and their characteristics. Detailed study of Conglomerate, Breccia, Sandstone, Mudstone and Shale, Limestone Metamorphic petrology- Agents and types of metamorphism, metamorphic grades, Mineralogical composition, structures & textures in metamorphic rocks. Important Distinguishing features of rocks as Rock cleavage, Schistosity, Foliation. Classification. Detailed study of Gneiss, Schist, Slate with engineering consideration.

**Module 3: Physical Geology**- Weathering. Erosion and Denudation. Factors affecting weathering and product of weathering. Engineering consideration. Superficial deposits and its geotechnical importance: Water fall and Gorges, River meandering, Alluvium, Glacial deposits, Laterite (engineering aspects), Desert Landform, Loess, Residual deposits of Clay with flints, Solifluction deposits, mudflows, Coastal deposits.

**Module 4: Strength Behavior of Rocks**- Stress and Strain in rocks. Concept of Rock Deformation & Tectonics. Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Main types of discontinuities according to size. Fold- Types and nomenclature, Criteria for their recognition in field. Faults: Classification, recognition in field, effects on outcrops. Joints & Unconformity; Types, Stresses responsible, geotechnical importance. Importance of structural elements in engineering operations. Consequences of failure as land sliding, Earthquake and Subsidence. Strength of Igneous rock structures.

**Module 5: Geological Hazards**-Rock Instability and Slope movement: Concept of sliding blocks. Different controlling factors. Instability in vertical rock structures and measures to prevent collapse. . Types of landslide. Prevention by surface drainage, slope reinforcement by Rock bolting and Rock anchoring, retaining wall, Slope treatment. Case study on black clay. Ground water: Factors controlling water bearing capacity of rock. Pervious & impervious rocks and ground water. Lowering of water table and Subsidence. Earthquake: Magnitude and intensity of earthquake. Seismic sea waves. Revelation from Seismic Records of structure of earth. Case Study on Elevation and Subsidence in Himalayan region in India. Seismic Zone in India.

**Module 6: Rock masses as construction material**- Definition of Rock masses. Main features constituting rock mass. Main features that affects the quality of rock engineering and design. Basic element and structures of rock those are relevant in civil engineering areas. Main types of works connected to rocks and rock masses. Important variables influencing rock properties and behavior such as Fresh rock Influence from some minerals. Effect of alteration and weathering. Measurement of velocity of sound in rock. Classification of Rock material strength. Core logging .Rock Quality Designation. Rock mass description.

**Module 7: Geology of dam and reservoir site**- Required geological consideration for selecting dam and reservoir site. Failure of Reservoir. Favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions, significance of discontinuities on the dam site and treatment giving to such structures.

**Module 8: Rock Mechanics**- Sub surface 9nvestigations in rocks and engineering characteristics or rocks masses; Structural geology of rocks. Classification of rocks, Field & laboratory tests on rocks, Stress deformation of rocks, Failure theories and sheer strength of rocks, Bearing capacity of rocks.

**Practicals:**

1. Study of physical properties of minerals
2. Study of different group of minerals.
3. Study of Crystal and Crystal system.
4. Identification of minerals: Silica group: Quartz, Amethyst, Opal; Feldspar group: Orthoclase, Plagioclase; Cryptocrystalline group: Jasper; Carbonate group: Calcite; Element group: Graphite; Pyroxene group: Talc; Mica group: Muscovite; Amphibole group: Asbestos, Olivine, Hornblende, Magnetite, Hematite, Corundum, Kyanite, Garnet, Galena, Gypsum.
5. Identification of rocks (Igneous Petrology): Acidic Igneous rock: Granite and its varieties, Syenite, Rhyolite, Pumice, Obsidian, Scoria, Pegmatite, Volcanic Tuff. Basic rock: Gabbro, Dolerite, Basalt and its varieties, Trachyte.
6. Identification of rocks (Sedimentary Petrology): Conglomerate, Breccia, Sandstone and its varieties , Laterite, Limestone and its varieties, Shales and its varieties.
7. Identification of rocks (Metamorphic Petrolody): Marble, slate, Gneiss and its varieties, Schist and its varieties. Quartzite, Phyllite.
8. Study of topographical features from Geological maps. Identification of symbols in maps.

**CEC305  
Building Materials & Construction**

**Unit 1**: **Bricks:** Classification, Characteristics of good bricks, Ingredients of good brick earth, Harmful substance in brick Earth, Different forms of bricks, testing of bricks as per BIS. Defects of bricks. Aggregates: Classification, Characteristics, Deleterious substances, Soundness, Alkali –aggregates reaction, Fine aggregates, Coarse aggregates, Testing of aggregates Lime: Impurities in limestone, Classification, Slaking and hydration, Hardening, Testing, Storage, Handling Cement & Concrete: Cement: OPC: Composition, PPC, Slag cement, Hydration, setting time Concrete: Types, ingredients, W/C ratio, Workability, Different grades in cement concrete, Tests on cement concrete.

**Unit 2: Mortars:** Classification, Uses, Characteristics of good mortar, Ingredients. Cement mortar, Lime mortar, Lime cement mortar, special mortars Wood and Wood Products:Classification of Timber, Structure, Characteristics of good timber, Seasoning of timber, Defects in Timber, Diseases of timber, Decay of Timber, Preservation of Timber Testing of Timber, Veneers , Plywood, Fibre Boards, Particle Boards, Chip Boards , Black Boards, Button Board and Laminated Boards, Applications of wood and wood products Paints, Enamels and Varnishes: Composition of oil paint, characteristic of an ideal paint, preparation of paint, covering power of paints, Painting: Plastered surfaces, painting wood surfaces, painting metal Surfaces. Defects, Effect of weather, enamels, distemper, water wash and colour wash, Varnish, French polish, and Wax Polish Miscellaneous Materials: Gypsum: Classification, Plaster of Paris, Gypsum wall Plasters, Gypsum Plaster Boards, Adhesives, Heat and sound insulating materials, Geo-synthetics.

**Unit 3: Foundations:** Function of Foundations, Essential requirement of good foundation, Different types of shallow and deep Foundations Brick masonry: Definitions, Rules for bonding, Type of bonds – stretcher bond, Header bond, English bond, Flemish Bond, Comparison of English Bond and Flemish Bond (one and one and half brick thick wall) Wall, Doors and Windows: Load bearing wall, Partition wall, Reinforced brick wall Common types of doors and windows of timber and metal.

**Unit 4: Stairs:** Technical Terms, Requirements of good stair, Dimension of steps, Classification, Geometric design of a dog legged stair case Flooring: Components of a floor, selection of flooring materials, Brick flooring, Cement concrete flooring, mosaic, marble, Terrazzo flooring, Tiled roofing Plastering and Pointing: Plastering with cement mortar, Defects in plastering, pointing, whitewashing, colour washing, Distempering, Roofs: Types, Pitched roofs and their sketches, Lean – to roof, King Post – Truss, Queen post truss and Simple steel Truss , Roof Covering materials: AC sheets GI sheet.

**Practicals:**

1. Tests on cement – specific gravity, fineness, soundness, normal consistency, setting time, compressive strength on cement mortar cubes.
2. Tests on fine aggregate – specific gravity, bulking, sieve analysis, fineness modules, moisture content, bulk density and deleterious materials.
3. Tests on coarse aggregate - specific gravity, sieve analysis, fineness modulus, bulk density.
4. Tests on Fresh Concrete: Workability: Slump, Vee-Bee, Compaction factor tests.
5. Hardened Concrete: Compressive strength on Cubes, Split tensile strength, Static modulus of elasticity, Flexure tests ,Non destructive testing (Rebound hammer & Ultrasonic pulse velocity).
6. Mix Design of Concrete.

**FOURTH SEMESTER**

**CEC406  
Concrete Technology**

**Module 1:** Concrete as a Structural Material, Chemical Composition of Cement, Hydration of Cement, Heat of Hydration and Strength, Tests on Cement and Cement Paste – fineness, consistency, setting time, soundness, strength. Types of Portland cement – ordinary, Rapid hardening, low heat, sulphate resisting, Portland slag, Portland pozzolana, super sulphated cement, white cement.

Quality of Water – Mixing Water, Curing Water, Harmful Contents

**Module 2:** Aggregates – Classification, Mechanical and Physical Properties, Deleterious Substances, Alkali-Aggregate Reaction, Sieve Analysis, Grading Curves, Fineness modules, Grading Requirements. Testing of Aggregates – Flakiness, Elongation Tests, Aggregate Crushing Value, Ten Percent Fines Value, Impact Value, Abrasion Value

**Module 3:** Admixtures – different types, effects, uses, Retarders and Super plasticizers.

**Module 4:** Properties of Fresh Concrete – Workability, Factors Affecting Workability, Slump Test Compacting Factor Test, Flow Table Test, Segregation, Bleeding, Setting Time, Mixing and Vibration of Concrete, Mixers and Vibrators, Curing methods, Maturity.

**Module 5:** Strength of Concrete – Water/Cement ratio, Gel/Space ratio, Strength in Tension, Compression**,** Effect of Age on Strength, Relation between Compressive and Tensile Strength, Fatigue Strength, Stress Strain Relation and Modulus of Elasticity, Poisson’s Ratio, Shrinkage and Creep, Compression Test on Cubes, Cylinders, Introduction to Non Destructive Tests (Rebound hammer & Ultrasonic pulse velocity)

**Module 6:** Mix Design by I.S. 20262 (2009), Light-weight, Polymer and Fibre-reinforced concrete, Special concrete; types and specifications, Fibre reinforced and steel Fibre reinforced concrete, Polymer concrete

**Practicals:**

1. Tests on cement – specific gravity, fineness, soundness, normal consistency, setting time, compressive strength on cement mortar cubes.
2. Tests on fine aggregate – specific gravity, bulking, sieve analysis, fineness modules, moisture content, bulk density and deleterious materials.
3. Tests on coarse aggregate - specific gravity, sieve analysis, fineness modulus, bulk density.
4. Tests on Fresh Concrete: Workability: Slump, Vee-Bee, Compaction factor tests.
5. Hardened Concrete: Compressive strength on Cubes, Split tensile strength, Static modulus of elasticity, Flexure tests ,Non destructive testing (Rebound hammer & Ultrasonic pulse velocity).

**CEC407  
Introduction to Fluid Mechanics**

**Module 1: Basic Concepts and Definitions** – Distinction between a fluid and a solid; Density,

Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with

temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension,

capillarity, Bulk modulus of elasticity, compressibility.

**Module 2: Fluid Statics** - Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, UTube Differential Manometer, Micromanometers. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

**Module 3: Fluid Kinematics**-Classification of fluid flow : steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates

**Module 4: Fluid Dynamics**- Surface and body forces; Equations of motion - Euler’s equation;

Bernoulli’s equation – derivation; Energy Principle; Practical applications of Bernoulli’s equation : venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced; Dimensional Analysis and Dynamic Similitude – Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham’s π-Theorem.

**Lab Experiments**

1. Measurement of viscosity

2. Study of Pressure Measuring Devices

3. Stability of Floating Body

4. Hydrostatics Force on Flat Surfaces/Curved Surfaces

5. Verification of Bernoulli’s Theorem

6. Venturimeter

7. Orifice meter

8. Impacts of jets

9. Flow Visualisation -Ideal Flow

10. Length of establishment of flow

11. Velocity distribution in pipes

12. Laminar Flow

**CEC408**

**Introduction to Solid Mechanics**

**Module 1:** Simple Stresses and Strains- Concept of stress and strain, St. Venant’s principle, stress and strain diagram,Elasticity and plasticity – Types of stresses and strains, Hooke’s law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson’s ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain Energy – Resilience Gradual, sudden, impact and shock loadings – simple applications.

**Module 2:** Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.

**Module 3:** Bending moment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

**Module 4:** Flexural Stresses-Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

**Module 5:** Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.

**Module 6:** Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay’s method. Use of these methods to calculate slope and deflection for determinant beams.

**Module 7:** Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.

**Module 8:** Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress,

longitudinal stress in a cylinder, and sphere subjected to internal pressures.

**Practical:**

1. Tension test
2. Bending tests on simply supported beam and Cantilever beam.
3. Compression test on concrete
4. Impact test
5. Shear test
6. Investigation of Hook’s law that is the proportional relation between force and stretching in
7. elastic deformation,
8. Determination of torsion and deflection,
9. Measurement of forces on supports in statically determinate beam,
10. Determination of shear forces in beams,
11. Determination of bending moments in beams,
12. Measurement of deflections in statically determinate beam,
13. Measurement of strain in a bar
14. Bend test steel bar
15. Yield/tensile strength of steel bar

**CEC409  
Surveying & Geomatics**

**Module 1: Introduction to Surveying:** Principles, Linear, angular and graphical methods,

Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying, Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile leveling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses; areas and volumes.

**Triangulation and Trilateration**: Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control - methods -triangulation -network- Signals. Baseline - choices - instruments and accessories - extension of base lines -corrections - Satellite station - reduction to centre - Intervisibility of height and distances - Trigonometric leveling - Axis single corrections.

**Module 2: Curves:** Elements of simple and compound curves – Method of setting out– Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve -Vertical curves

**Module 3: Modern Field Survey Systems:** Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations.

**Module 4: Photogrammetry Surveying:** Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereoplotting instruments, mosaics, map substitutes.

**Module 5: Remote Sensing**: Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.

**Practicals:**

**1. Chain surveying**

Preparing index plans, Location sketches, Ranging, Preparation of map, Heights of objects using chain and ranging rods, getting outline of the structures by enclosing them in triangles/quadrilaterals, Distance between inaccessible points, Obstacles in chain survey.

**2. Compass surveying**

Measurement of bearings, Preparation of map, Distance between two inaccessible points by chain and compass, Chain and compass traverse.

**3. Plane Table survey**

Temporary adjustments of plane table and Radiation method, Intersection, Traversing and Resection methods of plane tabling, Three-point problem.

**4. Levelling**

Temporary adjustment of Dumpy level, Differential levelling, Profile levelling and plotting the profile, Longitudinal and cross sectioning, Gradient of line and setting out grades, Sensitiveness of Bubble tube.

**5. Contouring**

Direct contouring, Indirect contouring – Block levelling, Indirect contouring – Radial contouring, Demonstration of minor instruments.

**6. Setting out of Simple Curves.**

**7. Traversing by Using Theodolite:** Preparation of Gales Table from field data.

**8. Traversing by using Total Station.**

**9. Use of Total Station for levelling and Contouring.**

**CEC410  
Material Testing & Evaluation**

**Module 1:** Introduction to Engineering Materials covering, Cements, M-Sand, Concrete (plain,

reinforced and steel fibre/ glass fibre-reinforced, light-weight concrete, High Performance Concrete, Polymer Concrete) Ceramics, and Refractories, Bitumen and asphaltic materials, Timbers, Glass and Plastics, Structural Steel and other Metals, Paints and Varnishes, Acoustical material and geotextiles, rubber and asbestos, laminates and adhesives, Graphene, Carbon composites and other engineering materials including properties and uses of these.

**Module 2:** Introduction to Material Testing covering, What is the “Material Engineering”?;

Mechanical behavior and mechanical characteristics; Elasticity – principle and characteristics; Plastic deformation of metals; Tensile test – standards for different material (brittle, quasi-brittle, elastic and so on) True stress – strain interpretation of tensile test; hardness tests; Bending and torsion test; strength of ceramic; Internal friction, creep – fundaments and characteristics; Brittle fracture of steel – temperature transition approach; Background of fracture mechanics; Discussion of fracture toughness testing – different materials; concept of fatigue of materials; Structural integrity assessment procedure and fracture mechanics.

**Module 3:** Standard Testing & Evaluation Procedures covering, Laboratory for mechanical testing; Discussion about mechanical testing; Naming systems for various irons, steels and nonferrous metals; Discussion about elastic deformation; Plastic deformation; Impact test and transition temperatures; Fracture mechanics – background; Fracture toughness – different materials; Fatigue of material; Creep.

**Tutorials** from the above modules covering, understanding i) Tests & testing of bricks, ii) Tests & testing of sand, iii) Tests & testing of concrete, iv) Tests & testing of soils, v) Tests & testing of bitumen & bituminous mixes, vi) Tests & testing of polymers and polymer based materials, vii) Tests & testing of metals & viii) Tests & testing of other special materials, composites and cementitious materials, Explanation of mechanical behavior of these materials.

**Practicals:**

1. Gradation of coarse and fine aggregates
2. Different corresponding tests and need/application of these tests in design and quality control
3. Tensile Strength of materials & concrete composites
4. Compressive strength test on aggregates
5. Tension I - Elastic Behaviour of metals & materials
6. Tension II - Failure of Common Materials
7. Direct Shear - Frictional Behaviour
8. Concrete I - Early Age Properties
9. Concrete II - Compression and Indirect Tension
10. Compression – Directionality
11. Soil Classification
12. Consolidation and Strength Tests
13. Tension III - Heat Treatment
14. Torsion test
15. Hardness tests (Brinnel’s and Rockwell)
16. Tests on closely coiled and open coiled springs
17. Theories of Failure and Corroboration with Experiments
18. Tests on unmodified bitumen and modified binders with polymers
19. Bituminous Mix Design and Tests on bituminous mixes - Marshall method
20. Concrete Mix Design as per BIS

**CED414**

**Instrumentation & Sensor Technologies for Civil Engineering Applications**

**Module 1:** Fundamentals of Measurement, Sensing and Instrumentation: Definition of measurement and instrumentation, physical variables, common types of sensors; Describe the function of these sensors; Use appropriate terminology to discuss sensor applications; and qualitatively interpret signals from a known sensor type, types of instrumentation, Senso Specifics, Permanent installations, Temporary installations;

**Module 2:** Sensor Installation and Operation: i) Predict the response of sensors to

various inputs; ii) Construct a conceptual instrumentation and monitoring program; iii) Describe the order and methodology for sensor installation; and iv) Differentiate between types of sensors and their modes of operation and measurement and v) Approach to Planning Monitoring Programs, Define target, Sensor selection, Sensor siting, Sensor Installation & Configuration, Advanced topic, Sensor design, Measurement uncertainty

**Module 3:** Data Analysis and Interpretation: a) Fundamental statistical concepts, b) Data reduction and interpretation, c) Piezometer, Inclinometer, Strain gauge, etc. d) Time domain signal processing, e) Discrete signals, Signals and noise and f) a few examples of statistical information to calculate are: Average value (mean), On average, how much each measurement deviates from the mean (standard deviation), Midpoint between the lowest and highest value of the set (median), Most frequently occurring value (mode), Span of values over which your data set occurs (range)

**Module 4:** Frequency Domain Signal Processing and Analysis: Explain the need for

frequency domain analysis and its principles; Draw conclusions about physical processes based on analysis of sensor data; Combine signals in a meaningful way to gain deeper insight into physical phenomena, Basic concepts in frequency domain signal processing and analysis, Fourier Transform, FFT (Fast Fourier Transform), Example problems: Noise reduction with filters, Leakage, Frequency resolution

**Tutorials** from the above modules demonstrating clearly the understanding and use for the sensors and instruments used for the problems posed and inferences drawn from the measurement and observations made along with evaluation report

**Practical:**

1. Instrumentation of typical civil engineering members/structures/structural elements
2. Use of different sensors, strain gauges, inclinometers,
3. Performance characteristics
4. Errors during the measurement process
5. Calibration of measuring sensors and instruments
6. Measurement, noise and signal processing
7. Analog Signal processing
8. Digital Signal Processing
9. Demonstration & use of sensor technologies

**CED415**

**BIM by Autodesk Revit Architecture**

**Unit 1: Introduction to Autodesk Revit Architecture -** User Interface Tour, Browsers, Bars, Palettes and Windows, Revit Architecture Help.

**Unit 2: Starting an Architectural Project ​​-** Starting a New Architectural Project, Navigation Tools, Configuring Global Settings.

**Unit 3: Creating Walls -** Creating Architectural Walls​, Creating Architectural Walls II.

**Unit 4: Using Basic Building Components-I -** ​​​Adding Doors, Adding Window and Wall Openings.

**Unit 5: Using the Editing Tools - ​​​**Working with Selection Sets, Editing Tools, Editing Tools II, Grouping Elements, Retrieving Information about Elements.

**Unit 6: Working with Datum Planes and Creating Standard Views -** ​​​Working with Levels, Working Grids, Working with Reference Planes and Work Planes, Controlling the Display of Elements, Working with Project Views.

**Unit 7: Using Basic Building Components-II - ​​​**Creating Floors, Creating Roofs,​Shape Editing Tools, Creating Ceilings, Adding Rooms

**Unit 8: Using Basic Building Components-III -** ​​​Working with Components, Adding Stairs, Adding Railings and Ramps Creating Curtain Walls.

**Unit 9: Adding Site Features - ​​​**Working with Site Features​, Property Lines and Building Pads, Adding Site Components​.

**Unit 10: Using Massing Tools -** ​​​Understanding Massing Concepts, Creating Massing Geometry in the Family Editor, Editing Massing Geometry in the Family Editor, Massing in the Conceptual Design Environment, Creating Massing Geometry in a Project, Creating Building Elements from Massing Geometry, Creating Families.

**Unit 11: Adding Annotations and Dimensions -** ​​​Adding Tags, Room Tags, Keynotes, Adding Symbols and Dimensions, Dimensioning Terminology and Dimensioning Tools, Adding Alternate Dimension Units and Spot Dimensions.

**Unit 12: Creating Project Details and Schedules -** ​​​Project Detailing in Autodesk Revit Architecture, Crop Regions, Fill Patterns, and Detail Components, Adding Text Notes, Creating Drafting Views, Revision Clouds, Working with Schedules.

**Unit 13: Creating Drawing Sheets and Plotting -** ​​​Creating Drawing Sheets, Creating Duplicate Dependent Views, Printing in Revit Architecture.

**Unit 14: Creating 3D Views -** ​​​Three Dimensional (3D Views), Dynamically Viewing Models with Navigation Tools, Orienting a 3D View, Generating Perspective Views, Using a Section Box.

**Unit 15: Rendering Views and Creating Walkthroughs** - ​​​Rendering in Revit Architecture, Working with Materials, Lights, Decals, and Entourage, Rendering Settings, Creating a Walkthrough, Autodesk 360 Rendering.

**Unit 16: Using Advanced Features -** ​​​Creating Structural Components, Generating Multiple Design Options, Using Area Analysis Tools, Masking Regions, Creating Displaced Views, Color Schemes, Working With Project Phasing Tools.

**Unit 17: Using Advanced Features II ​​​-** Working sharing Concepts, Elements Families, Browsers, Generating Shadows, Creating Solar Studies, Working with Point Clouds, Revit Architecture Interoperability, Linking Building Models and Sharing Coordinates, Working with Linked Models.

**FIFTH SEMESTER**

**CEC511**

**Hydraulic Engineering**

**Module 1**: Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates. Stoke’s law, Measurement of viscosity.

**Module 2**: Turbulent Flow- Reynolds experiment, Transition from laminar to turbulent flow.  
Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of  
turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of  
turbulence, Prandtl’s mixing length theory, universal velocity distribution equation, Resistance to  
flow of fluid in smooth and rough pipes, Moody’s diagram.

**Module 3**: Boundary Layer Analysis-Assumption and concept of boundary layer theory. Boundarylayer thickness, displacement, momentum & energy thickness, laminar and turbulent boundary  
layers on a flat plate; Laminar sub-layer, smooth and rough boundaries, Local and average friction coefficients. Separation and Control.

**Module 4:** Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity, Rayleigh  
method, Buckingham’s Pi method and other methods. Dimensionless groups. Similitude, Model  
studies, Types of models. Application of dimensional analysis and model studies to fluid flow  
problem.

**Module 5:** Introduction to Open Channel Flow-Comparison between open channel flow and pipe  
flow, geometrical parameters of a channel, classification of open channels, classification of open  
channel flow, Velocity Distribution of channel section.

**Module 6:** Uniform Flow-Continuity Equation, Energy Equation and Momentum Equation,  
Characteristics of uniform flow, Chezy’s formula, Manning’s formula. Factors affecting Manning’s Roughness Coefficient “n‟.Most economical section of channel. Computation of Uniform flow,  
Normal depth.

**Module 7: Non-Uniform Flow-** Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wire anemometer. Gradually Varied FlowDynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile by graphical, numerical and analytical approaches. Direct Step method, Graphical Integration method and Direct integration method.

**Module 8: Hydraulic Jump-** Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump. Energy dissipation and other uses, surge as a moving hydraulic jump, Positive and negative surges. Dynamics of Fluid Flow-Momentum principle, applications: Force on plates, pipe bends, and moments of momentum equation.

**Module 9: Flow through Pipes:** Loss of head through pipes, Darcy-Wiesbatch equation, minor  
losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in  
parallel, flow through laterals, flows in dead end pipes, siphon, power transmission through pipes,  
nozzles. Analysis of pipe networks: Hardy Cross method, water hammer in pipes and control  
measures, branching of pipes, three reservoir problem.

**Module 10: Computational Fluid Dynamics:** Basic equations of fluid dynamics, Grid generation, Introduction to in viscid incompressible flow, Boundary layer flow as applicable to C.F.D. Hydroinformatics: Concept of hydro informatics –scope of internet and web based modeling in water resources engineering.

**CEC512**

**Structural Analysis**

**Unit 1:** **Review of basic concept of mechanics:** Equilibrium, Free body diagram, Determinate and Indeterminate structures, Degree of indeterminacy for different types of structures: Beams, Frames,Trusses.

**Unit 2:** **Analysis of determinate structures:** Portal frames, arches, cables Strain energy: Due to axial load, bending and shear, Torsion; Castigliano's theorems, theorem of minimum potential energy, principle of virtual work, Maxwell’s theorem of reciprocal deflection, Betti’s law.

**Unit 3:** **Deflection of determinate structures:** Moment area and Conjugate beam method, Energy methods, Influence line diagrams: Statically determinate beams and trusses under series of concentrated anduniformly distributed rolling loads, criteria for maximum and absolute maximum moments and shears.Unit load method for beams, Deflection of trusses and simple portal frames.

**Unit 4:** **Analysis of statically Indeterminate beams:** Theorem of three moments, Energy methods, Forcemethod (method of consistent deformations) [for analysis of propped cantilever, fixed beams and continuous beams (maximum two degree of indeterminacy) for simple loading cases], Analysis of two- hinged arch.

**CEC513**

**Geotechnical Engineering**

**Module 1**: **Introduction**–Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison and difference between soil and rock. Basic Definitions and Relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity, etc. Relationship between volume weight, voids ratio- moisture content, unit weight- percent air voids, saturation moisture content, moisture content- specific gravity etc. Determination of various parameters such as: Moisture content by oven dry method, pycnometer, sand bath method, torsional balance method, nuclear method, alcohol method and sensors. Specific gravity by density bottle method, pycnometer method, measuring flask method. Unit weight by water displacement method, submerged weight method, core-cutter method, sand-replacement method.

**Module 2**: **Plasticity Characteristics of Soil -** Introduction to definitions of: plasticity of soil,  
consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency  
indices, flow & toughness indices, definitions of activity and sensitivity. Determination of: liquid  
limit, plastic limit and shrinkage limit. Use of consistency limits. Classification of Soils-Introduction of soil classification: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system. Identification: field identification of soils, general characteristics of soil in different groups.

**Module 3: Permeability of Soil -** Darcy’s law, validity of Darcy’s law. Determination of coefficient of permeability: Laboratory method: constant-head method, falling-head method. Field method: pumping- in test, pumping- out test. Permeability aspects: permeability of stratified soils, factors affecting permeability of soil. Seepage Analysis- Introduction, stream and potential functions, characteristics of flow nets, graphical method to plot flow nets.  
  
**Module 4: Effective Stress Principle -** Introduction, effective stress principle, nature of effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition.

**Module 5: Compaction of Soil-**Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density. Compaction in field, compaction specifications and field control.

**Module 6: Stresses in soils** *–* Introduction, stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq’s equation, Newmark’s Influence Chart. Contact pressure under rigid and flexible area, computation of displacements from elastic theory.

**Module 7: Consolidation of Soil** *-* Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, Terzaghi’s theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation.  
  
**Module 8: Shear Strength**- Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses,Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, pore pressure measurement, computation of effective shear strength parameters, unconfined compression test, vane shear test

**Module 9: Stability of Slopes -** Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts.

**Module 10: Soil Exploration-** Introduction, methods of site exploration and soil investigation,  
methods of boring, soil samplers, sampling procedures, trail pits, borings, penetrometer tests,  
analysis of borehole logs, geophysical and advance soil exploration methods.

**Practical Work:** List of tests on-  
1. Field Density using Core Cutter method.  
2. Field Density using Sand replacement method.  
3. Natural moisture content using Oven Drying method.  
4. Field identification of Fine Grained soils.  
5. Specific gravity of Soils.  
6. Grain size distribution by Sieve Analysis.  
7. Grain size distribution by Hydrometer Analysis.  
8. Consistency limits by Liquid limit  
9. Consistency limits by Plastic limit  
10. Consistency limits by Shrinkage limit.  
11. Permeability test using Constant-head test method.  
12. Permeability test using Falling-head method.  
13. Compaction test: Standard Proctor test.  
14. Compaction test: Modified Proctor test.  
15. Relative density.  
16. Consolidation Test.  
17. Triaxial Test (UU)  
18. Vane shear test  
19. Direct Shear Test  
20. Unconfined Compression Strength Test.

**CEC 514**

**Hydrology and Water Resource Engineering**

**Module 1**: **Introduction -** hydrologic cycle, water-budget equation, history of hydrology, world  
water balance, applications in engineering, sources of data.

**Module 2**: **Precipitation -** forms of precipitation, characteristics of precipitation in India,  
measurement of precipitation, rain gauge network, mean precipitation over an area, depth-areaduration relationships, maximum intensity/depth-duration-frequency relationship, Probable  
Maximum Precipitation (PMP), rainfall data in India.

**Module 3: Abstractions from precipitation -** evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltration indices.

**Module 4: Runoff -** runoff volume, SCS-CN method of estimating runoff volume, flow-duration  
curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of  
hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of  
India, environmental flows.

**Module 5: Ground water and well hydrology -** forms of subsurface water, saturated formation,  
aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells,  
equilibrium equations for confined and unconfined aquifers, aquifer tests.

**Module 6: Water withdrawals and uses –** water for energy production, water for agriculture, water for hydroelectric generation; flood control. Analysis of surface water supply, Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation.

**Module 7: Distribution systems -**canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels, alluvial channels, Kennedy’s and Lacey’s theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals, types of lining. Drainage of irrigated lands: necessity, methods.

**Module 8**: **Dams and spillways -** embankment dams: Classification, design considerations,  
estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Arch and buttress dams. Spillways: components of spillways, types of gates for spillway crests; Reservoirs- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, economic height of dam, selection of suitable site.

**CEC515**

**Environmental Engineering**

**Module 1**: **Water:** *-*Sources of Water and quality issues, water quality requirement for different  
beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply  
systems, Need for planned water supply schemes, Water demand industrial and agricultural water  
requirements, Components of water supply system; Transmission of water, Distribution system,  
Various valves used in W/S systems, service reservoirs and design.  
Water Treatment:aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes.

**Module 2**: **Sewage-**Domestic and Storm water, Quantity of Sewage, Sewage flow variations.  
Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers,  
Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore  
systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans, Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.

**Module 3**: **Air** *-* Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations

**Module 4**: **Noise-**Basic concept, measurement and various control methods.  
**Module 5: Solid waste management-**Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods- Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.

**Module 6**: **Building Plumbing***-*Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, Pressure reducing valves, Break pressure tanks, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures and fittings used.

**Module 7:** Government authorities and their roles in water supply, sewerage disposal, Solid waste management and monitoring/control of environmental pollution.

**Practical Work:**

1. Physical Characterization of water: Turbidity, Electrical Conductivity, pH

2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, inorganic

etc.

3. Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness

4. Analysis of ions: copper, chloride and sulfate

5. Optimum coagulant dose

6. Chemical Oxygen Demand (COD)

7. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD)

8. Break point Chlorination

9. Bacteriological quality measurement: MPN,

10. Ambient Air quality monitoring (TSP, RSPM, SOx, NOx)

11. Ambient noise measurement

**CEC516**

**Transportation Engineering**

**Module 1**: **Highway development and planning**-Classification of roads, road development in India, Current road projects in India; highway alignment and project preparation.

**Module 2**: **Geometric design of highways-:** Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems.

**Module 3**: **Traffic engineering & control-** Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting; problems.

**Module 4**: **Pavement materials-** Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements. Problems.

**Module 5: Design of pavements-** Introduction; flexible pavements, factors affecting design and  
performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems.

**Practical Work:**

1. Tests on highway materials – Aggregates- Impact value, Los-Angeles Abrasion value water absorption, Elongation & Flakiness Index.

2. Bitumen & bituminous materials: Specific gravity, penetration value, softening point, loss on heating.

3. Flash & Fire point test.

4. Stripping value test.

5. Design of B.C. & S.D.B.C. Mix

6. CBR Test.

7. Marshal Stability Test

**SIXTH SEMESTER**

**CEC617**

**Construction Engineering and Management**

**Module 1**: **Basics of Construction-** Unique features of construction, construction projects- types and features, phases of a project, agencies involved and their methods of execution.

**Module 2**: **Construction project planning-** Stages of project planning: pre-tender planning, preconstruction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks. PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.

**Module 3: Construction Methods basics:** Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges.

**Module 4: Construction Equipment basics*:***Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities.

**Module 5: Planning and organizing construction site and resources**- Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and leveling, Common Good Practices in Construction.

**Module 6: Project Monitoring & Control***-* Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating, Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

**Module 7: Contracts Management basics:**Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price, Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination, Changes & variations, Dispute Resolution methods.:

**Module 8: Construction Costs:****Make-up of construction cost:**Classification of costs, time-cost trade-off in construction projects, compression and decompression.

**CEC618**

**Engineering Economics, Estimating and Costing**

**Module 1**: Basic Principles and Methodology of Economics. Demand/Supply – elasticity –  
Government Policies and Application, Theory of the Firm and Market Structure. Basic Macroeconomic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes.

**Module 2**: Public Sector Economics –Welfare, Externalities, Labour Market. Components of  
Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve.

**Module 3:** Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control –Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method.

**Module 4:** Indian economy - Brief overview of post-independence period – plans. Post reform  
Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of  
people (M/F), Urbanization. Employment–Informal, Organized, Unorganized, Public, Private.  
Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors.

**Module 5:** Estimation */* Measurements for various items- Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying

**Module 6:** Specifications-Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures.

**Module 7:** Rate analysis-Purpose, importance and necessity of the same, factors affecting, task  
work, daily output from different equipment/ productivity.

**Module 8:** Tender- Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management.

**Module 9:** Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights. (1 lecture)

**CED601**

**Foundation Engineering**

**Unit 1: Earth pressure theories:** Plastic equilibrium of soil, Earth pressure at rest, Active & passive earth pressure, Rankine’s & Coulomb’s earth pressure theories, wedge method of analysis, estimation of earth pressure by graphical construction (Culmann Method).

**Unit 2: Retaining wall & sheet pile structures:** Proportions of retaining walls, stability checks, cantilever and anchored sheet piles, free earth and fixed earth method of analysis of anchored bulk heads.

**Unit 3: Stability of slopes:** Analysis of finite and infinite slopes, Swedish And friction circle method, Taylor’s stability number, Bishop’s method of stability analysis.

**Unit 4: Site investigation & soil exploration:** Planning of sub-surface exploration, methods, sampling, samples, Insitu tests: SPT, SCPT, DCPT, Field vane shear, Plate load test.

**Unit 5: Shallow foundations :** Safe bearing capacity, Terzaghi’s bearing capacity theory, effect of depth of embedment, water table, eccentricity of load, foundation shape on bearing capacity, Bearing capacity as per 1S 6403.

**Unit 6: Settlement analysis of shallow foundation:** Immediate and consolidation settlement, correction for rigidity and dimensional effects, settlement in various types of soil, IS-1904 and 8009 recommendations, Allowable bearing capacity.

**Unit 7: Deep foundations: Pile:** Types, load transfer mechanism, Determination of load carrying capacities of piles by static and dynamic formulae, Recommendations of IS 2911, Pile group: Group efficiency, Negative skin friction, pile load test.

**CED602**

**Design of RC Structures**

**Unit 1: Introduction:** Principles of design of reinforced concrete members-Working stress and Limit State method of design.

**Unit 2: Working stress method of design:** Basic concepts and IS code provisions (IS: 456 2000)for design against bending moment and shear forces \* Balanced, under reinforced and overreinforced beam/ slab sections; design of singly and doubly reinforced sections.

**Unit 3: Limit state method of design:** Basic concepts and IS code provisions (IS: 456 2000) for design against bending moment and shear forces; concepts of bond stress and development length; Use of ‘design aids for reinforced concrete’ (SP:16).

**Unit 4:** Analysis, design and detailing of singly reinforced rectangular, ‘T’, ‘L’ and doubly reinforced beam sections by limit state method.

**Unit 5:** Design and detailing of one-way and two-way slab panels as per IS code provisions.

**Unit 6:** Design and detailing of continuous beams and slabs as per IS code provisions.

**Unit 7: Staircases:** Types; Design and detailing of reinforced concrete doglegged staircase.

**Unit 8:** Design and detailing of reinforced concrete short columns of rectangular and circular cross sections under axial load. Design of short columns subjected to axial load with moments (uniaxial and biaxial bending) – using SP 16, Design of long columns.

**Unit 9:** Shallow foundations: Types; Design and detailing of reinforced concrete isolated square andrectangular footing for columns as per IS code provisions by limit state method.

**CED603**

**Solid and Hazardous Waste Management**

**Unit 1: Generation of Solid Waste:** Goals and objectives of solid waste management, Classification of solid waste, Municipal solid waste, Management of Municipal Solid Wastes, Municipal solid waste handling rules, 2000, Industrial solid waste, Commercial solid waste, Agricultural solid waste, Hazardous solid waste, Pathological waste, Solid waste generation, Characteristics of solid waste, Analysis of solid waste.

**Unit 2: Handling, Storage and Processing:** Public health and aesthetics, Onsite handling, Community containers, Container Locations, Numerical on container locations, On-site processing.

**Unit 3: Recovery and disposal method:** Collection systems, Equipment and labour requirement, Collection routes, Land filling, Incineration, Composting, Recycling.

**Unit 4: Solid waste management and control:** Biomedical waste, biomedical waste handling rules, 1998, Hazardous waste, Transportation of hazardous waste, Radioactive waste, Disposal of radioactive waste. Management of: Biomedical, Nuclear, Electronic and Industrial Solid Wastes and the rules and regulations.

**Unit 5: Environmental audit, Pollution Prevention, Facility Development and operation, Site Remediation:** Quantitative risk assessment, site and subsurface characterization, Containment, remedial alternatives.

**CED604**

**Advanced Highway and Transportation Engineering**

**Unit 1:Traffic Engineering :** Road user and vehicle characteristics; Traffic flow characteristics – Traffic Volume, Speed, Headway, Concentration and Delay; Traffic surveys & studies; Traffic estimation; Statistical applications in traffic engineering analysis; Parking; Road intersections –Basic traffic conflicts, classification of at-grade intersections, channelization, rotaries, traffic signals, signs and marking; Road Safety; Traffic System Management.

**Unit 2: Transportation planning:** Transportation planning at different levels; Transport Project planning– Planning studies and investigation; Elements of Urban Transportation Planning; Transport Demand Analysis; Preparation of Project Report.

**Unit 3: Railway Engineering :** Location surveys & alignment, Permanent way components, Gauges, Geometric Design, Points & crossings, Stations & Yards, Signalling, Track Maintenance.

**Unit 4: Airport Engineering :** Functional areas of airports: Runways, Taxiways, , Aprons, Terminal buildings; Classification of Airports; Airport site selection; Design of Runway, Runway orientation, Wind Rose diagram; Design of Taxiway and Terminal Building.

**SEVENTH SEMESTER**

**CED705**

**Pre-stressed Concrete**

**Unit 1: Introduction of Prestressed concrete:** Materials, prestressing system, analysis of prestress and bending stress, losses Shear and torsional resistance: design of shear reinforcement, design of reinforcement for torsion shear and bending. Deflections of prestressed concrete members: Importance, factors, short term and long term deflection.

**Unit 2: Limit state design criteria:** Inadequacy of elasticand ultimate load method, criteria for limit states,strength and serviceability. Design of sections for flexure: methods by Lin and Magnel.

**Unit 3: Anchorage Zone stresses in post tensioned members:** Stress distribution in end block, anchorage zone reinforcement.

**Unit 4: Composite construction of prestressed and in-situ concrete:** Types, analysis of stressesStatically Indeterminate structures: advantages of continuous member, effect of pre stressing, methods of achieving continuity and method of analysis of secondary moments.

**Unit 5: Prestressed concrete poles and sleepers:** Design of sections for compression and bending

**CED706**

**Pavement Design**

**Unit 1: Principles of Pavement Design :** Types of Pavements, Concept of pavement performance, Structural and functional failure of pavement, Different types of pavement performance, Different pavement design approaches Traffic Consideration in Pavement Design : Vehicle types, Axle configurations, Contact shapes and contact stress distribution, Concept of standard axle load, Vehicle damage factor, Axle load surveys, Estimation of design traffic.

**Unit 2: Pavement Material Characterization:** Identification of different type of materials Field and laboratory methods for characterization of pavement materials Analysis and Design of Flexible Pavements : Selection of appropriate theoretical model for flexible pavements, Analysis of different layers of flexible pavements based on linear elastic theory, Different methods of design of flexible pavements, IRC guidelines(IRC-37).

**Unit 3: Analysis and Design of Rigid Pavements :** Selection of appropriate theoretical models for rigid pavements, Analysis of wheel load stresses, curling, temperature differential, Critical stress combinations, Different methods of design of rigid pavements, IRC guidelines (IRC-58) Pavement Overlay Designs : Overlay design as per Indian Roads Congress guidelines (IRC-81) Overlay design as per AASHTO-1993 guidelines.

**CED707**

**Structural Dynamics & Earthquake Design**

**Unit 1: Theory of vibrations:** Degrees of freedom, Undamped single degree freedom system, Damped single degree freedom system, Natural frequency, modes of vibration, Introduction to multiple degree freedom system.

**Unit 2: Response of single degree freedom system due to harmonic loading:** Undamped harmonic excitation, Damped Harmonic excitation

**Unit 3: Response due to Transient loading:** Duhamel’s Integral, Response due to constant force, Rectangular load, Introduction to numerical evaluation of Duhamel’s integral of undamped system.

**Unit 4: Elements of seismology:** Fundamentals: Elastic rebound theory, Plate tectonics, Definitions of magnitude, Intensity, Epicenter etc., Seismographs, Seismic zoning, Response of Simple Structural Systems.

**Unit 5: Principles of earthquake resistant design:** Terminology, General principles and Design criteria, Methods of Analysis, Equivalent lateral force method of Analysis for multistoried building as per Indian Standard Code of Practice, Introduction to Response Spectrum Method, Fundamental concepts of Ductile detailing.

**CED708**

**Air and Noise Pollution Control**

**Unit 1:** Air pollutants, Sources, classification, Combustion Processes and pollutant emission, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects-Smoke, smog and ozone layer disturbance, Greenhouse effect.

Air sampling and pollution measurement methods, principles and instruments, Ambient air quality and emission standards, Air pollution indices

**Unit 2:** Air Act, legislation and regulations, control principles, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods. Particulate emission control, settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators and other removal methods like absorption, adsorption, precipitation etc. Biological air pollution control technologies, Indoor air quality.

**Unit 3:** Noise pollution: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Noise control methods

**CEC719**

**Design of Steel Structure**

**Unit 1: Materials and Specification:** Rolled steel section, types of structural steel, specifications Structure connections: Riveted, welded and bolted including High strength friction grip bolted joints– types of riveted bolted joints, assumptions, failure of joints, efficiency of joints, design of bolted ,riveted & welded joints for axial load. ii) Eccentric connection:- Riveted & bolted joints subjected to torsion & shear, tension & shear, design of riveted, bolted & welded connection.

**Unit 2: Tension members:** Design of tension members, I.S code provisions. Permissible stresses, Design rules, Examples.

**Unit 3: Compression members:** Effective lengths about major & minor principal axes, I.S code provisions. Permissible stresses, Design rules, Design of one component, two components and built up compression members under axial load. Examples. Built up columns under eccentric loading: Design of lacing and batten plates, Different types of Column Bases- Slab Base , Gusseted Base, Connection details

**Unit 4: Beams:** Permissible stresses in bending, compression and tension. Design of rolled steel sections, plated beams. simple Beam end connections, beam -Column connections. I.S code provisions.

**Unit 5: Plate girders:** Design of webs & flanges, Concepts of curtailment of flanges – Riveted & welded web stiffeners, web flange splices - Riveted, welded& bolted. Gantry Girder: Design gantry girder considering lateral buckling – I.S code provisions.

**CEC720**

**Design of RC and Steel Structures Lab**

**RCC structures**

1. General considerations: Design principle of R.C.C. sections. Limit state method of design Loads and stresses to be considered in the design as per I.S. code provision.

2. Design & detailing of a i) simply supported R.C.C Beam ii) Continuous T- Beam.

3. Design & Detailing of columns, isolated and combined footing

4. Design & detailing of a i) simply supported one way slabii) One way Continuous slab.

5. Design of different units: Slab, beam column, roofing and staircase from floor plan of a multi- storied frame building, typical detailing of a two way floor slab.

**Steel structures**

Problems on general consideration and basic concepts.

Discussion on different loads (i.e. wind load, Dead load, live load and others) as per IS875.

Design & drawing of the following components of a roof truss:

1. Members of the roof truss.

2. Joints of the roof truss members

3. Purlins

4. Gable bracings

5. Column with bracings

6. Column base plate

7. Column foundation

**EIGHTH SEMESTER**

**CED809**

**Repair & Rehabilitation of Structures**

**Unit 1:** Appraisal of damage and deterioration of structures by non-destructive and other techniques; Cause of deterioration.

**Unit 2:** Environmental aspects and earthquake effects; Repair and strengthening of superstructure – structural components, loadbearing wall, panel walls; Strengthening of foundation; Grouting; Grout material, guniting, shotcreting, under pinning.

**Unit 3:** Repair of steel structures – bridge, building, towers etc., monuments and historical structures. Prevention of water leakage instructures; Under-water repair; Durability of repairing material; Case histories.

**CED810**

**Dynamics of Soils & Foundations**

**Unit 1: Fundamental of vibrations**: Degrees of freedom, Natural frequency, Undamped single degree freedom system, Damped single degree freedom system, Transmissibility, Response to ground motion, and Introduction to multiple degree freedom system

**Unit 2: Introduction to machine foundation:** Types of Machine Foundations, General requirement of Machine foundations, Dimensional criteria, Design data, Permissible amplitude, Permissible Bearing pressure

**Unit 3:** Dynamic properties of Soil, Laboratory and field evaluation of soil properties as per IS codes

**Unit 4: Analysis and design of Block type Machine Foundation:** Modes of Vibrations, Methods of Dynamic Analysis, Design considerations for dynamically loaded foundations and constructional features; Design procedures for foundations for hammers, reciprocating engines, Vibration Isolation and damping.

**Unit 5: Liquefaction of soils:** Definition, Causes and effects of Liquefaction, Evaluation of Liquefaction potential, mitigation of Liquefaction Hazards.

**Unit 6**: **Propagation of elastic waves in soils:** Mechanism of wave propagation, Body waves, Surface waves, Rayleigh waves**.**

**CED811**

**Matrix Method of Structural Analysis**

**Unit 1:** Introduction to Flexibility Method of Matrix Analysis: Introduction to flexibility method, Element flexibility matrix, Principle of contragradience, Force Transformation Matrix, Member Flexibility matrix, Construction of structure flexibility matrix. Matrix determination of the displacement vector, Determination of member forces.

**Unit 2:** Analysis of Beams and Frames using Flexibility Method: Analysis of axially rigid continuous beams by flexibility method using Force Transformation Matrix , Analysis of rigid plane frames with axially rigid members by flexibility method using Force Transformation Matrix.

**Unit 3:** Introduction to Stiffness Method of Matrix Analysis: Fundamentals of the stiffness method, equivalent joint loads, Displacement and Transformation matrix. Member stiffness matrix, Total or System stiffness matrix.

**Unit 4:** Analysis of Beams and Frames using Stiffness Method: Continuous Beam and rigid frame analysis with axially rigid members by stiffness method using Displacement Transformation Matrix.

**Unit 5:** Introduction to Finite Element Method.

**CED812**

**Ground Improvement Techniques**

**Unit 1:** Insitu densification: Introduction, Compaction: methods and controls Densification of granular soil: Vibration at ground surface, Impact at ground surface, Vibration at depth (Vibroflotation), Impact at depth. Densification of Cohesive Soils: Preloading and dewatering, Design of Sand drains and Stone columns, Electrical and thermal methods

**Unit 2:** Geo-textiles: Over view: Geotextiles as separators, reinforcement. Geotextiles in filtration and drainage, geotextiles in erosion control.

**Unit 3:** Grouting: Over view: Suspension and Solution grout, Grouting equipment and methods, Grout design and layout, Grout monitoring schemes

**Unit 4:** Soil stability: Reinforced earth fundamentals, Soil nailing, Soil and Rock Anchors, Underpinning

**CED813**

**Bridge Engineering**

**Unit 1: Introduction:** Definition and Basic Forms, Component of bridge, classification of bridge,short history of bridge development. I.R.C Loads. Analysis of IRC Loads, Impact factors, Other loads to be considered, Importance of Hydraulic factors in Bridge Design.

**Unit 2: Reinforced concrete solid slab bridge:** Introduction, General design features, Effectivewidth method. Simply supported and cantilever Slab Bridge, analysis and design Box Culvert: Introduction, Design method and Design example.

**Unit 3: Beam and Slab Bridges** Introduction, Design of interior panel of slab. Pigeauds method,Design of longitudinal girder, Calculation of longitudinal moment, design example. Balanced Cantilever Bridges: General Features, Arrangement of supports, design features Articulation, Design example.

Unit 4: Steel Bridges: General features, types of stress, Design example. Plate Girder Bridge: Elements, design, lateral bracing, Box- girder Bridges.

**Unit 5: Composite Bridges**: General aspects, method of construction, analysis of composite section,shear connectors, design of composite beam. Cable Stayed Bridge: General features, Philosophy of design.