Sri Jayachamarajendra College of Engineering, Mysuru

SCHEME FOR AUTONOMOUS COURSE

DEPARTMENT OF CIVIL ENGINEERING

Syllabus of B.E. (Civil Engineering): I to VIII Semesters

2017-18

Engineering Mechanics

I Semester B.E. (Civil, CT&M, Env., Biotech, Mech., IP and PST)

Sub Code : CV110 Contact Hrs : 4/week
Credits : 04: 0: 0

Course Objectives:

- To analyse problems in engineering subjected to a force system and to compute the net effect.
- To analyse the equilibrium of rigid bodies.
- To determine the geometric properties of plane sections.

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1. Introduction to Engineering mechanics: Basic idealisations: Particle, Continuum, Rigid body and Point force; Newton's laws of motion, Definition of Force, Introduction to SI units, Elements of a force, Classification of force and force systems; Principle of physical independence of forces, Principle of superposition of forces, Principle of transmissibility of forces; Moment of a force, couple, moment of a couple, characteristics of a couple, Equivalent force: couple system; Resolution of a force, Composition of forces; Numerical problems on resolution of forces, moment of forces and couples and on equivalent force – couple system.

2. Composition of forces: Definition of Resultant; Composition of coplanar - concurrent force system, Principle of resolved parts; Numerical problems on composition of coplanar–concurrent force systems.

3. Composition of Coplanar: non-concurrent force system, Varignon's principle of moments; Numerical problems on composition of coplanar non-concurrent force systems.

4. Centroid of Plane Figures and Simple Built up Sections: Numerical problems.

5. Moment of inertia of plane figures; polar moment of inertia, Radius of gyration, Perpendicular axis theorem and Parallel axis theorem; Moment of inertia of built up plane figures; Numerical problems.

6. Equilibrium of forces: Definition of Equilibrant; Conditions of static equilibrium for different force systems, Lami's theorem; Numerical problems on equilibrium of coplanar – concurrent force system.

7. Types of supports, statically determinate beams, Numerical problems on equilibrium of coplanar – non-concurrent force system and support reactions for statically determinate beams; Numerical problems.

8. Friction: Types of friction, Laws of static friction, Limiting friction, Angle of friction, angle of repose; Impending motion on horizontal and inclined planes; Numerical problems.

Self-Learning:

- Vector method for resolution and composition of forces.
- Vector method for solving problems on equilibrium.
- Screw friction and belt friction.

Text Books:

- Beer, F.P. and Johnston Jr., E.R. (1982), Mechanics for Engineers, Vol. 1 – Statics, *McGraw-Hill Book Company, New York.*
- Rahman S.S. and Madhava Rao, V. (2006), Elements of Civil Engineering and Engineering Mechanics, *Sanguine Technical Publishers, Bengaluru.*

Reference Books:

- Merium, J.L. and Kraige, L.G. (2006), Engineering Mechanics, Vol. 1 – Statics, 3rd Edition, *John Wiley and Sons Inc., New York.*
- Kumar, K.L. (2008), Engineering Mechanics, 3rd Revised Edition, *Tata McGraw-Hill Publishing Company, New Delhi.*
- Boresi, A.P. and Schmidt, R.J. (2000), Engineering Mechanics*, CL-Engineering, USA.*

Course Outcome:

The student has the ability to

- analyse the given force system to compute its resultant (CO1).
- analyse the system of forces in equilibrium with or without frictional forces (CO2).
- determine the reactions at the supports of statically determinate systems (CO3).
- locate the centroid of plane figures and to compute the second moment of areas of standard sections (CO4).

Basic Computational Laboratory

I Semester B.E. (Civil, CT&M, Env. and Biotech)

Sub Code : BT/CV/CT/EV/12L Contact Hrs : 4/week
Credits : 0: 0: 1.5

Course Objectives:

- To identify and to define a computational engineering problem
- To develop experience in specifying and designing a solution to an engineering problem using a software tool
- To facilitate the students to the use of electronic spread sheet programs for engineering problem solving.

Use of Electronic spread sheet in Engineering

- Introduction to electronic spread sheets and their usage in engineering problem solving.
- Identify and describe the purpose and function of the extensive features of electronic spread sheet program.
- Working with electronic spread sheet for – Creating, saving, retrieving, formatting, editing, and printing worksheets – Simple calculations and creating formulas – Charting and Graphing – Performing What-If Analysis – Naming cells and ranges – Array Formulae, matrix manipulations – Working with Tables – Lookup tables – Conditional Formatting, Data Validation – Statistical Analysis – Numerical Analysis. Application of electronic spread sheets for solving Engineering problems – Macros and Programing electronic spread sheets (only demonstration).

References:

1. Larsen, R.W. (2017), Engineering with Excel, *5th Edition, Pearson Education Inc., USA.*
2. Parsons, J.J., Oja, D, Carey, P. and Des Jardins, C.A. (2017), Microsoft® Office 365™ & Excel 2016, Cengage Learning, USA.
3. Software user manuals.

Course Outcome:

The student has the

- ability to Identify, to define and to solve a computational engineering problem using software tool (CO1).
- ability to solve engineering problems using electronic spread sheet (CO2).

Strength of Materials

II Semester B.E. (Civil, CT&M, Env., Biotech, Mech., IP and PST)

Sub Code : CV210 Contact Hrs : 4/week
Credits : 4:0:0

Course Objectives:

- To introduce the concept of stress and strain.
- To calculate the stresses and strains due to axial & shear loading and due to temperature variations.
- To analyse the two dimensional compound stress system.
- To study the variation of bending and shear force along the length of the loaded beam due to different types of loads and to study the resulting stresses.
- To analyse the circular shafts subjected to torsional moment.
- To analyse the long columns for their critical loads.

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1. Simple Stresses and Strains: Concept of Stress and Strain; St. Venant's Principle; Hooke's Law; Stress–Strain Diagram for ferrous and non-ferrous materials, True stress and strain; Elastic Constants – Young's modulus, Rigidity modulus, Bulk modulus and Poisson's ratio; Relationships among elastic constants; Deformation of uniform bars; Bars of varying cross section; Deformation due to self weight; Volumetric strain; Generalized Hooke's law; Composite sections; Temperature stresses; Statically indeterminate problems; Relevant numerical problems.
2. Bending Moment and Shear Force in Beams: Definitions – Bending moment and Shear force, Relationship among Bending Moment, Shear Force and Load Intensity; Bending moment and Shear force diagrams for statistically determinate beams subjected to point force, UDL, UVL, Couple and their combinations; Relevant numerical problems.
3. Simple Bending Theory; Moment of resistance; Section modulus of different cross sectional shapes; Bending and shear stresses in beams and their distribution over the beam cross section, Relevant numerical problems.
4. Torsion of Prismatic Circular Shafts: Torsion equation; Strength and Stiffness of solid and Hallow circular shafts (Uniform cross sections); Transmission of power; Relevant numerical problems.
5. Compound Stresses: Analysis of generalized two dimensional stress system – Normal and shear stresses on any inclined plane; Principal stresses and Principal planes; Maximum shear stresses and maximum shear planes; Pure shear stresses and pure shear planes; Mohr's circle of stresses; Relevant numerical problems.
6. Thin and Thick Cylinders: Stresses in thin cylinders subjected to internal and external pressures; Hoop, Longitudinal and Volumetric strains in thin cylinders; Lame's equations for stresses in thick cylinders; Relevant numerical problems.
7. Theory of Long Columns: Euler's formula for different end conditions; Effective length of column; Slenderness ratio; Rankine – Gordon Formula; Eccentrically loaded columns – Secant formula; Relevant numerical problems.

Self-Learning:

- Beams of uniform strength.
- Stresses in spherical shells.
- Principal stresses in shafts.

Text Books:

- Beer, F.P. and Johnston, E.R. (Jr.), (2014), Mechanics of Materials 7th Edition, *McGraw-Hill Book Co., New York.*
- Basavarajaiah, B.S. and Mahadevappa, P. (2010), Strength of Materials, 3rd Edition, *CRC Press, India.*

References Books:

- Subramanian, R. (2007), Strength of Materials*, Oxford University Press, New Delhi.*
- Popov, E.P. (2005), Engineering Mechanics of Solids, 2nd Edition, *Prentice Hall of India Pvt. Ltd., New Delhi.*

Course Outcome:

The student has the

- ability to calculate the stresses and strains due to axial, shear, radial and longitudinal forces and also due to temperature variations (CO1).
- ability to analyse a two dimensional compound stress system (CO2).
- ability to draw bending moment and shear force diagrams for beams subjected to transverse loads and also to determine the bending and shearing stresses in beams (CO3).
- ability to determine the shear stress developed in shafts due to torsion and to design a shaft for the given conditions (CO4).
- ability to determine the critical and safe loads on long columns and also to determine the section of the long columns for the given conditions (CO5).

Elements of Civil Engineering & Engineering Mechanics

II Semester B.E. (EE, EC, IT, CS and IS)

Sub Code	:	CV220	Contact Hrs	:	4/week
Credits	:	4 : 0 : 0	Total Hrs	:	52

Course Objectives:

- The students of circuit branches are introduced to the field of Civil Engineering.
- To students are introduced to the basic infrastructural facilities such as Roads, Bridges and Dams.
- To students are introduced to analyse the problems in engineering subjected to a force system and to compute the net effect.
- To students are introduced to analyse the equilibrium of rigid bodies.
- To students are introduced to the determination of the geometric properties of plane sections.

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1. Introduction to Civil Engineering, Scope of different fields of Civil Engineering – Surveying, Building Materials, Construction Technology, Geotechnical Engineering, Structural Engineering, Hydraulics, Water Resources and Irrigation Engineering, Transportation Engineering, Environmental Engineering.
   Infrastructure: Types of infrastructure, Role of a Civil Engineer in the Infrastructural Development, Effect of the infrastructural facilities on socio-economic development of a country.
2. Roads: Basic Definitions, Cross sectional elements of roads, Components of road, Types of roads, and their functions.
3. Bridges and Dams: Definitions, Functions and Classification.
4. Introduction to Engineering mechanics: Basic idealisations – Particle, Continuum, Rigid body and Point force; Newton's laws of motion, Definition of force, Introduction to SI units, Elements of a force, Classification of force and force systems; Principle of physical independence of forces, Principle of superposition of forces, Principle of transmissibility of forces; Moment of a force, couple, moment of a couple, characteristics of a couple, Equivalent force - couple system; Resolution of forces, Composition of forces; Numerical problems on resolution of forces, moment of forces and couples, on equivalent force – couple system.
5. Composition of forces – Definition of Resultant; Composition of coplanar - concurrent force system, Principle of resolved parts; Numerical problems on composition of coplanar–concurrent force systems.
6. Composition of coplanar – non-concurrent force system, Varignon's principle of moments; Numerical problems on composition of coplanar non-concurrent force systems.
7. Centroid of plane figures; Locating the centroid of triangle, semi-circle, quadrant of a circle and sector of a circle using method of integration, Centroid of simple built up plane figures; Numerical problems.
8. Equilibrium of forces – Definition of Equilibrant; Conditions of static equilibrium for different force systems, Lami's theorem; Numerical problems on equilibrium of coplanar – concurrent force system.
9. Types of supports, statically determinate beams, Numerical problems on equilibrium of coplanar – non-concurrent force system and support reactions for statically determinate beams.
10. Friction – Types of friction, Laws of static friction, Limiting friction, Angle of friction, angle of repose; Impending motion on horizontal and inclined planes; Wedge friction; Ladder friction; Numerical problems
11. Moment of inertia of plane figures, polar moment of inertia, Radius of gyration, Perpendicular axis theorem and Parallel axis theorem; Moment of Inertia of rectangular, circular and triangular plane figures from method of integration; Moment of inertia of composite plane figures; Numerical problems.

Self-Learning:

- Fundamentals of railways and airways.

Text Books:

- Beer, F.P. and Johnston Jr., E.R. (1982), Mechanics for Engineers, Vol. 1 – Statics, *McGraw-Hill Book Company, New York.*
- Rahman S.S. and Madhava Rao, V. (2006), Elements of Civil Engineering and Engineering Mechanics, *Sanguine Technical Publishers, Bengaluru.*

Reference Books:

- Merium, J.L. and Kraige, L.G. (2006), Engineering Mechanics, Vol. 1 – Statics, 3rd Edition, *John Wiley and Sons Inc., New York.*
- Kumar, K.L. (2008), Engineering Mechanics, 3rd Revised Edition, *Tata McGraw-Hill Publishing Company, New Delhi.*
- Boresi, A.P. and Schmidt, R.J. (2000), Engineering Mechanics*, CL-Engineering, USA.*

Course Outcome:

The student has the

- knowledge of various streams of Civil Engineering, role of Civil Engineers in any constructional project and the ability to identify & classify the Civil Engineering infrastructural facilities (CO1).
- ability to analyse the given force system to compute its resultant (CO2).
- ability to analyse the system of forces in equilibrium with or without frictional forces (CO3).
- ability to determine the reactions at the supports of statically determinate systems (CO4).
- ability to locate the centroid of plane figures and to compute the second moment of areas of standard and built up sections (CO5).

Materials of Construction

Sub Code : CV310 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To study naturally available building materials.
- To study manufactured building materials.
- To study types of building materials, manufacturing processes, properties and uses.

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1. **Building Stones**
   - Classification
   - Quarrying of stones
   - Dressing of stones
   - Deterioration and preservation of stones
   - Requirements of good stones
   - Tests on stones
2. **Bricks and Tiles**
   - Classification of bricks
   - Good brick earth
   - Harmful ingredients
   - Properties of good bricks
   - Manufacture of bricks
   - Tests of bricks
   - Roofing tiles – properties
   - Flooring tiles – properties
3. **Cementitious Materials**
   - Lime -
     - Composition of lime
     - Classification of lime
     - Manufacture of lime
     - Activated – lime – puzzolona mixture
   - Cement – Introduction only
   - Puzzolanas – Meta kaolin, Silica Fume, Fly ash, Ground Blast Furness Slag and rice husk ash.
4. **Timber**
   - Classification of trees
   - Cross-section of an exogenous tree
   - Properties of good timber
   - Defects in timber
   - Decay of timber
   - Seasoning of timber
   - Preservation of timber
   - Fire resistance of timber
   - Tests on timber
   - Timber based products – Plywood, Wood Wool Boards, Lamin Boards.
5. **Metals and Alloys**
   - Ferrous metals – Cast iron, wrought iron, steel – types, properties and their uses in building industry.
   - Non-ferrous metal – Al, Copper, Lead, Tui, Zuic, Nickel – properties and their uses.
   - Alloys of copper and Al, Copper, Lead, Tui, Zuic, Nickel – properties and their uses.
6. **Paints, Varnishes and Distempers**
   - Definition
   - Functions
   - Characteristics
   - Types
7. **Composite Materials**
   - Introduction
   - Classification - Particle reinforced composite, Fiber reinforced composite, Structural composite – their applications.
8. **Insulating Materials**
   - Classification
   - Thermal insulating materials –
     - General aspects
     - Requirements
     - Classification
   - Sound insulating materials –
     - Requirements
     - Classification
9. **Glass, Rubber and Plastics**
   - Types
   - Properties
   - Uses
10. **Other Building Materials**
    - Construction chemicals and adhesives.
    - Alternative building blocks
    - Smart materials

Self-Learning:

- Alternative building blocks for masonry.
- Market forms of timber.
- Reinforced plastics.
- Types of structural steel.

Text Books:

- Varghese, P.C. (2009), Building Materials, *Prentice Hall of India, New Delhi.*
- Duggal, S.K., (2016), Building Materials, *New Age International Publications, New Delhi.*

Reference Books:

- Rai, M. and Jaisingh, M.P. (1986) Advances in Building Materials and Construction, *CBRI Publications, Roorkee.*
- Manjunath, K.S. (2008), Materials of Construction, *Sanguine Technical Publishers, Bengaluru.*
- Bhavikatti, S.S., (2012), Building Materials, *Vikas Publishing House Pvt. Ltd., New Delhi.*
- Rangwala .S.C, (2012), "Engineering Materials", *Charotor Publishing House, New Delhi.*
- Rajput, R.K. (2009), Engineering Materials, *S. Chand & Co., New Delhi.*

Course Outcome:

The student has the knowledge of

- masonry and cementitious materials (CO1).
- Timber and its products (CO2).
- metallic and composite materials (CO3).
- finishing and other building materials (CO4).

Analysis of Determinate Structures

Sub Code : CV320 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To understand the role of structural analysis in the structural design process.
- To identify, idealise and analyse simple engineering structures.
- To apply the knowledge of mathematics, science and engineering fundamentals to analyse simple engineering structures.

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1. **Structural System:** Introduction, Forms of Structures, Conditions of Equilibrium, Determinate and Indeterminate Structures, one-, two- and three-dimensional idealization of structural systems, Betti's law, Maxwell's Reciprocal theorem, Strain Energy Principle, Strain energy due to Axial load, Bending and Shear.
2. **Analysis of Pin Jointed Determinate Plane Truss:** Introduction, Assumptions, Analysis of truss by
   a). Method of joints,
   b). Method of Sections.
3. **Analysis of Cables:** Introduction, Analysis of Cables under concentrated loads and uniformly distributed loads with supports at same and different levels; Analysis of anchor cables.
4. **Analysis of Three Hinged Arches:** Introduction, Analysis of Three hinged Parabolic and Circular arches with supports at same and different levels.
5. **Moving Loads and ILD for Beams:** Introduction, ILD for simply supported beams, Analysis of simply supported beams under various standard types of moving loads.
6. **Deflection of Beams:** Introduction, Deflection and slope of beams by –
   a) Macaulay's Method
   b) Moment Area Theorems (Concepts only)
   c) Conjugate Beam Method (prismatic and non-prismatic beams)
   d) Castigliano's theorem (prismatic and non-prismatic beams)
   e) Unit load method (prismatic and non-prismatic beams)
7. **Deflection of Trusses:** Deflection of Trusses using Castigliano's theorem and Unit load method.

Self-Learning:

- Determination of slope and deflection of cantilever beams using Moment area method.

Text Books:

- Pandit, G.S., Gupta, S.P. and Gupta, R., (1999), Theory of Structures, Vol.–I, *Tata McGraw Hill, New Delhi.*
- Reddy C.S., (2010), Basic Structural Analysis, *Tata McGraw Hill, New Delhi.*
- Punmia, B.C., Jain, A.K. and Jain, A.K. (2004), Theory of Structures, *Laxmi Publication New Delhi.*

Reference Books:

- Norris, C.H. and Wilbur, J.B. (1960), Elementary Structural Analysis, International Student Edition. *McGraw Hill Book Co., New York.*

Course Outcome:

The student has the

- knowledge of basic concepts of structural analysis in the structural design process (CO1).
- ability to analyse and compute internal forces in plane trusses (CO2),
- ability to analyse arches and cables (CO3).
- ability to compute the deformations in determinate beams and trusses (CO4).
- ability to use the concept of ILD to find internal forces in determinate beams (CO5).

Fundamentals of Surveying

Sub Code : CV330 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To know the importance of surveying in Civil Engineering and to introduce the basic concepts of surveying.
- To learn fundamental concepts of planimetric survey and relief survey.

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1. **Introduction:** Surveying – Classification – Uses – Map and plan – Topographical maps – Basic principles of surveying – Precision and accuracy – Errors and types.
2. **Measurement of Horizontal Distances:** Chain and its types – Tape and its types – EDM devices – Ranging of a line – Chain and tape corrections – Numerical problems.
3. **Chain Surveying:** Accessories required – selection of stations and lines – Offsets and its types – Booking and chain survey work – Conventional symbols – Obstacles in chain survey – Numerical problems – Errors and precautions to be taken.
4. **Compass Surveying:** Prismatic compass and surveyor's compass - Bearing and types – Dip and declination – Accessories required for compass survey – computation of angles from bearings – Computation of Bearings of legs of a traverse knowing bearing of one leg and interior angles – local attraction – Detection and correction – Numerical problems – Errors and precautions to be taken.
5. **Introduction to Levelling:** Basic definitions – Fundamental axes and parts of a Dumpy level – Temporary adjustments – Curvature and refraction – simple levelling – Reciprocal levelling – Profile levelling – Cross sectioning – Fly levelling – Methods of booking – Fly back levelling – Arithmetic checks – Errors and precautions to be taken – Numerical problems.
6. **Contours:** Characteristics – Methods of contouring – Interpolation techniques – Uses – Grade contour – Inter-visibility problems.
7. **Plane Table Survey:** Accessories – Advantages and limitations – Orientation – Methods of plotting – Two point and three point problems and solutions – Errors and precautions to be taken.

Self-Learning:

- Survey of India topographic maps and map numbering.
- Latitude and longitude of a place.
- Overcoming obstacles in levelling.
- Computation of volume of earth work using cross-sectional details.
- Computation of volume of reservoir using contour maps.

Text Books:

- Chandra, A.M. (2002), Plane Surveying, *New Age International (P) Ltd., New Delhi.*
- Alak De, (2000), Plane Surveying, *S. Chand & Co. Ltd., New Delhi.*

Reference Books:

- Anderson, J. and Mikhail, E. (1985), Introduction to Surveying, *Mc-Graw Hill Book Co., New York.*
- Benister, A. (2006), Surveying, *Pearson Education, New Delhi.*

Course Outcome:

The student has the

- knowledge of basic principles of surveying considering the types of errors (CO1).
- ability to determine plannimetric distances (CO2).
- ability to determine directions using bearings and angles (CO3).
- ability to determine relative elevations of points and to develop contour maps (CO4).
- ability to prepare small maps using plane table survey (CO5)

Mechanics of Fluids

Sub Code : CV340 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to the properties of fluids and classification of fluids.
- To introduce the concept of static pressure of fluid and its measurement.
- To introduce the students to kinematics of fluid flow.
- To introduce the students to the basic equations of fluid flow and their applications.

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1. **Introduction:** Definition of Fluid, Distinction between solids & fluid, Distinction between liquids & gases, Concept of fluid continuum.
2. **Fluid Properties and Classification of Fluids:** Mass density, Specific Volume, Specific Weight, Specific gravity – Definitions, units and Dimensions. Viscosity, Newton's law of viscosity, Newtonian, Non-Newtonian Fluids, Ideal and Real fluids, Compressibility vapour pressure, surface tension – Definitions, units and dimensions. Capillarity – Theory and problems. Problems on Newton's law of viscosity.
3. **Fluid Pressure and its Measurement:** Definition of pressure, units and dimensions, pressure at a point in a static fluid. Pascal's law – Hydrostatic pressure law. Absolute, gauge and vacuum pressure. Measurement of pressure – Simple and Differential Manometer – Theory and problems, Micro-manometers and Mechanical pressure gauges.
4. **Hydrostatics:** Definition of total pressure, center of pressure, centroid, centroidal depth, depth of center of pressure, moment of Inertia, table of centroid & moment of Inertia for different geometric shapes, – Equation for hydrostatic force and depth of center of pressure on plane surfaces (vertical and inclined), – Problems on hydrostatic force vertically submerged surfaces – Problems on inclined submerged surfaces, –Hydrostatic force on submerged curved surfaces, problems, – Pressure diagram, problems.
5. **Kinematics of Fluid Flow:** Description of fluid flow, Lagrangian and Eulerian approaches. Classification of flow, steady & unsteady, uniform and non-uniform. – Definition of path line, streamline, streak line, stream tube, one, two, three dimensional flows. Rotational and irrotational flow, – Acceleration of flow in one dimensional flow derivation of continuity equation in differential form – Definition of velocity potential, stream functions, stream line, equipotential line, Relation between velocity potential and stream function. – Laplace equation. Problem on continuity equation – Problem on velocity potential and stream function.
6. **Dynamics of Fluid Flow:** Concept of Inertia force and other forces causing motion. Introduction to Non-dimensional numbers. – Derivation of Euler's equation and Bernoulli's equation with assumption and limitation. – Modification of Bernoulli's equation, problem on Bernoulli's equation without and with losses. – Problems on Bernoulli's equation – Application of Bernoulli's equation – Venturimeter, Pitot tube, problems. Momentum equation, problems.

Self-Learning:

- Basic principles of stability of floating and submerged bodies.

Text Books:

- Modi, P.N. and Seth, S.M. (2002), Hydraulics and Fluid Mechanics including Hydraulic Machines, *Standard Book House, Delhi.*
- Subramanya, (2001), Fluid Mechanics & Hydraulic Machines, *Tata McGraw-Hill Education, New Delhi.*
- Bansal, R.K. (2009), Fluid Mechanics and Hydraulic Machines, *Laxmi Publications, New Delhi.*

Reference Books:

- Rouse, H. (2011), Elementary Mechanics of Fluids, *Dover Publications, Inc. New York.*
- Arora, K.R. (2005), Fluid Mechanics, Hydraulic and Hydraulics, *Standard Book House, Delhi.*
- Cruise, J.F., Singh, V.P. and Sherif, M.M. (2007), Elementary Hydraulics, (1st Edition), *Thomson Learning, USA.*
- Douglas, J.F., Gasoriek, J.M., Swaffield, J. and Jack L. (2006), Fluid Mechanics, *Prentice Hall, USA.*

Course Outcome:

The student has

- the ability to analyse the properties of fluids (CO1).
- the ability to determine / measure static fluid pressure (CO2).
- knowledge of kinematics of flow and to analyse the stream lines & equi-potential lines of fluid flow (CO3).
- the ability to analyse the dynamics of fluid flow and its applications (CO4).

Concrete Technology

Sub Code : CV350 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to concrete and its ingredients.
- To introduce the students to properties of fresh and hardened concrete.
- To introduce the students to mix design of concrete and testing of concrete.

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1. Concrete ingredients: Cement- chemical composition, manufacture of OPC by wet and dry process, hydration of cement, types of cement. Testing of cement.
Fine aggregate- grading analysis, specific gravity, bulking, moisture content, deleterious materials.
Coarse aggregate- Importance of size, shape and texture. Grading of aggregates. Fineness modulus.
Water- qualities of water. Use of sea water for mixing concrete.
Admixtures – chemical admixtures- Plasticizers, accelerators, retarders and air entraining agents. Mineral admixtures- Fly ash, silica fumes and rice husk ash

2. Fresh Concrete: Workability – factors affecting workability,
Measurement of workability – slump, compaction factor, vee -bee and 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; Ready Mix Concrete.

3. Hardened concrete: Factors affecting strength, w/c ratio, gel-space ratio. Maturity concept
Effect of aggregate properties,
Relations between compressive strength, tensile strength and bond strength and modulus of rupture.
Elasticity – Relation between modulus of elasticity and strength,
Factors affecting modulus of elasticity, Poison's ratio.
Creep – measurement of creep, factors affecting creep, effect of creep
Shrinkage of concrete- plastic shrinkage and drying shrinkage, factors affecting shrinkage, moisture movement.
Durability – definition and significance of durability. Permeability.
Sulphate attack, chloride attack, carbonation, freezing and thawing.

4. Concrete Mix Design: Concept of Mix design, Variables in proportioning and exposure conditions.
Procedure of mix design as per IS 10262-2009.
Numerical examples of Mix design.

5. Non Destructive Testing of Concrete: Penetration and pull out test, rebound hammer test, ultrasonic pulse velocity – Principles, applications and limitations.

Self-Learning:

- Mix design of concrete by methods other than the Indian Standard code of practice.

Text Books:

- Neville, A.M., (2011), Properties of Concrete, *Pearson Education Ltd., England.*
- Shetty, M.S. (1982), Concrete Technology (Theory and Practice), *S. Chand and company, New Delhi.*
- Gambhir, M.L. (2004), Concrete Technology, *Tata McGraw-Hill Education, New Delhi.*

Reference Books:

- Neville, A.M. and Brooks J.J. (2010), Concrete Technology, *Prentice Hall, England.*
- Gambhir, M.L. (1992), Concrete Manual, *Dhanpat Rai & Sons, New Delhi.*
- IS: 10262-2009: Indian Standard Concrete Mix Proportioning-Guidelines, *BIS, New Delhi.*
- SP 23 (1982), Handbook on Concrete Mixes, *BIS, New Delhi.*
- Manual of Concrete Practice (2015), *ACI, USA.*

Course Outcome:

The student has the

- knowledge of the ingredients of good concrete (CO1).
- ability to analyse the properties of fresh concrete (CO2).
- ability to analyse the properties of hardened concrete (CO3).
- ability to design concrete as per Indian Standard code of practice (CO4).
- ability to do Non-destructive testing of concrete (CO5).

Surveying Practice-I

Sub Code : CV36L Contact Hrs : 3/week
Credits : 0:0:1.5

Course Objectives:

- To facilitate the students to develop their intellectual and motor skills to conduct the surveying works based on objectives.
- To train the students of civil engineering in using various surveying Instruments - care and adjustments.
- To train the students to collect the field data, field notes and to apply corrections required using suitable methods before plotting or setting-out.

Part – A

Exercise-1 : To study different types of chains and types (LC, capacity, IS: specification). Defect detection.
To study about ranging rods, pegs and arrows and there uses.

Exercise-2 : To study perpendicular setting devices like cross staff, optical square, prism square – Understanding of basic principle of construction.

Exercise-3 : To study prismatic compass, surveyor's compass – comparison.

Exercise-4 : To study Dumpy level, Temporary adjustments.
Other types of levels.

Exercise-5 : To study accessories used in plane table survey.
Adjustments in the field.

Part – B

Exercise-1 : To determine the distance between two points by direct ranging.
To setout perpendicular by geometrical and instrumental methods.

Exercise-2 : To setout rectangles, triangles, hexagons using chain / type and other accessories.

Exercise-3 : To measure the bearing of lines.
To measure legs and bearings of closed traverse and to compute angles. Determination of errors after plotting.

Exercise-4 : To determine distance of an inaccessible object using compass.
To determine distance between two inaccessible objects using compass.

Exercise-5 : To setout triangles, rectangles, pentagon and hexagon using compass and other accessories.

Exercise-6 : To establish temporary bench mark in the field by carrying levels from permanent bench mark. Fly back to check accuracy.

Exercise-7 : To determine RL of points starting from TBM – different methods of booking and checks.
To conduct reciprocal levelling.

Exercise-8 : Profile levelling for water supply line / sewage line – plotting.
Profile levelling for highways including cross section levelling – plotting.

Exercise-9 : Block levelling and contour map generation.

Exercise-10 : Plotting by radiation and intersection.
Plotting traverse on plane table.
Bessel's solutions to 3 point problem.

NOTE: Exercise of Part-B is to be performed only after completing corresponding exercise in Part-A.

Reference Books:

- Chandra, A.M. (2002), Plane Surveying, *New Age International (P) Ltd., New Delhi.*
- Alak De, (2000), Plane Surveying, *S. Chand & Co. Ltd., New Delhi.*
- Anderson, J. and Mikhail, E. (1985), Introduction to Surveying, *Mc-Graw Hill Book Co., New York.*
- Benister, A. (2006), Surveying, *Pearson Education, New Delhi.*

Course Outcome:

The student has the ability to

- use various surveying instruments (CO1).
- prepare planimetric and topographic maps of small areas (CO2).
- prepare comprehensive report of the survey work conducted (CO3).

Basic Materials Testing Laboratory

Sub Code : CV37L Contact Hrs : 3/week
Credits : 0:0:1.5

Course Objectives:

- To introduce the students of civil engineering, the philosophy behind the material testing and various methods of testing of materials used in construction industry and the importance of the results thus obtained.
- To facilitate the students to develop their intellectual and motor skills to conduct tests on basic engineering materials used in construction industry.
- To train the students to analyse the data obtained from the laboratory testing rationally to get meaningful results, which are helpful in the analysis and design of structural elements.

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1. Tension tests on Mild steel and HYSD bars.
2. Compression tests on Mild steel, Cast iron and Wood.
3. Torsion test on Mild steel.
4. Double shear test on Mild steel.
5. Impact tests on Mild steel: Izod test and Charpy test.
6. Bending test on wood (Two point loading)
7. Hardness tests on metals: Rockwell, Brinell's and Vicker's hardness tests.
8. Test on open coiled helical spring.
9. Test on bricks and Masonry blocks: Dimension tolerance tests, Density test, Water Absorption test, Compressive Strength test,
10. Test on Tiles: Water Absorption test, Wet Transverse Strength test.
11. Use of strain gauges (Demonstration):

Text Books:

- Davis, H.E., Troxell, G. and Hauck, G. (1982), Testing of Engineering Materials, IV Edition, *McGraw Hill Publications, New York.*
- Relevant Bureau of Indian Standard Codes.

Course Outcome:

The student has the

- knowledge of various procedures of testing of engineering materials and the fundamentals of testing methodology (CO1).
- ability to conduct testing of engineering materials as per the standard procedures of testing (CO2).
- ability to analyse the test data rationally and to prepare the test report (CO3).

Building Construction

Sub Code : CV410 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to various components of buildings.
- To introduce the students to the concept of green buildings and earthquake resistant construction practices.

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1. **Foundations**
    a. Definitions
    b. Foundations
    c. Setting out of foundation works
    d. Timbering of trenches
    e. Types of foundations
    f. Foundations in black cotton soils / problematic soils.
2. **Masonry**
    a. Stone masonry – Setting out, joints, types
    b. Brick masonry – Terminologies, Bonds and Reinforced brick work.
    c. Block masonry – Concrete block, Stone composite, brick – stone composite.
    d. Types of walls
    e. Masonry arches and types
    f. Lintel, Chejja, Canopy and balcony - Functions
3. **Roofs**
    a. Features of a good roof
    b. Classification
    c. Steel and timber trusses.
4. **Lifts and Elevators**
    a. Types
    b. Requirements
    c. Geometric design
5. **Flooring, Plastering and Painting:**
    a. Purpose
    b. Types
6. **Door and Windows:**
    a. Positioning and proportioning
    b. Types
7. **Damp Proofing and Water Proofing:**
    a. Causes
    b. Effects
    c. Methods
8. **Ancillary Works:**
    a. Form works
    b. Shoring
    c. Scaffolding
9. **Green Buildings:**
    a. Concepts and requirements
    b. Energy conservation in buildings
    c. Rating of buildings
10. **Earthquake – Resistant Buildings:**
    a. Terminology
    b. Magnitude and intensity of earthquake
    c. Zones
11. **Improving earthquake resistance of buildings**

Self-Learning:

- Causes of failure of foundation and remedial measures.
- Fixtures for doors and windows.
- Safety, health and welfare facilities at construction sites.

Text Books:

- Varghese, (2007), Building Construction, *Prentice Hall of India, New Delhi.*
- Punmia, B.C. (1993), Building Construction, *Laxmi Publishers, New Delhi.*
- Bhavikatti, S.S. (2012), Building Construction, *Vikas Publishing House Pvt. Ltd., New Delhi.*

Course Outcome:

The student has the

- ability to identify and understand the significance of each and every component of a building (CO1).
- ability to do the geometric design of stair cases (CO2).
- knowledge of the earthquake resistant and green buildings (CO3).

Analysis of Indeterminate Structures

Sub Code : CV420 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To apply the knowledge of mathematics, science and engineering fundamentals to solve relatively complex engineering structures.
- To apply the knowledge of matrix approach in classical methods of structural analysis.
- To introduce the concept of plastic analysis and carryout plastic analysis of continuous beams.

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1. **Introduction:** Degree of static and kinematic indeterminacy – Beams, plane frames and trusses, Methods of analysis of indeterminate structures – Force and displacement methods.

2. **Force Method of Analysis:**
   a) Consistent deformation method: Concept, Application to analysis of propped cantilever beam and fixed beams.
   b) Clapeyron's theorem – Applications.
   c) Matrix Method- Flexibility approach - Introduction, Analysis of continuous beams using system approach (static indeterminacy ≤ 3).

3. **Displacement Method of Analysis:**
   a) Slope deflection method - Introduction, Analysis of continuous beams and simple orthogonal portal frames without sway (kinematic indeterminacy ≤ 3).
   b) Moment distribution method - Introduction, Analysis of continuous beams and simple orthogonal portal frames with and without sway.
   c) Matrix Method – Stiffness Approach - Introduction, Analysis of continuous beams using system approach (kinematic indeterminacy ≤ 3).

4. **Plastic Analysis:** Introduction, Plastic hinge, Plastic moment capacity, Shape factor, Collapse load, Basic theorems, Plastic analysis of beams.

Self-Learning:

- .Analysis of simple orthogonal portal frames with sway using slope deflection method.

Text Books:

- Reddy C.S., (2010), Basic Structural Analysis, *Tata McGraw Hill, New Delhi.*
- Pandit, G.S., Gupta, S.P. and Gupta, R., (1999), Theory of Structures, *Tata McGraw Hill, New Delhi.*
- Rajasekaran, S. and Sankarasubramanian, G. (2015), Computational Structural Mechanics, *Prentice Hall India Pvt. Ltd., New Delhi.*

Reference Books:

- Kinney, J.S. (1962), Indeterminate Structural Analysis, *Oxford Book Co., New Delhi.*
- Norris, C.H. and Wilbur, J.B. (1960), Elementary Structural Analysis, International Student Edition. *McGraw Hill Book Co., New York.*
- Jain, A.K. (2015), Advanced Structural Analysis, *Nem Chand & Bros., Roorkee, India.*
- Prakash Rao, D.S. (1996), Structural Analysis: A Unified Approach, *University Press, England.*
- Wang, C.K. (2014), Intermediate Structural Analysis, *Tata McGraw-Hill Education Pvt. Ltd., New Delhi.*

Course Outcome:

The student has the

- ability to identify indeterminate structures and determine the degree of indeterminacy (CO1).
- ability to analyze simple indeterminate beams using consistent deformation method (CO2).
- ability to analyze continuous beams & simple portal frames using slope deflection and moment distribution methods (CO3).
- ability to use matrix methods to analyse indeterminate beams (CO4).
- ability to determine shape factors & plastic moments and to perform plastic analysis of continuous beams (CO5).

Higher Surveying

Sub Code : CV430 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to accurate and higher order survey methods.
- To introduce the students to design and setting-out of curves for highways and railways.
- To introduce the students to the computation of earth works.

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1. **Theodolite:** Types – Fundamental axes and parts – Temporary adjustments – Measurement of horizontal angles and vertical angles.
2. **Trigonometric Levelling:** Problems with base accessible and inaccessible – Single plane and double plane methods – Total station instruments – Capabilities – Numerical problems.
3. **Tacheometry:** Basic principle – Tacheometric equation for horizontal and inclined line of sight – Method of tacheometry – Numerical problems.
4. **Traverse Survey:** Latitude and departure – Dependent and independent coordinates – Methods of plotting – Error of closure – Balancing the closed traverse using Bowditch's rule and Transit rule.
5. **Simple Curves:** Elements – Methods of setting out – Numerical problems.
6. **Compound and Reverse Curves:** Elements – Methods of setting out – Numerical problems.
7. **Transition Curves:** Types – Methods of setting out.
8. **Vertical Curves:** Types – Methods of setting out.
9. **Measurement of Earthwork for Roads:** Methods for computation of earthwork - trapezoidal & prismoidal formulae with and without cross slopes.

Self-Learning:

- Prolonging straight lines using theodolite.
- Digital theodolites.
- Trigonometric levelling in geodetic survey.
- Setting out of curves using total station.

Text Books:

- Chandra A.M. (2002), Plane Surveying, *New Age International (P) Ltd., New Delhi.*
- Alak De, (2000), Plane Surveying, *S. Chand & Co. Ltd., New Delhi.*

Reference Books:

- James Anderson and Edward Mikhail, (1985), Introduction to Surveying, *McGraw Hill Book Co., New York.*
- Benister, A. (2006), Surveying, *Pearson Education, New Delhi.*

Course Outcome:

The student has the ability to

- analyse theodolite and tacheometric survey data (CO1).
- balance and compute the coordinates the closed traverse (CO2).
- design the elements of curves for setting (CO3).
- compute volume of earth work (CO4).

Hydraulics and Flow Measurements

Sub Code : CV440 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to flow through pipes.
- To introduce the students to open channel flow.
- To introduce the students to flow measurements.
- To introduce the students to dimensional analysis and model studies.

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1. **Flow Through Pipes:** Definition of flow through pipes, Reynolds' number, classification of flow, Definition of hydraulic gradient, energy gradient. – Major and minor losses in pipe flow, equation for head loss due to friction (Darcy-Weishbach equation). – Friction factor for pipes. Pipes in series, pipes in parallel and equivalent pipe. – .Problems on Darcy-Weishbach equation – Minor losses (types), equation for head loss due to sudden expansion. – Problem on minor losses; Pipe networks – Hardy Cross Method.
2. **Water Hammer in Pipes:** Definition, Equation for pressure rise due to gradual closure of valves. Equation for pressure due to sudden closure of valves in rigid & Elastic pipes, problems. Surge tanks, their functions and types.
3. **Flow Measurements:** Flow through Orifices; classification, hydraulic coefficients of an Orifice and relation between them. – Equation for co-efficient of velocity, problems. – Submerged and large rectangular Orifices. – Flow through mouth pieces, classification, equation for discharge and pressure head for an external cylindrical mouth piece. Flow over notches, classification, equation for discharge over a V-notch, problems. – Equation for discharge over rectangular and trapezoidal notches, Cippoletti notch, problems. Types of Nappe, ventilation of weirs, Broad crested weirs, problems.
4. **Flow in Open Channels:** Definition of open channels, classification, difference between pipe flow & open channel flow, types of flow, Geometric properties of open channels
   Uniform flow in open channels, Chezy's equation derivation and Manning's formulae.
   Problems on uniform flow, Most economical open channels. Derivation of conditions for rectangle, triangle trapezoidal and circular sections, Problems on most economical sections.
   Specific energy, definitions, specific energy curve, Critical flow concept, Conditions for minimum specific energy and maximum discharge.
   Critical flow in rectangular channels, problems
   Hydraulic jump in rectangular channels, derivations with Froude number concept.
   Problems on Hydraulic Jump.
5. **Dimensional Analysis & Model Similitude:** Introduction to Dimensional Analysis, units & dimensions, Table of Dimensions.
   Dimensional Homogeneity.
   Methods of Analysis – Rayleigh's & Buckingham's π theorem.
   Problems on Raleigh's & Buckingham's π theorem.
   Model Studies – Introduction, Similitude, Dimensionless parameters.
   Types of models – Undistorted and Distorted models.
   Froude's model law – theory & problems.
   Reynolds' model law, Theory and problems.

Self-Learning:

- Introduction to gradually varied flow and Venturi flume – theory and problems.

Text Books:

- Modi, P.N. and Seth, S.M. (2002), Hydraulics and Fluid Mechanics including Hydraulic Machines, *Standard Book House, Delhi.*
- Bansal, R.K. (2009), Fluid Mechanics and Hydraulic Machines, *Laxmi Publications, New Delhi.*
- Ven Te Chow, (2009), Open-Channel Hydraulics, *The Blackburn Press, USA.*

Reference Books:

- Arora, K.R. (2005), Fluid Mechanics, Hydraulic and Hydraulics, *Standard Book House, Delhi.*
- Cruise, J.F., Singh, V.P. and Sherif, M.M. (2007), Elementary Hydraulics, (1st Edition), *Thomson Learning, USA.*
- Douglas, J.F., Gasoriek, J.M., Swaffield, J. and Jack L. (2006), Fluid Mechanics, *Prentice Hall, USA.*

Course Outcome:

The student has the ability to

- analyse pipe flow and design the pipes & pipe networks (CO1).
- analyse open channel flow and design open channels (CO2).
- obtain the coefficients of flow measuring devices (CO3).
- analyse fluid flow problems using dimensional analysis (CO4).
- do model analysis (CO5).

Elements of Engineering Geology and Geotechnical Engineering

Sub Code : CV450 Contact Hrs : 4/week
Credits : 04: 0:0

Course Objectives:

- To introduce the students of Civil Engineering to the basics of engineering geology, processes involved in the formation of rocks and soils, structural geological features and their importance in the field of Civil Engineering.
- To introduce the students the basics of geotechnical engineering, soil composition, soil – water interaction, index properties of soils & their determination and soil classification systems.

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1. Engineering Geology and its importance in Civil Engineering practice; Geology & Groundwater; Rocks – Rock formation and Rock classification (i.e. igneous, sedimentary and metamorphic rocks); Rock forming minerals.
2. Structural Geology – Outcrop; Stratification; Dip and strike; Fractures in rocks; Folds – folding in rocks, classification of folds; Faults – basic definitions, classification of faults; Significance of folds and faults in engineering; Joints in rocks; Unconformity – types and engineering significance.
3. Definitions of Soil and Geotechnical Engineering; Soil formation – Weathering processes (i.e. physical and chemical weathering); Different types of soil sediments.
4. Introduction to chemical bonds – Primary valence bonds (i.e. covalent, ionic and metallic bonds) and secondary valence bonds (i.e. hydrogen bond and van der Waals' forces).
5. Soil composition – Clay minerals and non-clay minerals; Clay minerals – Building blocks of clay minerals, Typical clay minerals in soils (kaolinite, illite and montmorillonite) – their formation and structure; Isomorphous substitution in soils; specific surface of clay minerals.
6. Soil – water interaction: Electrical diffuse double layer, Cation exchange capacity of clays; Soil fabric and structure of granular soils (i.e. single grained structure) and of clay soil (i.e. flocculent and dispersed structures), composite soil structure.
7. Soil as a three phase system; Definitions of water content, void ratio, porosity, air content, percentage air voids, degree of saturation, specific gravity, densities (i.e. bulk density, dry density, saturated density and submerged density), unit weights (i.e. bulk unit weight, dry unit weight, saturated unit weight and submerged unit weight) and inter-relationship.
8. Water content of soil and its determination; Specific gravity of soil solids and its determination.
   Index properties of soils and their determination: Particle size distribution – particle size classification (i.e. IS and MIT systems), sieve analysis, sedimentation analysis (hydrometer analysis only); Consistency limits – liquid limit, plastic limit and shrinkage limit; Mechanisms controlling liquid and shrinkage limits; Laboratory determination of consistency limits and controlling mechanisms; Flow index, plasticity index, consistency index, toughness index and liquidity index; Activity of clays; Characteristic water contents: Free swell limit and settling limit – Definitions, Mechanisms involved and laboratory determination, significance; Free swell index, Modified free swell index, Free swell ratio – controlling mechanisms, determination procedures and uses; In-situ density and its determination – core cutter and sand replacement methods; Density index and its determination.
9. Soil classification: Plasticity chart and its importance / limitations; Unified soil classification system and Indian standard classification system.
   Field identification of soils.

Self-Learning:

- Elements of physical geology and geological processes on earth.
- Methods of determining specific gravity and liquid limit of fine-grained soils by methods other than the conventional methods.

Text Books:

- Murthy, V.N.S. (2007), Text Book of Soil Mechanics and Foundation Engineering, *CBS Publishers and distributors, New Delhi.*
- Gopal Ranjan and Rao, A.S. (2006), Basic and Applied Soil Mechanics, *New Age International (P) Ltd., Publishers, New Delhi.*
- Parbin Singh, (2006), Engineering and General Geology, *S.K. Kataria and Sons, Delhi.*

Reference Books:

- Alam Sing, (2006), Soil Engineering: In Theory and Practice, *CBS Publishers, New Delhi.*
- Krynine D.P. and Judd, W.R. (1957), Principles of Engineering Geology and Geotechnics, *McGraw–Hill Book Company, New York.*
- Punmia, B.C., Jain, A.K. and Jain, A.K. (2005), Soil Mechanics and Foundations, *Laxmi Publicaiton (P) Ltd., Bengaluru.*
- Holtz, R.D. and Kovacs, W.D. (1981), An Introduction to Geotechnical Engineering, *Prentice Hall, Engle Wood Cliffs, New Jersey.*
- SP: 36 (Part-I): 1987, Compendium of Indian Standards on Soil Engineering, *BIS, New Delhi.*

Course Outcome:

The student has the

- ability to explain various geological processes taking place on the surface of the earth, to identify structural features of geological formations and to explain their importance in the field of Civil Engineering (CO1).
- knowledge of various soil forming processes, bonding forces, soil composition and soil-water interaction (CO2).
- ability to use the interrelationships among various soil parameters to solve soil related problems (CO3).
- ability to determine the water content, specific gravity and index properties of soils and to understand the mechanisms involved (CO4).
- ability to classify / identify the soils (CO5).

Surveying Practice – II

Sub Code : CV46L Contact Hrs : 3/weak
Credits : 0:0:1.5

Course Objectives:

- To facilitate the students to develop their intellectual and motor skills to conduct the surveying works based on objectives.
- To train the students of civil engineering in using Theodolite and Tacheometers.
- To train the students to set-out horizontal curves.

Exercise-1 : To learn the use of Theodolite – Temporary adjustment – Least count of scales.

Exercise-2 : To use a Theodolite to measure horizontal angles – Method of repetitions and Reiterations.

Exercise-3 : Measurement of vertical angles.
Trigonometric levelling – Elevation of an object when base is accessible.

Exercise-4 : Elevation of an object – Base inaccessible – Single plane and double plane method.

Exercise-5 : Distance and difference in elevation between two inaccessible points – Double plane method.

Exercise-6 : Determination of Tacheometric constants (Dumpy level and theodolite)
Use of Tachemeter to determine distances

Exercise-7 : Setting out simple curves by linear methods – Ordinates from long cord and back.

Exercise-8 : Setting out compound curves and reverse curves.

Exercise-9 : Study of minor instruments – Clinometer – Ghat tracer – Planimeter – Pantograph – Telescopic alidade with Beaman stadia arc.

Exercise-10 : Study and use of Total station instruments

Reference Books:

- Chandra A.M., (2002), Plane Surveying, *New Age International (P) Ltd., New Delhi.*
- Alak De, (2000), Plane Surveying, *S. Chand & Co. Ltd., New Delhi.*
- Anderson, J. and Mikhail, E. (1985), Introduction to Surveying, *McGraw Hill Book Company, New York.*
- Benister, A. (2006), Surveying, *Pearson Education, New Delhi.*

Course Outcome:

The student has the ability to

- use Thodolite and Techeometer for data collection (CO1).
- set-out horizontal curves for Highways and Railways (CO2).
- prepare comprehensive report of the survey work conducted (CO3).

Concrete Laboratory

Sub Code : CV47L Contact Hrs : 3/week
Credits : 0:0:1.5

Course Objectives:

- To facilitate the students to develop their intellectual and motor skills to conduct the tests as per the standards.
- To provide the students of civil engineering hands on experience in the testing of cement, aggregates and concrete both in plastic and hardened states.
- To train the students to analyse the test data to conform to IS specifications.

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1. TESTS ON CEMENT

Normal consistency, setting time, Soundness by Le chatelier's method, Soundness by autoclave method, Compression strength test, Fineness by sieving, Fineness by Blaine's air permeability method, Specific gravity of cement and cementations materials.

2. TESTS ON AGGREGATES

Specific Gravity test, Water absorption test, rodded density test, Angularity number, Determination of voids by density approach.

3. TESTS ON FRESH CONCRETE

Slump test, Compaction factor test, Vee Bee test, Flow test.

4. HARDENED CONCRETE

Compressive strength test using cubes and cylinder for medium and high strength concrete, Split tensile strength test using cylinders and cubes, Flexural strength test, Use of accelerated curing tank.

5. CONCRETE MIX DESIGN

A study on concrete mix design as per IS: 10262-2009 for medium strength and high strength concrete with and without admixtures.

6. USE OF NDT INSTRUMENTS

Introduction to Non-destructive Testing, Codal Provisions, Use of rebound hammer, UPV tester, Profometer, Resistivity meter, Corrosion meter, Core cutter. To establish relation between rebound number and UPV for 3 different grades of concrete cast for nominal mix proportion.

Text Books:

- Shetty, M.S. (1982), Concrete Technology (Theory and Practice), *S. Chand and company, New Delhi.*
- Gambhir, M.L. (2004), Concrete Technology, *Tata McGraw-Hill Education, New Delhi.*
- Relevant BIS codes on Cement, Concrete and Aggregates.

Reference Books:

- Neville A.M. and Brooks J.J. (2010), Concrete Technology, *Prentice Hall, England.*
- Kumar Mehta, P. (2002), Concrete – Structure, Properties and Materials, *Prentice Hall, New Jersey, USA*.
- IS: 10262-2009: Indian Standard Concrete Mix Proportioning-Guidelines, *BIS, New Delhi.*
- SP 23 (1982), Handbook on Concrete Mixes, *BIS, New Delhi.*

Course Outcome:

The student has the

- ability to test concrete and its ingredients using relevant IS codes (CO1).
- ability to carry out mix design as per IS code provisions (CO2)
- knowledge of NDT instruments and their usage (CO3)
- ability to analyse the test results rationally, to certify the materials and to prepare the test report (CO4).

Construction Management, Planning, Equipments, and Entrepreneurship

Sub Code : HU510 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to fundamentals of management, planning and scheduling procedures.
- To introduce the students to major construction equipments.
- To introduce the students to concept of network compression and time cost trade-off, network and resources allocation and integrated system for construction project management.
- To introduce the students to the concept of entrepreneurship.

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1. Management: Introduction, Meaning, Nature and Characteristics of Management; Scope and Functional Areas of Management; Management as a Science, Art or Profession; Management & Administration; Roles of Management; Levels of Management.

2. Construction Projects Planning & Phases: Project Management, Characteristics Feature Of A Project, Development Of Construction Project – Defining Work Tasks – Defining Precedence Relationships Among Activities – Estimating Activity Durations And Resources Requirement.

3. Scheduling Procedures and Techniques: Introduction, Scheduling Using Net Work Analysis- Introduction, Terms and Definitions, Types of Networks, Rules for Drawing Network, Fulkerson's Rule for Numbering the Event, Related Problems.

(a) Pert Network- Introduction, Time Estimates, Terms and Definition, Calculation of Slack, Probability of Completion Time for a Project, Related Problems.
(b) CPM Network (A-O-A Network)-Introduction, Differences Between CPM And PERT, Terms And Definition, Calculation Of Floats, Related Problems.
(c) Precedence Net Work (A-O-N Network)- Logic of Precedence Diagrams, Advantages, Drawing A-O-N Network From A-O-A Network And Related Problems.

4. Network Compression and Time Cost Trade-Off: Network Compression, Direct And Indirect Cost, Step in Optimization of Cost, Related Problem.

5. Network and Resources Allocation: Histogram, Resource Smoothening, Resource Leveling And Related Problem.

6. Construction Equipment: Introduction – Various Earth Moving Equipments – Hoisting Equipments – Concrete Mixer And Plants – Conveyors And Rollers – Trenching Machines – Equipment For Highway Construction – Factors For Selecting Equipments – Special Equipments – Economic Life Of Equipments – Operating Cost – Maintenance Cost – Depreciation.

7. Integrated System for Construction Project Management: Activity And Project Planning, Project Estimation, Materials Scheduling, Cash Budgets, Pay Roll, Cost Control, Accounting Report, Defining Work Items.

8. Introduction to Project Management Software: Related Problems on CPM & PERT.

9. Entrepreneurship: Meaning of Entrepreneur; Evolution of Concept and Functions of Entrepreneur; Types of Entrepreneur; Entrepreneur - An Emerging Class; Concept of Entrepreneurship; Evolution of Entrepreneurship; Development of Entrepreneurship; Stages in Entrepreneurial Process; Role of Entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship – Its Barriers.

Self-Learning:

- Bar charts in planning of construction project.
- Modern construction equipment.

Text Books:

- Chitkara, K.K., Construction Project Management – Planning, Scheduling and Controlling, Tata McGraw Hill, New Delhi, 2000.
- Purifoy R.L., Construction Planning Equipments and Methods, Tata McGraw Hill Publications, Third Edition, 2010.
- Veerabhadrappa Havinal, Management and Entrepreneurship, New Age International, New Delhi, 2009.

Reference Books:

- Ahuja, H.N.,Project Management, John Wiley, New York, 1999.
- NICMAR Publications, Construction Project Management Techniques, 2008.
- Sharma, S.C., Construction Equipments, Khanna Publishers, New Delhi, 2018.
- Naidu, N.V.R and Krishna Rao, T., Management and Entrepreneurship, I.K. International Publishing Housing Pvt. Ltd., New Delhi., 2008.
- Antil J.M. and Woodhead R.W., Critical Path Methods in Construction Practice, John Wiley, Canada,1999.
- James, O., CPM in Construction Management, McGraw Hill, New York, 1999.

Course Outcome:

The student has the

- knowledge of principles of management, planning and entrepreneurship (CO1).
- ability to plan and schedule the construction projects using CPM and PERT (CO2).
- ability to determine operating and maintenance costs of construction equipments (CO3).
- ability to use software related to construction management (CO4).

WATER SUPPLY AND SANITARY ENGINEERING

Sub Code : CV510 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to the concept of urban water supply.
- To introduce the students to source and quality of potable water, testing methods and standards.
- To introduce the students to the theoretical concept of water treatment and design of treatment units.
- To introduce the students to the concept of waste management.

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1. **Introduction:** Need for protected water supply. Points to be considered for public water supply. Arrangements for distribution of water.
2. **Demand of Water:** Types of water demands-domestic, institutional, commercial and fire demand. Public uses, per capita consumption-factors affecting per capita demand, population forecasting – different methods with problems, variations in water demand. Peak factors, design periods and factors governing the design periods.
3. **Sources of Water Supply:** selection of source, Surface and subsurface sources – suitability with regard to quality and quantity, Mass diagram.
4. **Quality of Potable Water:** Objectives - Physical, Chemical and Microbiological examinations, Water - borne diseases, Sampling techniques, Drinking water standards – WHO and BIS guidelines, Health significance of Fluoride, Nitrates and Iron.
5. **Treatment of Water:** Objectives – Flow chart, Screening, Plain Sedimentation, Design of settling tanks. Factors affecting Coagulation, functions of coagulation, Dosage of coagulants. Sedimentation followed by Coagulation, Combined Coagulation – Sedimentation chambers.
6. **Filtration:** Mechanism – Theory of Filtration, Types of filters. Slow Sand and Rapid Sand filters – operation, cleaning and their design.
7. **Disinfection and Softening:** Theory of disinfection, Types of disinfection, Chlorination, Chlorine demand and Residual chlorine. Definition of Softening and removal of hardness by Lime Soda process and Zeolite process.
8. **Sanitary Engineering:** Definition and Importance, Quantity of sewage, Design of sewers, Flow diagrams, Organic constituents of sewers – Aerobic and Anaerobic reactions.
9. **Sewer Appurtenances:** Materials for sewer pipes, Laying of sewers, Design and Characteristics of sewage. Manhole, Drop Manhole, Inverted Siphon and sewer outlets.
10. **Disposal and Treatment of Sewage:** Disposal methods and Preliminary Treatment of sewage – Sedimentation - Type.
11. **Introduction to Solid Waste Management**

Self-Learning:

- Estimation of design population of any locating or area and calculation of total water requirement.
- To study advanced water and waste water treatment methods.
- Application of software for population forecast and estimation of total water demand.
- Collection and distribution network for water supply.
- Potable water from sea water.
- Removal of heavy metals from waste water.

Text books:

- Garg, S.K., Water Supply Engineering, Khanna Publishers, New Delhi.
- Punmia B.C. and Jain, A., Environmental Engineering, Lakshmi Publications, New Delhi.
- Husain, S.K., Water Supply and Sanitary Engineering, Oxford Publishing, New Delhi.

Reference books:

- Hammer, M.J. and Hammer Jr., M.J., Water Technology, Prentice Hall of India Pvt. Ltd., New Delhi.
- Peavey, H.S. and Rowe, D.R., Environmental Engineering, McGraw Hill Book Company, New York.
- Tchnobanoglous, G., Environmental Engineering, McGraw Hill International Edition, New Delhi.
- Metcalf and Eddy, Waste Water Treatment, Disposal and Re-use, Tata McGraw Hill Publication, 2003.

Course Outcome:

The student has the

- ability to determine water demand as per national and international standards and estimate design population (CO1).
- ability to identify sources of water and tests water for its quality (CO2).
- knowledge of various methods of water treatment and to design features and functions of different water treatment units (CO3).
- ability to analyse characteristics of waste water (CO4).
- knowledge of methods of sewage disposal and to design the disposal systems (CO5).

Design of RC Structures

Sub Code : CV520 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the basic concepts of reinforced concrete design and compare different philosophy of design.
- To introduce the basic principles of mechanics as applied to the analysis and design of reinforced concrete elements.
- To introduce the design procedure for RC elements according to IS: 456-2000 with limit state format.
- To develop skills regarding detailing and drafting of various RC structural elements as per codes of practices.

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1. **General Features Of Reinforced Concrete:** Introduction, Materials for Reinforced Concrete and Code requirements, Loads and their types, Design Philosophy of Working stress method, Ultimate load method and Limit State Method.
2. **Principles of Limit State Design and Ultimate Strength of R.C. Section:** Philosophy of limit state design, Principles of limit states, Factor of Safety, Characteristic and design loads, Characteristic and design strength, General aspects of Ultimate strength, Stress block parameters for limit state of collapse, Ultimate flexural strength of singly reinforced rectangular sections, Ultimate flexural strength of doubly reinforced rectangular sections, Ultimate flexural strength of flanged sections, Ultimate shear strength of RC sections, Ultimate torsional strength of RC sections, Concepts of development length and anchorage, Analysis examples of singly reinforced, doubly reinforced, flanged sections, shear strength and development length.
3. **Serviceability Limit States:** General aspects, Deflection limits in IS: 456 – 2000 for beams and slabs, modification factors, Cracking in structural concrete members, Calculation of deflections and crack width, Durability requirements as per IS: 456-2000.
4. **Design of Beams:** Practical requirements, Size of beam, Cover to reinforcement, spacing of bars, Design procedures for critical sections for moments and shears, Anchorages of bars, check for development length, Reinforcement requirements, Slenderness limits for beams to ensure lateral stability, Design examples for Simply supported and Cantilever beams for rectangular and flanged sections. Detailing requirements and drawing.
5. **Design of Slabs:** General consideration of design of slabs, Rectangular slabs spanning one direction, Rectangular slabs spanning in two directions for various boundary conditions. Design of simply supported, cantilever and one way continuous slabs and two way slabs as per IS: 456 – 2000. Detailing requirements and drawing
6. **Design of Columns:** General aspects, effective length of column, loads on columns, slenderness ratio for columns, minimum eccentricity, design of short axially loaded columns, design of column subject to combined axial load and uniaxial moment and biaxial moment using SP – 16. Detailing requirements and drawing.
7. **Design of Footings:** Introduction, Types of footings, Design of isolated square and rectangular footings for axial load, axial load and uniaxial moment, design of pedestal, Detailing requirements and drawing.

Self-Learning:

- Design of RC structures using methods other than working stress & limit state methods and international codes.

Text Books

- Varghese, P.C., Limit State Design of Reinforced Concrete, Prentice-Hall of India Private Limited, New Delhi, India
- Jain, A.K., Limit State Method of Design, Nem Chand and Bros., Roorkee, India.

Reference Books

- Park, P. and Paulay, T., Reinforced Concrete, John Wiley & Bros, New York, USA.
- Punmia, B.C., Jain, A.K. and Jain, A.K., Limit State Design of Reinforced Concrete, Laxmi Publication, New Delhi, India.
- BIS codes namely IS: 456:2000, IS:875-1987, SP-16, SP-23 and SP-34.

Course Outcome:

The student has the

- knowledge of RCC and to compare the different philosophies of design (CO1)
- ability to apply principles of limit state design and compute ultimate strength of RC section (CO2)
- ability to analyse RC elements for serviceability conditions (CO3).
- ability to design RC beams & slabs and to prepare detailing as per Indian Standard code of practice (CO4).
- ability to design RC columns & footings and to prepare detailing as per Indian Standard code of practice (CO5).

Highway Engineering

Sub Code : CV530 Contact Hrs : 3/week
Credits : 3:0:0

Course Objectives:

- To introduce students to transportation engineering principles with emphasis on the safe and efficient operation of highways.
- To describe the criteria, standards and engineering procedures used to design principal elements of highways.
- To describe the standards and specifications for materials used in pavement constructions.

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1 **Introduction:** Importance of Transportation. Different modes of transportation, characteristics and comparison of different modes. Importance of roads in India. Scope of Highway Engineering.

2 **Highway Development and Planning:** Road Types and classification, road patterns. Planning surveys, Master plan - saturation system of road planning, phasing road development program. Road Development - Present scenario of road development in India (NHDP & PMGSY) and in Karnataka (KSHIP & KRDCL). Road development Plan – Vision 2021.

3 **Highway Alignment and Surveys:** Alignment, factors affecting alignment, engineering surveys for new and realignment projects.

4 **Highway Geometric Design:** Factors controlling the design, design of geometric elements – highway cross section elements, Sight distance, horizontal and vertical alignment.

5 **Pavement Materials:** Properties and requirements of Subgrade Soil, Road Aggregates, Bitumen/Asphalt – Tar – Emulsion – Cutback. Tests on highway materials for evaluating the required properties.

6 **Highway Pavement Design:** Types of pavements, Components of pavements – Design factors, Determination of ESWL by equal stress criteria. IRC method of flexible pavement design. Stresses in rigid pavement and design of rigid pavements as per IRC guidelines excluding design of joints.

7 **Highway Drainage System:** Surface and Sub-subsurface drainage system for road pavements, types, functions and basic design principles.

8 **Highway Economics and Finance:** Highway user benefits – Highway costs – Economic analysis – Role, Basic principles, Techniques. Highway financing – BOT, BOOT and Annuity concepts.

Self-Learning:

- Design concepts of geometric elements and highway pavements by methods other than IRC method.

Text Books:

- Khanna, S.K. and Justo, C.E.G., Highway Engineering, Nem Chand and Bros, Roorkee.
- Kadiyali, L.R. and LAL, N.B., Principle and practice of Highway Engineering, Khanna Publishers, New Delhi.
- Subramanyam, K.P., Transportation Engineering–I, Scitech Publications, Chennai.

Reference Books:

- Relevant IRC codes.
- Chakraborthy, P., Principles of Transportation Engineering, Prentice-Hall, New Delhi.
- Specifications for Roads and Bridges by MoRT&H, IRC, New Delhi.

Course Outcome:

The student has the

- knowledge of Highway planning, alignment and surveys (CO1).
- knowledge of pavement materials and their characterisation (CO2).
- ability to do design of geometrical elements of highways (CO3).
- ability to design the pavement layers (CO4).
- knowledge of Highway Economics and Finance (CO5).

Hydraulic Machinery

Sub Code : CV540 Contact Hrs : 3/week
Credits : 03:0:0

Course Objectives:

- To introduce students to the concept of impact of jet on different types of vanes used in hydraulic machinery.
- To introduce the working principles of different types of hydraulic turbines and pumps and to study their performance.

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1. **Impact of Jet on Flat Vanes:** Introduction to Impulse – momentum equation and its applications Force exerted by a jet on a stationery vane – Derivations. Force exerted by a Jet on a moving vane – Derivations – Problems.

2. **Impact of Jet on Curved Vanes:** Force exerted by a jet on a series of curved vanes. Concept of velocity triangles. Equation for work done & efficiency. Problems on force exerted by a Jet on a series of curved vanes.

3. **Hydraulic Turbines:** Introduction, Elements of hydro electric power plants, Classification of turbines.

4. **Hydraulic Turbines (Impulse):** Introduction, Pelton Wheel – theory, equation for work done and efficiency of Pelton wheel, design parameters, Problems on Pelton Wheel.

5. **Hydraulic Turbines (Reaction):** Theory, equation for work done and efficiency, design parameters; Problems on Francis turbine – Main components and working principle; Kaplan turbine – Main components and working principle; Problems on reaction turbines.

6. **Performance of Turbines:** Specific speed of a turbine, Equation for the specific speed, problems, Unit quantities of a turbine, definitions, equations and problems, Characteristics curves of a turbine, Governing of turbine, Cavitations in turbine, Draft tubes: types.

7. **Pumps:** Definition of pump, Positive displacement and centrifugal pumps; difference between pump and turbine, classification, component centrifugal pump, General principle of working, Priming and priming devises. Work done and efficiencies of a centrifugal pump, Minimum starting speed, cavitation in centrifugal pumps. Multistage centrifugal pumps - classification. Problems on components and working principles of submersible pumps.

Self-Learning:

- Reciprocating pump and gear pump.
- Modern types of pumps and turbines.

Text Books:

- Modi, P.N. and Seth, S.M., Hydraulics & Fluid Mechanics, Standard Book House, New Delhi
- Jagadish Lal., Hydraulics and Fluid Mechanics, Metropolitan Book Publishers, New Delhi.
- Priyani, V.B., Fundamental Principles of Hydraulics, Charotra Press, Anand.
- Bansal R.K., Text Book on Fluid mechanics & Hydraulic Machines, Laxmi Publications, New Delhi..

Reference Books:

- Jain, A.K., Fluid Mechanics, Khanna Publishers, New Delhi.
- Raghunath. H M., Fluid Mechanics & Machinery, CBS Publishers, New Delhi.
- Arora K.R., Hydraulics & Fluid Mechanics, Standard Book house, New Delhi.
- Cruise, J.F., Singh, V.P. and Sherif, M.M., Elementary Hydraulics, 1st Edition, Thomson Learning.
- Gupta, S.C., Fluid Mechanics and Hydraulic Machines, Pearson Education, India

Course Outcome:

The student has the

- ability to use Impulse-momentum principle and velocity diagrams to analyse the impact of jet on vanes of hydraulic machines (CO1).
- knowledge of hydraulic turbines, the ability to design hydraulic turbines and to analyse the performance of hydraulic turbines (CO2).
- knowledge of pumps & their working and the ability to analyse their performance (CO3).

Geotechnical Engineering

Sub Code : CV550 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to the meaning, importance and procedure of sub-surface exploration.
- To introduce the students to the knowledge of various engineering properties of soils.

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1. **Flow of Water Through Soils**: Darcy's law – assumptions and validity, superficial velocity and seepage velocity, coefficient of permeability and coefficient of percolation; Determination of coefficient of permeability of soils - lab and field methods; Factors affecting coefficient of permeability; Coefficient of permeability of stratified soil deposits.
2. **Effective Stress Concept**: Total stress, pore water pressure and effective stress; Effective stress equation and its limitation; Modified effective stress equation; Capillary phenomenon in soils; Quick sand phenomenon.
3. **Compaction of Soils:** Basic definitions, mechanisms involved; Standard and modified Proctor compaction tests and their Indian Standard versions; Factors affecting compaction; Effect of compaction on soil properties; Field compaction methods and equipments; Field compaction control.
4. **Compressibility of Soils:** Basic definitions; Spring analogy; Normally consolidated, Over consolidated and Under consolidated soils; Pre-consolidation pressure and its determination – Casagrande and log-log methods; Terzaghi's one dimensional consolidation theory – Assumptions and limitations; Consolidation characteristics of soils – compression index, coefficient of volume change and coefficient of consolidation; Laboratory one dimensional consolidation test – equilibrium void ratio and its determination by height of solids method and change in void ratio method, determination of compression index, determination of coefficient of consolidation by Taylor's, Casagrande's, Rectangular hyperbola and one point methods; Coefficient of secondary compression and its determination; Determination of coefficient of permeability from consolidation test – direct and indirect methods.
5. **Shear Strength of Soils:** Concept of shear strength, Mohr – Coulomb failure theory; Conventional and modified failure envelops; Total and effective shear strength parameters; Factors affecting shear strength of soils; Determination of shear strength parameters of soils – direct shear test, triaxial compression test, Vane shear test; Unconfined compression test; Tests under different drainage conditions; Skempton's pore pressure parameters; Sensitivity of clays and thixotropy in clays.
6. **Subsurface Exploration:** Importance, exploration program; Methods of exploration: Boring, sounding tests, geophysical methods – electrical resistivity and seismic refraction methods; Types of samples – undisturbed, disturbed and representative samples; Samplers, sample disturbance, area ratio, recovery ratio, clearance; Soil sampling; Rock sampling, RQD; Stabilization of bore holes; Typical boring log; Number and depth of borings for buildings and dams; Determination of ground water level by Hvorslev method (Raising water level method); Control of ground water during excavation: Dewatering – Ditches and sumps, Well point system, Shallow well system, Deep well system, vacuum method, Electro – Osmosis method.

Self-Learning:

- Methods of determining coefficient of consolidation of fine-grained soils by methods other than the Taylor's method, Casagrande's method, Rectangular hyperbola method and one point method.

Text Books:

- Murthy, V.N.S., Text Book of Soil Mechanics and Foundation Engineering, CBS Publishers and Distributors, New Delhi, 2007.
- Gopal Ranjan and Rao, A.S., Basic and Applied Soil Mechanics, New Age International (P) Ltd., Publishers, New Delhi, 2006.

Reference Books:

- Bowles, J.E., Foundation Analysis and Design, McGraw-Hill Company, Inc, New York, 1997.
- Punmia, B.C., Soil Mechanics and Foundations, Laxmi Publicaiton (P) Ltd., Bengaluru, 1994.
- Holtz, R.D. and Kovacs, W.D., An Introduction to Geotechnical Engineering, Prentice Hall, Engle Wood Cliffs, New Jersey, 1981.
- Compendium of Indian Standards on Soil Engineering – SP36 (Part – I): 1987, BIS, New Delhi. .

Course Outcome:

The student has the

- knowledge of various sub-surface exploration programmes during a soil investigation project and ability to apply them (CO1).
- ability to understand and apply the Darcy's law to the problems related with the flow through soils (CO2).
- ability to compute effective stresses in soils (CO3).
- knowledge of the compaction process and to determine the compaction characteristics of soils (CO4).
- knowledge of the consolidation process, ability to determine the consolidation characteristics of soils & to apply them for solving geotechnical engineering problems (CO5).
- knowledge of shear strength of soils and to determine the shear strength parameters of soils (CO6).

Building Planning & Drawing

Sub Code : CV56D Contact Hrs : 3/week
Credits : 0:0:1.5

Course Objectives:

- To introduce the students of civil engineering to the concept of engineering drawing and its importance as the language of field engineers.
- To train students to prepare working drawings of various elements of buildings, to develop plan, elevation and sectional views of buildings.

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1. To prepare working drawings for
    a. Wall footing
    b. Column footing
    c. RCC dog legged stair
    d. RCC open well stair
    e. Steel truss.

2. Functional design of buildings (Residential, Public and Industrial): Orientation of buildings, Building standards, Determination of carpet area, Plinth area and FAR.

3. Development of plan, elevation and sectional elevation of residential buildings
    a. Single bed room
    b. Double bed room
    c. Two storey building
    d. Sloped roof building

4. Planning and development of single line diagrams of
    a. Residential Building
    b. Primary health centre
    c. College canteen
    d. Primary school building
    e. Library and information science building

5. For a given single line diagram of a building, preparation of:
    a. Diagram showing water supply line
    b. Diagram showing sanitary line
    c. Diagram showing electrical layout for buildings.

Text Books:

- Gurucharan Singh and Jagadeesh Singh, Building Planning, Designing and Scheduling, Standard Publishers and Distributors, New Delhi.

Reference Books:

- Kale, C.M., Shah, M.G. and Patki, S.Y., Building Planning and Drawing, Tata McGraw Hill Publishers, New Delhi.

Course Outcome:

The student has the ability to

- plan and prepare relevant drawings for structural units of a building (CO1).
- plan and prepare relevant drawings of different types of buildings (CO2).
- prepare line diagram for building services (CO3).
- determine carpet area, plinth area and FAR of buildings (CO4).

Highway Material Testing Laboratory

Sub Code : CV57L Contact Hrs : 3/week
Credits : 0:0:1.5

Course Objectives:

- To facilitate the students to develop their intellectual and motor skills to conduct tests on materials used for highway construction.
- To provide the students of civil engineering, hands on experience in testing & quality control of highway materials to obtain their basic, index and engineering properties.
- To train the students to analyse the data obtained from the laboratory testing of highway materials rationally to draw conclusions, which are required in the field highway engineering practice.

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1. **Road Aggregates:** Gradation, Specific gravity, Water absorption, Crushing, Abrasion, Impact and Shape tests.

2. **Bituminous Materials and Mixes:** Specific Gravity, Penetration, Ductility, Softening point, Flash and fire point, Viscosity and Solubility tests; Marshall Stability test and Mix design procedure.

3. **Subgrade Soil:** CBR test and Plate Bearing test on subgrade soil.

References:

- Khanna, S.K. and Justo, C.E.G., Highway Material Testing Laboratory Manual, Nem Chand & Bros, Roorkee
- Specifications for Roads and Bridges by MoRT&H, IRC, New Delhi.
- Relevant IRC and BIS codes

Course Outcome:

The student has the ability to

- test road aggregates (CO1).
- test bituminous materials and mixes (CO2).
- test sub-grade soil (CO3).
- analyse the test results rationally and prepare the test report (CO4).

Hydraulics and Hydraulic Machinery Laboratory

Sub Code : CV58L Contact Hrs : 3/week
Credits : 0:0:1.5

Course Objectives:

- To facilitate the students to develop their intellectual and motor skills to conduct experiments to study the performance of flow measuring devices and hydraulic machines.

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1. Hydraulic coefficient of vertical orifice.
2. Mouth pieces (Cylindrical, convergent, divergent and convergent divergent)
3. Calibration of triangular and rectangular notches.
4. Broad crested weir.
5. Major loss (Head loss due to friction).
6. Minor losses (Sudden expansion, Sudden contraction, bends and elbows)
7. Calibration of venturi meter.
8. Determination of coefficient of impact for flat, hemispherical and conical vanes.
9. Performance tests on a single stage centrifugal pump
10. Performance tests on a multi stage centrifugal pump
11. Performance tests on a Pleton wheel
12. Performance tests on Francis or Kaplan turbine.

Reference Books:

- Modi, P.N. and Seth, S.M., Hydraulics and fluid mechanics, Standard Book House, New Delhi.
- Asawa, G.S., Experimental Fluid Mechanics, Engineering Model and Equipmente, Roorkee.
- Likhi, S.K., Hydraulics, Laboratory Manual, Wiley Eastern Ltd., New Age International Ltd., New Delhi.

Course Outcome:

The student has the ability to

- conduct experiments to calibrate / determine coefficients of flow measuring devices (CO1).
- conduct experiments to determine major and minor losses in pipe flow (CO2).
- conduct performance tests on vanes, turbines and pumps (CO3).
- analyse the test results rationally and to prepare the test report (CO4).

Design of Steel Structures

Sub Code : CV610 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To learn the behavior and properties of structural steel
- To understand the different design philosophies for the design of steel components
- To introduce analysis and design of structural steel connections and their detailing
- To introduce design of axially loaded and flexural steel members and their detailing as per IS:800-2007

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1. **Structural Steel:** Manufacture, Metallurgy, Engineering properties and characteristics, Types of sections, Rolling process – necessity and importance, Specifications, Advantages and disadvantages. Loads and loading standards, Assessment of wind load and earthquake loads as per IS codes.

2. **Design Approaches:** Methods of design – working stress, LRFD and Limit state design, Fundamental concepts, Performance criteria, Comparison of methods, Specifications of IS code for limit state design.

3. **Connections:** Bolted connections – Types of bolts, specifications, Strength, Pitch, Gauge and edge distances, Bolt value, Analysis and design of bolted connections subjected to direct and eccentric loadings. Welded connections – Types of welds, specifications, strength, continuous and intermittent welds, Design of welded connections subjected to direct and eccentric loadings.

4. **Design of Tension Members and Lug Angles:** Types of tension members, sectional areas, types of failure, design strength, design of tension members, lug angles and splices

5. **Design of Axially Loaded Compression Members**: Types of section, section classification, column formulae, buckling classification. Design strength of simple members and struts, Design of built up and compound members including splicing, lacing and battening, Design of column bases and foundation.

6. **Design of Flexural Members:** Concept of lateral restraint, laterally supported and unsupported beams, section classification, Elastic and plastic sections modulus, Determination plastic section modulus of sections, IS criteria for design, Design of simple and plated beams.

Self-Learning:

- Special bolts, parallel and non-parallel flange sections, their advantages and disadvantages, codes of practice, special steels and tubular sections.

Text Books

- Limit State Design of Steel Structures S. K. Duggal, Tata McGraw Hill Education Private Limited, New Delhi, India, 2015.
- Design of Steel Structures By Limit State Method by S. S. Bhavikatti, as Per IS: 800—2007, Second Edition, I K International Publishing House, India, 2010.

Reference Books

- Design of Steel Structures by N. Subramanyam, Oxford University Press, New Delhi, india, 2008.
- Design of steel structures-1 by Rama Chandra and Virendra Gehlot, Scientific Publishers, india , 2009
- Design of Steel Structures by P. Dayarathnam, Prentice Hall India, New Delhi, india, 2011
- IS: 800-2007- General Construction in Steel – Code of Practice, (Third Revision).
- IS: 875, steel tables and other relevant codes.

Course Outcome:

The student has the

- knowledge of the behavior of steel as structural material and analysis of various loads and design philosophies as applied to structural steel (CO1).
- ability to analyze and design tension members and their connections (CO2).
- ability to analyze and design axially loaded compression members including bases & foundations (CO3)
- ability to analyze and design built up and compound members, splicing, lacing & battening (CO4).
- ability to analyze and design flexural members (CO5).

Advanced Design of RC Structures

Sub Code : CV620 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to the basic concepts in the behavior and design of advanced reinforced concrete structural elements namely flat slabs, grid floors, retaining walls and water tanks.
- To introduce the students to the concepts related to analysis and design of advanced RC members according to IS: 456-2000.
- To impart the students the skills regarding detailing and drafting of advanced RC members as per codes of practices.

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1. Design of components of a RC framed structure and its detailing.

2. Design of flat slab floor system-Preliminary design basis-codal provisions-Detailed design and detailing.

3. Design of grid floor system- Preliminary design basis-codal provisions-Detailed design and detailing.

4. Design of RC retaining walls-Cantilever and counter fort type and detailing.

5. Design of water retaining structures-Design concepts. Detailed design of circular and rectangular water tanks resting on ground and detailing.

6. Design of Stair Cases: General features, types of stair case, loads on stair cases, effective span as per IS code provisions, Design of stair cases and detailing.

Self-Learning:

- Design of RC structures using methods other than working stress & limit state methods and international codes.

Text Books

- Limit State Design of Reinforced Concrete by P.C. Varghese, Prentice-Hall of India Private Limited, New Delhi, India.
- Advanced Reinforced Concrete Design by P.C. Varghese, Prentice-Hall of India Private Limited, New Delhi, India.

Reference Books

- Reinforced Concrete by Park & Paulay, John Wiley & Bros, New York, USA
- Limit State Design of Reinforced Concrete by B.C. Punmia, Ashok Kumar Jain & Arun kumar Jain, Laxmi Publication, New Delhi, India.
- BIS codes namely IS: 456:2000, IS:875-1987, IS:3370, SP-16, SP-23 and SP-34

Course Outcome:

The student has the ability to

- analyse, design and to prepare detailing of RC framed structure (CO1).
- analyse, design and to prepare detailing of flat slab floor system & grid floor system (CO2).
- analyse, design and to prepare detailing of retaining walls (CO3).
- analyse, design and to prepare detailing of water retaining structures (CO4).
- analyse, design and to prepare detailing of stair cases (CO5).

Railway and Airport Engineering

Sub Code : CV630 Contact Hrs : 3/week
Credits : 3:0:0

Course Objectives:

- The students are introduced to transportation engineering principles with emphasis on the safe and efficient operation of Railways and airways
- The students are introduced to the criteria, standards and engineering procedures used to design principal elements of the railway.
- The students are introduced to the criteria, standards and engineering procedures used to design principal elements of airport.

RAILWAY ENGINEERING

1 **Introduction:** Role of railways in transportation, Indian Railways, selection of routes.

2 **Permanent Way:** Introduction, requirements for an ideal permanent way, typical cross sections of single and double line B.G. tracks – in cutting , embankment and electrified tracks. Gauges and types of gauges with dimensions. Coning of wheels and tilting of rails. Track stresses in rails, sleepers, ballast and subgrade. Problems on these. Rails functions requirements, types of rail sections, length of rails, defects in rails. Wear on rails, rail joints, welding of rails, creep of rails.

3 **Ballast and Sleepers:** Functions, requirements, types, track fittings and fasteners, calculation of quantity of materials needed for laying a track. Traction and tractive resistances, tractive power, Hauling capacity. Problems on above.

4 **Geometric Design of Track:** Necessity of Geometric Design of railway track, gradient and types of gradient. Speed of train, curve, transition curve, super elevation, cant- deficiency, negative cant- speed calculation based on Indian Railways Formulae for High speed tracks only-problems on above.

5 **Points and Crossing:** Necessity and its components, turnout, design of turnout, Types of switches, crossings, track junctions. Stations and yards, marshalling yard, signalling and interlocking, track defects, track maintenance, level crossing, Indian Railway standards (no derivations, only relevant problems). Equipment in stations and yards such as turn-table, water columns, fouling marks, buffer stops etc.

AIRPORT ENGINERING

6 **Introduction:** Introduction to airport engineering, Recent Development by AAI. Layout of an airport with component parts and functions of each, Aircraft Characteristics – Airport Classifications - Site selection- Regional Planning.

7 **Runway Design:** Orientation of runway by using wind rose diagram, the runway configurations- basic length of the runway –corrections to runway length by ICAO and FAA specification- runway cross sections- problems on above.

8 **Taxiway Design:** Factors affecting the layout of the taxiway-geometrics of taxiway- design of Exit taxiways- ICAO Specifications. Problems on above.

9 **Visual Aids:** Airport marking – lightings- ILS, other navigational aids.

Self-Learning:

- Sustainable Railways for high speed trains.

Text Books:

- Railway Engineering by Saxena and Arora, Dhanpat Rai and Sons, New Delhi.
- Railway Engineering by Satish Chandra and Agarwal, M.M., Oxford University Press, New Delhi
- Airport Planning and Design by Khanna, Arora and Jain, Nem Chand & Bros, Roorkee.

Reference Books:

- Indian railway Track by Agarwal M.M, Jaico Publications, Bombay.

Course Outcome:

The student has the

- knowledge of railway engineering, various railway elements and their requirements (CO1).
- ability to estimate materials required for different elements of railway track (CO2).
- ability to do the geometric design of railway track (CO3).
- knowledge of airport characteristics & planning and ability to do the runway design of Air Ports as per ICAO and FAA specifications (CO4).
- ability to do the design of taxiway of Air Ports as per ICAO Specifications (CO5).

Engineering Hydrology

Sub Code : CV640 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to basic concepts of hydrology.
- To introduce the students to the importance of ground water and rainwater harvesting.

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1. **Introduction:** Definition of hydrology. Importance of hydrology. India's water availability. Practical applications of hydrology. Hydrologic cycle (Horton's qualitative and engineering representations)
2. **Precipitation:** Definition. Forms and types of precipitation. Measurement of rain fall – Non-recording and recording type of rain gauges. Optimum number of rain gauge stations. Consistency of rainfall data. Computation of mean rainfall. Estimation of missing rainfall data. Presentation of precipitation data - moving average curve, mass curve, rainfall hyetographs.
3. **Losses from Precipitation:** Introduction. EVAPORATION: Definition, Process, Factors affecting, Measurement using IS Class A Pan. Estimation using empirical formulae. INFILTRATION: Definition, factors affecting infiltration capacity, measurement - Double ring infiltrometer. Harton's infiltration equation, infiltration indices - Problems.
4. **Runoff:** Definition. Concept of catchment. Water budget equation. Components. Factors affecting. Rainfall - runoff relationship using simple regression analysis.
5. **Design Flood:** Introduction, Estimation by empirical formulae, Rational method.
6. **Hydrographs:** Definition. Components of Hydrograph. Hydrograph separation, Unit hydrograph and its derivation from simple and complex hydrograph. S-curve and its uses – Problems.
7. **Ground Water Hydrology and Well Hydraulics:** Scope and importance of ground water hydrology. Aquifer parameters. Steady radial flow into wells in unconfined and confined aquifers. Types of wells, Safe yield, Yield of an open well – Pumping tests, Recuperation test – Problems.
8. **Stream Flow Measurement:** Introduction. Measurement of stage. Measurement of velocity. Measurement of discharge by Area – velocity method and slope area method. Simple stage discharge relation.
9. **Rainwater Harvesting:** Introduction. Necessity, advantages. Urban and Rural rainwater harvesting. Methods of ground water recharge.

Self-Learning:

- Knowledge of recent mathematical models for forecasting flood.
- Latest developments in stream flow measurement.

Text Books:

- Engineering Hydrology by Subramanya K, Tata McGraw Hill, New Delhi.
- A Text Book of Hydrology by Jayarami Reddy, Lakshmi Publications, New Delhi.
- Hydrology by H.M. Raghunath, Wiley Eastern Publication, New Delhi.

Reference Books:

- Hand Book of Hydrology by Ven Te Chow, McGraw Hill Company,
- Hydrology and Water Resources Engineering by R.K. Sharma and Sharma,, Oxford and IBH, New Delhi.
- Hydrology and Water Resources Engineering by Garg S.K., Khanna Publishers, New Delhi.
- Applied Hydrology by Linsley, Kohler and Paulhus, Wiley Eastern Publication, New Delhi.
- Ground Water Hydrology by Todd, Wiley Eastern Publication, New Delhi.

Course Outcome:

The student has the ability to

- anlayse and present the rainfall data (CO1).
- estimate the losses from precipitation (CO2).
- develop rainfall - runoff relationship (CO3).
- analyse hydrographs and their components (CO4).
- analyse well hydraulics, stream flow and rain water harvesting systems (CO5).

Applied Geotechnical Engineering

Sub Code : CV650 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to various geotechnical structures such as foundations, slope, retaining walls and deep excavations.
- To introduce the students to the geotechnical analysis and design of geotechnical structures
- To introduce the students the knowledge of SBC and settlement characteristics of soils.
- To introduce the students to the stresses in soils.

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1. **Stresses in Soil:** Boussinesq's and Westergard's theories for concentrated, circular, rectangular, line and strip loads; Comparison of Boussinesq's and Westergard's analyses; Newmark's chart; Pressure distribution diagrams, Contact Pressure.
2. **Flownets:** Laplace equation (No derivation) – Assumptions and Limitations only; Characteristics and uses of flownets; Methods of drawing flownets for dams and sheet piles; estimating quantity of seepage and exit gradient; Determination of phreatic line in earth dams with and without filter; Piping and protective filter, graded filter.
3. **Lateral Earth Pressure:** Active and Passive Earth Pressures, Earth Pressure at rest, Earth pressure coefficients; Earth pressure theories - Rankine's and Coulomb's – Assumptions and limitations; Graphical solutions for active earth pressure (Cohesionless soil only) – Culmann's and Rebhan's methods; Lateral earth pressure in cohesive and cohesionless soils,; Earth pressure distribution.
4. **Stability of Earth Slopes:** Types of slopes, Causes and types of failure of slopes; Definition of factor of safety; Stability of finite and infinite slopes – Methods of slices, Friction circle method, Fellineous method; Taylor's stability number.
5. **Bearing Capacity & Foundation Settlement:** Definition of ultimate, net and safe bearing capacities, Allowable bearing pressure; Terzaghi's and Brinch Hansen's bearing capacity equations – assumptions and limitations; Bearing capacity of footings subjected to eccentric loading; Effect of ground water table on bearing capacity; Plate load test, Standard Penetration Test, Cone Penetration Test; Settlement Analysis, Data for settlement analysis; Computation of settlement; Concept, Immediate, Consolidation and Secondary settlements (no derivation); Tolerance, BIS Specifications for total and differential settlements of footings and rafts.
6. **Deep Excavation:** Arching in soil; Difficulties in deep excavation; Methods of excavation.

Self-Learning:

- Application of GEOSTUDIO software for the analysis of lateral earth pressure, slope instability and bearing capacity problems.
- Case studies of failures of retaining walls, natural and man-made slopes, foundation due to loss of bearing capacity and / or due to excessive settlement

Text Books:

- Soil Mechanics and Foundation Engineering by Punmia B. C., 16th Edition, Laxmi Publishing Co., New Delhi, 2005.
- Soil Mechanics and Foundation Engineering by Murthy. V. N. S., 4th Edition, UBS Publishers and Distributors, New Delhi, 1996.

Reference Books:

- Foundation Analysis and Design by Bowles. J. E., 5th Edition, McGraw Hill Publishing Co., New York, 1996.
- Basic and Applied Soil Mechanics by Gopal Ranjan and Rao A.S.R., New Age International (P) Ltd., New Delhi, 2000.
- Geotechnical Engineering by Venkataramaiah. C., 3rd Edition, New Age International Pvt. Ltd., New Delhi, 2006.
- Soil Mechanics by Craig. R. F., Van Nostrand Reinhold Co. Ltd, 1987.
- Principles of Geotechnical Engineering by Braja M Das, 5th Edition, Thomson Business Information India (P) Ltd., India, 2002.
- Soil Engineering in Theory and Practice by Alam Singh and Chowdhary G.R., CBS Publishers and Distributors Ltd, New Delhi, 1994.
- Foundation Engineering Handbook by Wintercorn and Fang, 2nd ed. Van Nostrand Reinhold Company, 1991.

Course Outcome:

The student has the

- ability to determine the stresses in soils for different loading conditions and understanding of deep excavation in soils (CO1).
- ability to draw flownets for sheet files and earth dams (CO2).
- ability to compute lateral earth pressure for different field conditions (CO3).
- ability to analyse the stability of earth slopes (CO4).
- ability to compute the bearing capacity of soils and to determine foundation settlements (CO5).

Special Concretes

Sub Code : CV661 Contact Hrs : 4/week
Credits : 4:0:0

Course Objectives:

- To introduce the students to special concretes, their importance.
- To introduce the students to the significance of microstructure modification to improve the mechanical properties of concrete.
- To introduce the students to the mix design criteria of special concretes.
- To introduce the students to the practical application of various special concretes.

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1. Fundamentals of concrete technology in relation to special concrete requirements, types of special concretes and their applications.

2. **Fiber Reinforced Concrete:** Fibre material, mix proportions, fibre content – distribution, orientation and interfacial bond. Fibre concrete properties in fresh state. Strengthen behaviour in tension, compression and bending. Toughness and related tests, Mix design criteria and application.

3. **High Density Concrete:** Materials, placement method, properties in wet and hardened state, Mix design criteria and applications.

4. **Lightweight Concrete:** Classification, Properties of light weight concrete, Strength and durability, Design of lightweight concrete mixes.

5. **High Strength Concrete:** General introduction, significance of HSC, methods of making HSC, materials and mix proportions. Application of HSC, Ultra HSC, Methods of making Ultra HSC.

6. **Polymer Concrete:** Materials, Types, Properties, Mix design criteria and its applications.

7. **High Performance Concrete:** General introduction and significance of HPC. Mix design criteria using plasticizes, SP, HP, Pozzolonic materials such as fly ash, ground granulated blast furnace slag, silica fumes, metakaolin rice husk ash.

8. **Self Compacting Concrete:** Introduction, Properties, Test methods and its application.

Self-Learning:

- Ferro-cement, Shot Crete concrete and Roller compacted concrete.
- Mix design of self-compacting concrete.

Text Books

- Concrete Microstructures, Properties and Materials by P.K. Mehta, and Paulo J.M., Monteiro, Indian Edition.
- Properties of Concrete by A.M. Neville, Longmans, 4th Edition, 1995

Reference Books

- Relevant National, International Codes, Technical Papers and Internet Information for Special Concrete.

Course Outcome:

The student has the

- knowledge of special concretes and their importance (CO1).
- ability to do the mix design of fiber reinforced concrete (CO2).
- ability to do the mix design of high density and lightweight concretes (CO3).
- ability to do the mix design of polymer, high strength and high performance concretes (CO4).
- knowledge of self-compacting concrete (CO5).

Advanced Surveying

Sub Code : CV662 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to the higher level surveying like triangulation, topographic surveying, hydrographic surveying, GPS survey and computational adjustments in surveying.

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1. Review of basic principles of surveying, Horizontal and vertical distance measurements, Comparison of various methods available, Plotting methods, Need for better methods.

2. Topographic surveying, Scale of topographic maps, Precision, Methods of representing relief, Establishment of control, Location of details, Electronic positioning system, DTM and DEM in topographic surveying.

3. Hydrographic Surveying: Methods, Shore line survey, Tides and tide groups, Sounding, Equipment, Measurement of angles, Locating soundings, Reduction of soundings, Plotting, Capacity computation, Stream gauging.

4. Triangulation, Objectives, Classification, Layout, Strength of figures, Signals, Base line measurement, Satellite station and reduction to centre, Computation in triangulation, Trilateration, Computations, Advantages and disadvantages.

5. Survey adjustments, Accuracy and precision, Weight of observations, Laws of weights, Least square method, Determination of MPV, Triangulation adjustment.

6. Global Positioning System (GPS), System overview, Working principle, Satellite ranging, Pseudo-random code, Position calculation, GPS errors and their calculations, Dilution of precision, Doopler effect. Geodry, Branches, Co-ordinate systems, GPS datum, GPS and heights, Mean sea level. GPS receiver and its features, Types, Selection of receiver, Manufactures.

7. Performance enhancement, GPS surveying methods: Positioning methods, Field survey procedure, Differential positioning, Static surveying, Applications.

Self-Learning:

- Elements of astronomy - co-ordinates and time.
- Trilateration techniques.
- Non-engineering use of GPS.

Reference Books:

- Higher Surveying by A.M. Chandra, New Age International (P) Ltd., Publishers.
- Global Positioning System, Principles and Applications by Satheesh Gopi, Tata McGraw Hill Publication Company Ltd., New Delhi.
- Plane Surveying by Alak De, S. Chand & Co. Ltd., New Delhi, 2000.
- Introduction to Surveying by James Anderson and Edward Mikhail, Mc-Graw Hill Book Company, 1985.
- Surveying by Arthur Benister, Pearson Education, 2006.

Course Outcome:

The student has the

- ability to do the error analysis to find MPV of observed quantities in surveying (CO1).
- knowledge of topographic surveying (CO2).
- knowledge of Hydrographic Surveying (CO3).
- ability to analyse triangulation survey data (CO4).
- knowledge of GPS surveying (CO5).

Matrix Methods of Structural Analysis

Sub Code : CV663 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:
- To introduce the students to system approach and element approach in matrix method of analysis.
- To introduce the students to the analysis of trusses, beams and simple portal frames using flexibility and stiffness methods by element approach.
- To introduce the students to the concepts of direct stiffness method involving formulation and assembly of stiffness matrices.

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1. **Flexibility Method:** Introduction to flexibility method, Element flexibility matrix, Force Transformation Matrix, Construction of structure flexibility matrix. Determination of member forces.

2. Analysis of axially rigid continuous beams, rigid plane frames and pin jointed plane trusses by flexibility method using Force Transformation Matrix (Degree of static indeterminacy ≤ 3).

3. Concepts of lack of fit and temperature in pin jointed plane truss.

4. **Stiffness Method:** Fundamentals of the stiffness method, Element stiffness matrix, Displacement Transformation Matrix, Principle of contragradience, Construction of structure stiffness matrix. Determination of member forces.

5. Analysis of axially rigid continuous beams, rigid plane frames and pin jointed plane trusses by stiffness method using Displacement Transformation Matrix (Degree of kinematic indeterminacy ≤ 3).

6. **Direct Stiffness Method:** Introduction, Local and global co-ordinate system, Member Stiffness Matrix for truss element, beam element and grid element, Transformation of variables, Transformation of the member stiffness matrix, Computation of internal forces.

7. Analysis of trusses by direct stiffness method (Degree of kinematic indeterminacy ≤ 3).

Self-Learning:
- Use of electronic spread sheet and software tools to perform matrix structural analysis.

Text Books:
- Structural Analysis A Matrix Approach by Pandit G.S. and Gupta S.P., Tata Mc Graw-Hill, New Delhi, 1981.
- Basic structural Analysis, Reddy C.S., Tata Mc Graw-Hill, New Delhi, 1996.
- Computational structural Mechanics by Rajshekharan S., Sankara Subramanian G., PHI, New Delhi, 2001.
- Matrix, Finite Elements, Computer and Structural Analysis by Mukhopadhyay M., Oxford & IBH, 1984.

Reference Books:
- Matrix Analysis of framed structures by Weaver W., Gere J.M., CBS publishers and Distributors, New Delhi, 1986.
- Structural Analysis – A Unified Classical and Matrix Approach by Ghali A., Neville A.M., and Brown T.G., Spon Press, London, 2004.
- Structural Analysis by Negi L.S. and Jangid R.S., Tata Mc Graw-Hill, New Delhi, 1997.
- Introduction to Matrix Methods of Structural analysis by Martin H.C., International Text Book Company, 1996.

Course Outcome:
The student has the
- ability to analyse trusses, beams and simple portal frames using element approach by flexibility method (CO1).
- ability to analyse trusses, beams and simple portal frames using element approach by stiffness method (CO2).
- ability to use direct stiffness method for formulation and assembly of stiffness matrices in trusses and beams (CO3).

Pavement Materials and Construction

Sub Code : CV664 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to the varieties of pavement materials and their characterisation.
- To introduce the students to the criteria, standards and engineering procedures used for construction of different types of pavements.

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1 Soil: Overview, Soils in Subgrade, Soil Classification, Characterization relevant to pavement engineering, Sub-base and Unstabilised Base, Soil stabilization – concepts and methods.

2 Aggregates: Origin, Classification, Requirements, Properties and tests on road aggregates, Concept of Size and Gradation – design gradation, aggregate blending, Artificial and marginal aggregates.

3 Binders: Source, Composition, Requirements, Properties and tests, Bituminous emulsions and Cutbacks – Characteristics, Classification and Selection, Tests, Uses, Modified Binders, physical properties as per BIS and IRC, application of the test results on pavement performance.

4 Bituminous Mixes: Physical and Volumetric Properties, Types, Design of bituminous mixes, Concept of Superpave.

5 Equipment in Highway Construction: Various types of equipment for excavation, grading and compaction – their working principle, advantages and limitations, Special equipment for bituminous and cement concrete and stabilised soil road construction.

6 Construction of Subgrade: Earthwork, grading and construction in embankments and cuts, Preparation of subgrade, quality control tests as per IRC/MoRTH.

7 Construction of Flexible Pavements: Specification of materials for construction of flexible pavement layers, construction methods and field quality control checks for various pavement layers as per IRC/MORTH specifications; concept of recycling of bituminous layers and full depth reclamation.

8 Construction of Concrete Pavements: Specification of materials, Construction method for concrete pavement and field control checks, Construction of various types of joints, Concrete White topping, Inter-locking concrete paver blocks, roller compacted concrete.

Self-Learning:

- Rheological properties of pavement materials.

Text Books:

- 'Highway Engineering' Khanna, S.K. and Justo, C.E.G., Nem Chand and Bros, Roorkee.
- 'Principle and practice of Highway Engineering', Kadiyali, L. R. and Lal, N. B, Khanna Publishers, New Delhi.

Reference Books:

- 'Hot Mix Asphalt Materials, Mixture Design and Construction', Freddy, L.R., Prithvi, S. K., Brown, E. R., Dah-Yinn Lee and Thomas, W. K., NAPA Education Foundation, Maryland
- Relevant IRC codes
- MoRTH, 'Specifications for Road and Bridge Works', IRC, New Delhi.

Course Outcome:

The student has the

- knowledge of materials used in pavement construction and their characteristics (CO1).
- knowledge of functions and requirements of pavement layers (CO2).
- ability to design bituminous mixes (CO3).
- knowledge of various equipments used in highway construction (CO4).
- knowledge of flexible and rigid pavement construction (CO5).

Design of Structural Masonry

Sub Code : CV665 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:
- To introduce the students to masonry structures.
- To introduce the students to the design of various components of masonry structures.

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1. **Fundamentals:** Introduction to Masonry structures – Materials for Masonry – Material properties – Elements – Building systems – Types of construction – Design Philosophy – Current Usage

2. **Masonry Structural Forms:** Testing methods, failure modes and factors affecting– Axial compression – Combined axial compression and flexure – Out-of-plane bending – In-plane tensile strength – Shear strength along joints

3. **Design of Axially Loaded Walls:** Characteristic compressive strength of Masonry – Thickness of wall – Slenderness – Eccentricity of applied loading – Combined slenderness and eccentricity–Eccentricities in Columns

4. **Design of Laterally Loaded Walls:** Design Strength of Panels – Edge Support Conditions and Continuity – Limiting Dimensions – Freestanding Walls – Shear Strength – Walls containing openings

5. **Columns and Pilasters:** Column behaviour – Failure modes – Design considerations –Pilasters design

6. **Masonry Infilled Frames:** Stiffness Characteristics – Micro and macro modeling analysis.

Self-Learning:
- Use of software tools for designing structural masonry components.

Text Book:
- McKenzie W.M.C., Design of Structural Masonry, Palgrave, New York, 2001.

Reference Books:
- Drysdale R. G., Hamid A. A. and Baker L. R., Masonry Structures Behaviour and Design, Prentice Hall, New Jersey, 1994.
- Dayaratnam P, Brick and Reinforced Brick Structures, Oxford and IBH, New Delhi
- IS: SP20 - Hand Book on Masonry Design and Construction, BIS Publications.

Course Outcome:
The student has the
- knowledge of masonry structures and materials used in masonry structures (CO1).
- knowledge of masonry structural forms (CO2).
- ability to design axially loaded and laterally loaded masonry walls (CO3).
- ability to design masonry columns and pilasters (CO4).
- ability to analyse masonry infilled frames (CO5).

Computer Applications Laboratory

Sub Code : CV67L Contact Hrs : 3/week
Credits : 0:0:1.5

Course Objectives:

- To identify the operational features of computer program and their use in engineering computations.
- To facilitate the students to develop their intellectual and computational skills to analyse the structure using available software.
- To facilitate the students to the use of electronic spread sheet programs for analysis, design and estimation of structures.
- To facilitate the students to develop their intellectual and computerised drafting skills.

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1. **Structural Analysis and Design Tools**
   Use of commercially available structural engineering software for analysis and design of simple structural systems like beams, slabs, frames, etc.

2. **Use of Electronic spread sheet in Civil Engineering**
   Introduction to electronic spread sheets and their usage in engineering problem solving. Identify and describe the purpose and function of the extensive features of electronic spread sheet program MS-Excel. Working with MS-Excel for – Creating, saving, retrieving, formatting, editing, and printing worksheets – Simple calculations and creating formulas – Charting and Graphing – Performing What-If Analysis – Naming cells and ranges – Array Formulae, matrix manipulations – Working with Tables – Lookup tables – Conditional Formatting, Data Validation – Statistical Analysis – Programing with VBA.

   Application of MS-EXCEL for solving Civil Engineering problems like analysis, design, estimation, etc.

3. **Use of AUTOCAD in Civil Engineering Drawings**
   Basics of AUTOCAD – Drawing tools: Lines, Circle, Arc, Polyline, Multiline, Polygon, Rectangle, Spline, Ellipse – Modify tools: Erase, Copy, Mirror, Offset, Array, Move, Rotate, Scale, Stretch, Lengthen, Trim, Extend, Break, Chamfer and Fillet – Using Text : Single line text, Multiline text, Spelling, Edit text – Special Features : View tools, Layers concept, Dimension tools, Hatching, Customization, Working with multiple drawings.

   Preparation of following drawings for the data given using AUTOCAD
   - Detailing of Simple Building Components
   - Detailing of RCC and Steel Structural Components.
   - Plan, elevation and sectional elevation of residential and public buildings.

References:

- Respective software user manuals.

Course Outcome:

The student has the ability to

- do structural analysis and design using software (CO1).
- solve civil engineering problems using electronic spread sheet (CO2).
- do detailing of RC and steel structural components (CO3).
- prepare plan and elevations of residential and public buildings (CO4).
- prepare reports (CO5).

Geotechnical Engineering Laboratory

Sub Code : CV68L Contact Hrs : 3/week
Credits : 0:0:1.5

Course Objectives:

- To facilitate the students to develop their intellectual and motor skills to conduct tests on soils.
- To provide the students of civil engineering, hands on experience in the testing of soils to obtain their basic, index and engineering properties.
- To train the students to analyse the data obtained from the laboratory testing of soils rationally to obtain soil properties required in the field geotechnical engineering practice.

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1. Determination of specific gravity of coarse grained and fine-grained soils.

2. Determination of *in situ* density:
    a. Core cutter method
    b. Sand Replacement method

3. Grain size analysis of soils: sieve analysis.

4. Determination of Atterberg limits of fine-grained soils:
    a. Determination of liquid limit
    b. Determination of plastic limit
    c. Determination of shrinkage limit and shrinkage factors

5. Determination of compaction characteristics of soils:
    a. Light compaction test
    b. Heavy compaction test

6. Determination of coefficient of permeability of soils:
    a. Constant head permeability test
    b. Variable head permeability test

7. Determination of unconfined compressive strength of soils

8. Determination of shear strength parameters of soils
    a. Box shear test
    b. Triaxial compression test (Unconsolidated, undrained condition)

9. Determination of undrained shear strength of soil by vane shear test

10. Determination of pre-consolidation pressure, compression index, coefficient of volume change and coefficient of consolidation by one dimensional consolidation test.

11. Free-swell tests.

12. Determination of relative density of sands.

13. Demonstration of hydrometer test.

References:

- Compendium of Indian Standards on Soil Engineering – SP36 (Part – I & Part – II): 1987, BIS, New Delhi.
- Soil testing for Engineers by Lambe, T.W., Wiley Eastern Ltd., New Delhi.
- Manual of Soil Laboratory Testing by Head, K.H., Vol. 1, 2 & 3, Princeton Press, London, 1986.
- Engineering Properties of Soil and their Measurements by Bowles, J.E., McGraw-Hill Book Co., New York, 1988.

Course Outcome:

The student has the ability to

- test the basic and index properties of soils (CO1).
- test the engineering properties of soil (CO2).
- analyse the test data rationally and to prepare the test report (CO3).

Advanced Design of Steel Structures

Sub Code : CV710 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives: The students are introduced

- to analysis and design advanced steel structural elements such as plate girders and gantry girders, their connections as per national code of practices.
- to plastic analysis of beams and frames, and hence design of steel structural elements for laterally supported and unsupported conditions,
- to analysis and design of tubular steel structural elements for axial and flexural elements, their connections as per national code of practices.
- to detailing of advanced steel structural elements.

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1. **Design of Plate Girders:** Basic components and their structural function, typical sections, failure criteria, preliminary design, Design of flange plates, Design of web plate-simple post critical and tension coefficient method, Serviceability design, Design of bearing and intermediate stiffeners, curtailment of plates, splices and joints.(Welded plate girder only)
2. **Design of Gantry Girder:** Components of industrial crane systems, function of gantry girder, Loads and their combinations, Impact factor, Determination of bending moments and shear forces, Design procedure and guidelines as per IS:800-2007, Joint details
3. **Plastic Analysis of Steel Structures:** Plastic analysis of beams and simple frames, Analysis-Independent and combined mechanisms, Analysis of continuous beams and irregular frames by mechanism, Determination of plastic moment and collapse load, Plastic design examples.
4. **Tubular Structures:** Introduction, Design principles for tubular structural components, joint details and specifications, Design examples for tension, compression and flexural elements, Stress concentration in tubular connections.
5. **Detailing of Steel Structures:** Detailing principles, Basic connections, Simple sketches of plate girders and their components, tubular structures with joint details, gantry girder and detailing, simple trusses and their detailing

Self-Learning:

- Introduction to types of trusses and their elements, design of truss elements using Tata structural steel tubes, Components of industrial buildings and mill bents.

Text Books

- Duggal, S.K., Limit State Design of Steel Structures, Tata McGraw Hill Education Private Limited, New Delhi, India, 2015.
- Bhavikatti, S.S., Design of Steel Structures By Limit State Method, as Per IS: 800—2007, Second Edition, I.K. International Publishing House, India, 2010.

Reference Books:

- Subramanian, N., Steel structures-Theory and Practice, Oxford University Press, India, 2011.
- Rama Chandra and Virendra Gehlot, Design of steel structures-1, Scientific Publishers, India, 2010
- Shah, V.L. and Karve, S.R., Limit state design of steel structures, Structures Publications, Pune, 2009.
- Rama Chandra and Virendra Gehlot, Design of steel structures-2, 9th revised and enlarged edition, Scientific Publishers, India.
- Punmia, B.C., Jain, A.K. and Jain, A.K., Comprehensive Design of Steel Structures, Laxmi Publications, New Delhi, 2011
- Relevant BIS codes.

Course Outcome:

The student has the ability to

- analyze and design plate girders as per Indian Standards including free hand structural detailing (CO1).
- analyze and design gantry girders as per Indian Standards including free hand structural detailing (CO2).
- perform plastic analysis of beams & frames and plastic design of components including free hand structural detailing(CO3).
- analyze and design steel structural elements using structural steel tubes including free hand structural detailing(CO4).
- draw and detail steel structural components and their connections using tools (CO5).

Design of Pre-stressed Concrete Structures

Sub Code : CV720 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- The students are introduced to the principles of pre-stressing and materials used in pre-stressed concrete.
- The students are introduced the analysis of pre-stressed concrete structures.
- The students are introduced the design of pre-stressed concrete beams.

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1. **Materials:** High strength concrete and steel, Stress-Strain characteristics and properties.

2. **Basic Principles of Pre-stressing:** Fundamentals, Load balancing concept, Stress concept, centre of Thrust. Pre-tensioning and post tensioning systems, tensioning methods and end anchorages.

3. **Analysis of Sections for Flexure:** Stresses in concrete due to pre-stress and loads, stresses in steel due to loads, Cable profiles.

4. **Losses of Pre-Stress:** Various losses encountered in pre-tensioning and post tensioning methods, determination of jacking force.

5. **Deflections:** Deflection of a pre-stressed member – Short term and long term deflections, Elastic deflections under transfer loads and due to different cable profiles. Deflection limits as per IS 1343. Effect of creep on deflection, load verses deflection curve, methods of reducing deflection

6. **Limit State of Collapse:** Flexure - IS Code recommendations – Ultimate flexural strength of sections.

7. **Limit State of Collapse:** Shear - IS Code recommendations, shear resistance of sections, shear reinforcement. Limit state of serviceability – control of deflections and cracking.

8. **Design of end Blocks:** Transmission of prestress in pretensioned members, transmission length, Anchorage stress in post-tensioned members. Bearing stress and bursting tensile force-stresses in end blocks-Methods, I.S. Code, provision for the design of end block reinforcement.

9. **Design of Beams:** Design of pre-tensioned and post-tensioned symmetrical and asymmetrical sections. Permissible stress, design of prestressing force and eccentricity, limiting zone of pre-stressing force cable profile.

Self-Learning:

- Pre-stressed bridges.

Text Books:

- Krishna Raju, N., Pre-stressed Concrete, Tata Mc. Graw Publishers.
- Dayarathnam, P., Pre-stressed Concrete, Oxford and IBH Publishing Co.

Reference Books:

- Lin, T.Y. and Burns, N.H., Design of pre-stressed concrete structures, John Wiley & Sons, New York.
- Sinha, N.C. and Roy, S.K., Fundamental of pre-stressed concrete, S. Chand & Co., Ltd., New Delhi.
- Ramamrutham, S., Pre-stressed Concrete, Dhanpat Rai & Sons, New Delhi.
- IS: 1343: 1980

Course Outcome:

The student has the

- knowledge of the principles of pre-stressing and materials used (CO1).
- ability to analyse pre-stressed concrete structural elements for stresses and deflections (CO2).
- ability to design cable profile (CO3).
- ability to do the design of end blocks (CO4).
- ability to do the limit state design of beams (CO5).

Irrigation Engineering & Hydraulic Structures

Sub Code : CV730 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- The students are introduced to various irrigation methodologies, components of irrigation works, hydraulic structures such as reservoirs, dams and spillways.

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1. **Introduction:** Definition. Benefits and ill effects of irrigation. Sources of water for irrigation. Systems of irrigation: Surface and ground water, flow irrigation, Lift irrigation, Bhandhara irrigation.

2. **Irrigation and Water Requirements of Crops:** Definition of duty, Delta and Base period, Relationship between Duty, Delta and Base period, Factors affecting duty of water. Evapo-transpiration. Crops and crop seasons in India, Crops grown in Karnataka, their seasons, Agro-climatic zones of Karnataka. Irrigation efficiency, Frequency of irrigation, drainage.

3. **Canals:** Definition. Types of canals, Alignment of canals. Design of canals by Kennedy's and Lacey's methods.
   CANAL WORKS: *Canal regulators*: Classification and suitability. *Canal drops:* Classification. Hydraulic design principles for notch type drop. Cross drainage works: Classification.

4. **Reservoirs**: Definitions. Investigation for reservoir sites. Storage zones. Determination of storage capacity and yield of a reservoir using mass curve. Basics of reservoir operations.

5. **Diversion Works**: Definition. Layout. Types of weirs and Barrages. Design of Impermeable floors – Bligh's and Lane's theories – Simple design problems. Khosla's theory – Method of independent variables.

6. **Dams (General):** Definition, Classification of dam, Factors governing selection of type of dam, Selection of site for a dam.

7. **Gravity Dams**: Definition. Forces acting on a Gravity dam. Modes of failures. Elementary and practical profile. Low and high gravity dams. Principal and shear stresses. Drainage galleries.

8. **Earthen Dams**: Introduction. Types of earthen dams. Failure of earthen dams. Preliminary design. Drainage arrangements. Phreatic line. Stability analysis.

9. **Arch Dams and Buttress Dams**: Arch Dams -Types, Forces on Arch Dams, Thin cylinder theory of design, Buttress dams - Types.

10. **Spillways**: Definition. Types of Spillways. Energy dissipaters - Types.

Self-Learning:

- Drip irrigation.
- Design principles of dams and spillways.

Text Books:

- Modi, P.N., Irrigation, Water Resources, and Water Power Engineering, Standard Book House, New Delhi.
- Punmia, B.C., Pande B.B.L., Jain, A.K. and Jain, A.K., Irrigation and Water Power Engineering, Laxhmi Publications, New Delhi.

Reference Books:

- Garg, S.K., Irrigation Engineering and Hydraulic Structures, Khanna Publications, New Delhi.
- Michael, A.M., Irrigation Theory and Practices, Vikas Publications, New Delhi.
- Sharma, R.K., Text Book of Irrigation Engineering and Hydraulic Structures, Oxford and IBH Publishing Co., New Delhi.

Course Outcome:

The student has the

- the knowledge of irrigation and different types of irrigation(CO1).
- ability to determine water requirements for crops (CO2).
- the knowledge different types of dams and their components (CO3).
- ability to analyse the forces acting on the dam sections and do the stability analysis (CO4).
- ability to do the design of components of irrigation system (CO5).

Photogrammetry and Remote Sensing

Sub Code : CV741 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:
- The students are introduced to the fundamentals of photogrammetry and remote sensing.

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1. **Photogrammetry:** Introduction – Basic Principles – Photo theodolite – Definitions – Horizontal and Vertical angle from teerestial photograph – Horizontal position of a point from photo graphic measurement from camera horizontal axis – Elevation of point by photographic measurement – focal length.

2. **Aerial Camera – Scale of Photograph:** Determination of height of lens for a vertical photograph – Relief displacement – Scale of tilted photograph – computation of a length of line between points of different elevation from measurement on a tilted photograph.

3. **Determination of Flying Height for a Tilted Photograph:** Tile distortion – Relief displacement – Combined effect of tile and relief – flight planning for Aerial Photogrammetry, Ground control – Stereoscopic vision – Drift mosaics, Relevant numerical examples in the above topics.

4. **Remote Sensing:** Introduction – Historical sketch of Remote Sensing – Idealized remote sensing – Basic principles of remote sensing – Electromagnetic energy Electromagnetic spectrum- Wave length regions and their application in remote sensing – characteristics of solar radiation – Basic radiation law – EM radiation and atmosphere – Interaction of EM radiation with earth surface – Remote sensing observation platforms – sensors – Application of Remote Sensing.

Self-Learning:
- Principles of digital photogrammetry.
- Infrared remote sensing.

Text Books:
- Punmia, B.C., Jain, A.K. and Jain, A.K., Higher Surveying, Laxhmi Publications, New Delhi.
- Wolf, P.R., Element of Photogrammetry, Mc Graw Hill International.
- Lillesand, T.M. and Kiefer, R.W., Remote Sensing & Image Interpretation, John Wiley, New York, 2000.

Reference Books:
- NNRMS DOS, Natural Resource Management – A New Perspective, Govt. of India, Bangalore.
- Sabins, F.F., Remote Sensing Principles and Interpretation, W.H. Freeman and Co., New York.

Course Outcome:
The student has the
- knowledge of fundamentals of photogrammetric surveying and its applications (CO1).
- ability to analyse the geometry of aerial photographs (CO2).
- ability to analyse the geometry of terrestrial photographs (CO3).
- knowledge of physics of satellite remote sensing technology and applications (CO4).

Ground Improvement Techniques

Sub Code : CV742 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:
- The students are introduced to the meaning and importance of ground improvement.
- To introduce the students to various ground modification techniques.
- To introduce the students to the modifications of soil properties.

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1. **Ground Improvement:** Definition, Need and objectives of soil improvement, Classification of ground improvement techniques, Factors to be considered in the selection of the best soil improvement technique.

2. **Mechanical Modification:** Definition, Objectives; Compaction: Principle of modification; Field compaction: Shallow surface compaction – Equipments required, Deep compaction – Dynamic consolidation, Vibro-compaction and explosion; Compaction theories; Factors affecting compaction; Properties of compacted cohesive and non-cohesive soils; Compaction control; Specifications of compaction requirements.

3. **Hydraulic Modification:** Definition, Objectives; Traditional dewatering methods: Open sumps and ditches, gravity wells, Vacuum dewatering; Design of dewatering systems; Pre-loading with and without vertical drains; Radial consolidation; Geosynthetics for filtration, Drainage and seepage control; Electro-kinetic dewatering: Electro osmosis and electrophoresis, Practical aspects and typical applications.

4. **Physical and Chemical Modifications:** Definition, Objectives; Modification by granular admixtures; Cement stabilization; Lime stabilization; Bituminous stabilization; Stabilization with chlorides, hydroxides, gypsum, and lignin; Engineering benefits of chemical modification; Fly ash and its application in ground modification; Grouting: Definition, Objectives, categories of grouting, grout materials, grouting techniques and controls, practical applications.

5. **Modification by Inclusion and Confinement (Only Concepts):** Reinforced earth: Bar and mesh reinforcement; Geosynthetics in soil reinforcement; In-situ ground reinforcement; Ground anchorage, rock bolting and soil nailing; Soil confinement: Concept, Use of Crib walls, Gabions and Mattresses.

Self-Learning:
- Application of coal ashes in ground improvement projects.
- Case studies dealing with various ground improvement techniques.

Text Books:

- Hausmann, M., Engineering principles of ground modification, McGraw-Hill Publication, New York, 1990.
- Ingles. C.G. and Metcalf J.B., Soil Stabilization; Principles and Practice, Butterworths, London, 1972.

Reference Books:

- Nelson J.D. and Miller D.J., Expansive soils, John Wiley and Sons, 1992.
- Purushothama Raj P., Ground Improvement Techniques, Laxmi Publications, New Delhi, 1999.
- Koerner R.M., Construction and Geotechnical Method in Foundation Engineering, McGraw-Hill Publication, New York 1985.
- Sridharan, A., and Prakash, K., Geotechnical Engineering Characterisation of Coal Ashes, CBS Publishers and Distributors, New Delhi, 2007.

Course Outcome:
The student has the
- ability to suggest a particular type of ground improvement technique for improving a specific property of soil (CO1)
- knowledge of mechanical modification techniques (CO2).
- knowledge of hydraulic modification techniques (CO3).
- knowledge of physical and chemical modification techniques (CO4).
- knowledge of modification techniques by inclusion and confinement (CO5).

Groundwater Hydrology

Sub Code : CV743 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- The students are introduced to the importance groundwater.
- The students are introduced to the groundwater hydrology.
- The students are introduced to aquifer properties, well hydraulics, groundwater exploration and groundwater recharge.

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1. **Introduction:** Importance. Groundwater development in India, Groundwater potential in India, Vertical distribution of sub-surface water. Definition of aquifer, Aquifuge, Aquitard and Aquiclude. Confined and unconfined aquifers.

2. **Aquifer Properties:** Aquifer parameters – Specific yield, Specific retention, Porosity, Storage coefficient, derivation of the expression. Determination of specific yield. Land subsidence due to ground water withdrawals.

3. **Darcy's Law and Hydraulic Conductivity:** Introduction. Darcy's law. Hydraulic conductivity. Coefficient of permeability and Intrinsic permeability, Transmissibility, Permeability in Isotropic, Unisotropic layered soils. Steady one dimensional flow.

4. **Well Hydraulics – Steady Flow:** Introduction. Steady radial flow in confined and unconfined aquifers. Pumping tests.

5. **Well Hydraulics – Unsteady Flow:** Introduction. General equation derivation; Theis method, Cooper and JaCob method, Chow's method. Solution of unsteady flow equations.

6. **Ground Water Development:** Types of wells. Methods of constructions. Tube well design. Dug wells. Pumps for lifting water: Working principles, Power requirements; Ground water quality.

7. **Ground Water Exploration:** Seismic method, Electrical resistivity method, Bore hole geo-physical techniques, Remote sensing method.

8. **Ground Water Recharge and Runoff:** Recharge by vertical leakage. Artificial recharge. Ground water runoff. Ground water budget.

9. **Conjunctives use of Surface and Ground Water.**

Self-Learning:

- Ground water pollution and remedial measures.

Text Books:

- Raghunath, H.M., Ground Water, Wiley Eastern Limited, New Delhi.
- Todd, K., Ground Water Hydrology, Wiley and Sons, New Delhi.
- Rastogi, A.K., Numerical Ground Water Hydrology, Penram International Publishing (India), Pvt. Ltd., Mumbai.

Reference Books:

- Bower, H., Ground Water Hydrology, McGraw Hill, New Delhi
- Garg, S.K., Ground Water and Tube Wells, Oxford and IBH, New Delhi.
- Walton, W.C., Ground Water Resource Evaluation, McGraw Hill, New Delhi.

Course Outcome:

The student has the

- knowledge of importance of ground water and ground water potential (CO1).
- knowledge of different types of aquifers and ability to determine the specific yield of aquifers (CO2).
- ability to design of tube wells (CO3).
- ability to compute power requirement for ground water development (CO4).
- ability to determine ground water runoff and prepare ground water budget (CO5).

Fundamentals of Earthquake Engineering

Sub Code : CV744 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- The students are introduced to the basics of vibrations and structural dynamics.
- The students are introduced to the basics of earthquake forces and their effects.
- The students are introduced to the concept of earthquake resistant construction.

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1. Introduction to structural dynamics: D'Alembert's principle, degrees of freedom, damping, simple harmonic motion, free vibration, forced vibration, natural frequency and damping.

2. Engineering seismology: Introduction, theory of plate tectonics, seismic waves, magnitude and intensity, seismic zoning map of India. Seismograph and Seismogram. Accelerograph and Accelerogram, Earthquake ground motion, Duration, Ground parameters- amplitude, frequency content, estimation of ground motion parameters.

3. Earthquake Geotechnical Engineering: Liquefaction of soil, Site effect, dynamic lateral earth pressure, earthquake resistant design of foundation, Base isolation

4. Building configuration for earthquake resistant design: effect of plan and elevation irregularities, effect of soft storey and mass irregularities, Earthquake resistant design of RC and Masonry structures

5. Determination of design lateral loads: Seismic design philosophy, concept of response spectrum, equivalent lateral force method to determine lateral forces on building.

6. Disaster Management: Types of disasters, Components, Objectives, Methods and Case Studies

Self-Learning:

- Report on significant past earthquakes, statistics on ground motion and damage, typical failures, disaster management etc.
- Case studies of performance and failures of geotechnical structures, RC and masonry structures during earthquakes

Text Books:

- Agarwal, P. and Shrikande, M., Earthquake resistant design of structures, PHI India, New-Delhi, 2006.
- Duggal, S.K., Earthquake resistant design of structures, Oxford University Press, 2007.

Reference Books:

- Kramer, S.L., Geotechnical earthquake engineering, Prentice Hall, New York, 1996.
- IS 1893-2002 (Part 1), Criteria for earthquake resistant design of structures, BIS, New-Delhi.
- IS 13920-1993, Ductile detailing of R C Structures subjected to seismic force, BIS, New-Delhi.
- Earthquake Tips, NICEE, https://www.nicee.org/EQTips

Course Outcome:

The student has the

- ability to solve problems of vibrations of SDoF systems (CO1).
- knowledge of basics of engineering seismology and earthquake geotechnical engineering (CO2)
- knowledge of the common seismic irregularities and the concept of earthquake resistant design of RC and Masonry structures (CO3).
- ability to estimate the lateral forces on buildings due to seismic effects and knowledge of basic disaster management (CO4).

Information Measurement Theory

Sub Code : CV745 Contact Hrs : 4/week
Credits : 04: 0:0

Course Objectives:

- To introduce the students of Civil Engineering to the basics of Information Measurement Theory, Kashiwagi Solution Model and Risk Management model in construction industry.
- To introduce the students of Civil Engineering to the basics of Best Value Delivery and Best Value Performance Information Procurement System in construction industry.

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1. Course overview, Introduction, Information Measurement Theory (IMT), Natural Laws, Conditions, Events, Perception of Information and Processing Speed, Use of Dominant Information and Maximisation of Decision Making, Related Videos and Discussion.

2. Kashiwagi Solution Model (KSM) – Introduction, Information, Decision Making, and the KSM, Experience, Emotion, Events and the KSM, Understanding our Environment using KSMs, Understanding Individuals using KSMs, Related Videos and Discussion.

3. Decision Making and Dominant Information - Introduction, Concept, Reality, Decision Making, Expert and Dominant Information, Trust and Relationship, Related Videos and Discussion.

4. Risk Management Model – Introduction, No Decision Structure, Methodology – Examples, Supply Chain Structure, Impact of New Project Management, Risk Management Model, Traditional System, Vendor Risk Management, Related Videos and Discussion.

5. Who Is On My Molecule – Introduction, Concept, Dominant Value of WIOMM, Equilibrium, Opposing Forces, Point of Space, Conclusion.

6. Control and Influence – Introduction and Concepts, Dominant Examples of “No Control or Influence”.

7. Best Value Delivery - Introduction, Best Value Performance Information Procurement System (BV PIPS), Resistance to BV PIPS (Price based system and Blind practices), Operators, Functions and Characteristics of PIPS.

8. Best Value Performance Information Procurement System – Introduction, Four Phases, Objective of BV PIPS, Methodology of BV PIPS – Prequalification, Selection, Clarification and Execution, Schedule of BV PIPS Process.

Text Books:

1. 2014 Information Measurement Theory with the “Kashiwagi Story” by Dean T. Kashiwagi, Kashiwagi Solution Model (KSM), Mesa, Arizona, 2014.
2. 2014 Best Value Standard by Dean T. Kashiwagi, Kashiwagi Solution Model (KSM), Mesa, Arizona, 2014.

Course Outcome:

The student has the

- ability to understand the natural laws, various conditions and events influencing decision making (CO1).
- ability to use Information measurement theory and Kashiwagi solution model to minimise the decision making and risk in construction industry (CO2).
- ability to minimise risk in project management through project information, milestone schedule, cost deviation, and risk management plan (CO3).
- knowledge of Best Value Delivery and Best Value Performance Information Procurement System in construction industry (CO4).

Pavement Analysis and Design

Sub Code : CV751 Contact Hrs : 4/week
Credits : 4:0:0

Course Objectives:

- The students are introduced to the pavement engineering principles with emphasis on the safe and efficient operation of highways.
- The students are introduced to the criteria, standards and engineering procedures used to design highway pavements

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1 **Introduction:** Importance, Functions, Requirements, Types and Uses of Pavements - Factors affecting Design and Performance of Pavements – Functions and Significance of various layers – Factors affecting the choice and selection of pavement type.

2 **Theoretical Considerations for Structural Design:** Flexible pavements – Stresses, Strains and Deflections in Homogeneous Masses – Layered systems concept, Elastic Solutions, Visco-elastic Solutions.
Rigid pavements - General conditions in Rigid Pavement Analysis, Types of Stresses and Causes –Wheel Load Stresses, Warping Stresses, Frictional Stresses, Combined Stresses.

3 **Traffic:** Different types of highway traffic, Measurement of traffic load, Load distribution concept, Load equivalency factors – ESAL and ESWL of Multiple Wheels, Repeated Loads – Sustained Loads and Pavement behaviour under repeated traffic load applications.

4 **Distress And Performance:** Distresses in Asphalt and Concrete pavements, Major distress mechanisms and material characterisation – Performance prediction and applications.

5 **Pavement Structural Design:** Structural Design – Approaches, Development, Principle, Design steps – IRC method of Flexible and Rigid pavement design – Joints in Pavements and their Functions, Design of Joint Details, Concrete white topping, Mechanistic-Empirical design of flexible and rigid pavements; design of composite pavements

6 **Drainage:** Sources and effect of water, Estimating Flow, Surface and Subsurface Drainage System, Consideration of Drainage in Pavement Design, design of surface and sub-surface drainage systems

7 **Sustainable Pavements:** Engineering Economy, Concept of Life Cycle Cost – Approaches & Techniques, Cost-Saving Concepts – Perpetual Pavements, Recycling techniques; green highways

Self-Learning:

- Comparative studies on pavement design procedures.

Text Books:

- Khanna, S.K. and Justo, C.E.G., Highway Engineering Nem Chand and Bros, Roorkee.
- Kadiyali, L.R. and Lal, N.B., Principle and practice of Highway Engineering, Khanna Publishers, New Delhi.

Reference Books:

- Mallick, R.B. and El-Korchi, T., Pavement Engineering – Principles and Practice', by, CRC Press, Taylor & Francis Group, New York.
- Chakraborty, P. and Das, A., Principles of Transportation Engineering, Prentice-Hall, USA.
- Yoder, E.J. and Witczack, M.W., Principles of Pavement Design, - 2nd edition, John Wiley, New York.
- Huang, Y.H., Pavement Analysis and Design, Prentice Hall, USA.
- Papagiannakis, A.T. and Masad, E.A., Pavement Design and Materials, John Wiley, USA..
- Relevant IRC codes

Course Outcome:

The student has the

- knowledge of structural behavior of pavements (CO1).
- ability to perform structural analysis of pavements (CO2).
- ability to do the design of flexible and rigid pavements using IRC method (CO3).
- ability to do the design of surface and sub-surface drainage systems (CO4).

Theory of Elasticity

Sub Code : CV752 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- The students are introduced to advanced technique of analyzing stress distribution in a continuum.
- The students are introduced to the solution of complex continuum problems.
- The students are introduced to analyse 2D or 3D problems.

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1. Introduction to Mathematical theory of elasticity, definition of continuum, stress and strain at a. point, constitutive laws, Generalised Hooke's Law, Strain- displacement relations, in Cartesian and polar coordinate system.

2. Differential equations of equilibrium, boundary conditions, compatibility equations, Airy's stress function, Stress polynomials, St. Venant's principle, compatibility equation.

3. Plane stress and plane strain idealization, Principal stresses and strains, measurement of surface strains, strain rosettes, Mohr's circle of stress and strain both graphical and analytical method.

4. Two-dimensional problems in rectangular coordinates, bending of a cantilever beam subjected to end load, Simply supported beam subjected to UDL, Simply supported beam subjected to point load.

5. Two-dimensional problems in polar coordinates. Stress distribution symmetrical about an axis, Rotating discs, Lame's problem-thick cylinder. Effect of circular holes on stress distribution in plates subjected to tension and compression. Stress concentration factor, Bending of a curved bar by a force at the end.

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

Self-Learning:

- To develop excel programme for anlaysis of stresses, strains and stress-strain relationship.

Text Books:

- Sitharam, T.G. and Govindaraju, L., Applied Elasticity, Internline Publishers, Bengaluru, 2008.
- Timoshenko, S.P. and Goodier, J.N., Theory of Elasticity - International Students, Edition, McGraw Hill Book Co. Inc., New Delhi.

Reference Books:

- Valliappan, C., Continuum Mechanics Fundamentals, Oxford and IBH Publishing Co. Ltd., New Delhi.
- Srinath, L.S., Advanced Mechanics of Solids, Tata McGraw Hill Publications Co.Ltd., New Delhi.
- Venkataraman, B. and Patel, S.A., Structural Mechanics with Introduction to Elastity and Plasticity, McGraw Hill Book Inc., New York.
- Singh, A.K., Mechanics of Solids, Prentice hall of India Pvt. Ltd. New Delhi -2007.

Course Outcome:

The student has the

- knowledge of distinction between strength of materials and theory of elasticity (CO1).
- ability to develop stresses on inclined planes, principal stresses and their planes, maximum shear stresses and their planes, octahedral stresses using analytical and Mohr Circle approaches (CO2).
- ability to develop strains on inclined planes, principal strains and their planes, maximum shear strains and their planes, octahedral strains analytical and Mohr Circle approaches (CO3).
- ability to develop stress – strain relationships in plane stress and plane strain and solve application problems in Cartesian and Polar coordinate systems (CO4).

Urban Planning and Modern Architecture

Sub Code : CV753 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- The students are introduced to the concept of town planning, the principles and styles of architecture.

Part A-Urban Planning

1. Introduction: evolution of planning, objects, principles and necessity of town planning, growth of towns, requirements of new towns, present position of planning in India, land use planning and neighborhood planning.
2. zoning: meaning of the term zoning, objectives, principles, importance, aspects and advantages of zoning, zoning powers, transition zones
3. housing: importance, demand, requirements, low cost housing, slums-causes and effects,' clearance of slums, building bye laws
4. development of master plan-objectives, necessity and features of master plan, data collected, drawings prepare, stages of preparation and method of execution of development plan

Part B –Modern Architecture

5. introduction: aim and importance of architecture, role of an engineer and an architect
6. principles and qualities of architecture: the aesthetic and the functional components in architecture
7. vernacular architecture in India-post independent buildings, planning of new capitals
8. Study of works of contemporary architects like Le Corbusier, rohe, Kahn, Charles Correa, B.V. Doshi.

Self-Learning:

- Case studies.

Text Books:

- Rangwala, Town Planning, Charotar Publishing House Pvt. Ltd., Anand, India.
- Gurucharan Singh and Jagadish Singh, Building Planning, Designing, and Scheduling, Standard Publishers, New Delhi
- Muthu Shoba and Mohan, Principles of Architecture, Oxford University Press, New Delhi

Reference Books:

- Ramegowda, K.S., Town and Country Planning, Prasaranga, University of Mysore, Mysuru.
- Gallion, A.B. and Eisner, S., Urban Design, Wiley Publishers, New York.
- Fletcher, B.T., A. History of Architecture, Batsford Publication, London.

Course Outcome:

The student has the

- ability to develop master plan for urban areas (CO1).
- ability to provide necessary facilities required for the development of a locality in a town (CO2).
- knowledge of basic principles of modern architecture in construction (CO3).
- knowledge of the works of contemporary architects (CO4).

Advanced Foundation Engineering

Sub Code : CV754 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- The students are introduced to shallow and deep foundation design under different soil conditions.
- The students are introduced to machine foundations and foundations on expansive soils.

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1 **Bearing Capacity & Settlement:** Presumptive bearing capacity according to BIS, Factors affecting bearing capacity, Factors influencing selection of depth of foundation, types of shallow foundations, Settlement of Shallow Foundations: Immediate, consolidation, & differential settlements, Factors influencing settlement, Safe Bearing Capacity and Allowable Bearing Pressure.

2 **Shallow Foundations:** Principles of Design of foundation, Definition for Shallow and Deep foundation, Requirements for geotechnical and structural aspects of design, Proportioning of footings for equal settlement. Proportioning of isolated footing, combined footing, Strap footing, Strip footing and Raft foundation.

3 **Pile Foundations – Single Pile:** Historical Development, Necessity of pile foundations, Classification, Load bearing capacity of single pile by Static formula, Dynamic formula, Pile load test and Penetration tests, Laterally Loaded Pile.

4 **Pile Foundations – Group Effect:** Pile groups, group action of piles in sand and clay, group efficiency of piles, settlement of piles, negative skin friction, Under reamed piles.

5 **Well Foundations:** Historical Development, Different shapes and characteristics of wells, Components of well foundation. Forces acting on well foundation. Sinking of wells. Causes and remedies for tilts and shifts.

6 **Drilled Piers & Caissons:** Construction, advantages and disadvantages of drilled piers. Design concepts and Advantages and disadvantages of open, pneumatic and floating caissons.

7 **Foundations on Expansive Soils:** Definition, Identification, Mineral Structure, Index properties of expansive soils, Swell potential and Swell pressure, Free swell, Tests on expansive soils, foundation treatment for structures in expansive soil, CNS layer.

8 **Machine Foundations:** Types of Machine foundations, basic definitions in vibration, degrees of freedom of a block foundation, general criteria for design of machine foundation, free and forced vibrations, vibration analysis of a machine foundation, determination of natural frequency, vibration isolation and control.

Self-Learning:

- Design of laterally loaded piles.
- Design of machine foundations.
- Case studies of failures of foundations.

Text Books:

- Murthy, V.N.S., Soil Mechanics & Foundation Engineering, CBS Publishers and Distributors, New Delhi.
- Das, B.M., Principles of Foundation Engineering, Thomson Publishers, USA.
- Punmia, B.C., Soil Mechanics and Foundations, Laxmi Publicaiton (P) Ltd., Bengaluru.
- Bowles, J.E., Foundation Analysis and Design, 5th Ed, McGraw Hill Pub. Co., New York, 1996.
- Murthy, V.N.S., Advanced Foundation Engineering, Sai Tech Publications, New Delhi.

Reference Books:

- Day, R.W., Geotechnical and Foundation Engineering – Design and Construction, McGraw-Hill, New York
- Gunaratne, M., The Foundation Engineering Handbook, Taylor and Francis (CRC Press), New York.
- Varghese, P.C., Foundation Engineering, Prentice Hall of India, New Delhi

Course Outcome:

The student has the

- ability to analyse and proportion shallow foundations (CO1).
- ability to analyse and proportion pile foundation systems (CO2).
- knowledge of different types of caisson, design and construction of caisson (CO3).
- knowledge of design of machine foundations (CO4).
- knowledge of expansive soils, ability to characterize them and to suggest appropriate treatment for foundations on expansive soils (CO5).

Design of Steel – Concrete Composite Structures

Sub Code : CV755 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- The students are introduced to the concept of steel-concrete composite construction.
- The students are introduced to the design of steel-concrete composite elements.

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1. **Fundamentals**: Introduction to steel-concrete composite construction –Types of composite construction– Basic concepts of composite structures – Material properties – Advantages – Design Philosophy – Current Usage

2. **Shear Connection:** Shear connection – Methods – Properties of Shear connectors – Partial interaction – Effect of slip on stresses and deflection – Longitudinal shear in composite slabs.

3. **Composite Beams:** Types – Basic behaviour – Ultimate strength design –Deflection – Shear connector behaviour – Fire resistance – Continuous beams – Beams with composite slabs

4. **Composite Floor Slabs:** Behaviour as formwork – Composite behaviour – Dynamic behaviour – Serviceability –Concentrated loads and slab openings – Fire resistance – Slim floor decking – Profiled sheeting

5. **Composite Columns:** Encased columns – Concrete filled steel tubes – Resistance to axial compression – Resistance to combined compression and uniaxial bending – Effect of shear – Fire resistance

6. **Composite Frames:** Principles of frame behaviour – Frame analysis and design – Design of non-sway composite frames – Design using software

Self-Learning:

- Use of composite elements in framed structures and bridges.

Text Book:

- Johnson R.P., Composite Structures of Steel and Concrete, Blackwell Publishing Ltd., UK, 2004

Reference Books:

- David, N.A. (Ed), Composite Construction, Spon Press, UK, 2003
- Davison B. and Owens G.W. (Ed), Steel designers' manual, Wiley Blackwell, UK, 2012
- Sabnis, G.M., Handbook of Composite Construction Engineering, Van Nostrand Reinhold, New York, 1979.
- Teaching Resource Material Prepared by Institute for Steel Development & Growth (INSDAG), Calcutta
- Relevant IS codes and Euro codes

Course Outcome:

The student has the

- knowledge of composite structural behavior (CO1).
- ability to analyse and design shear connections (CO2).
- ability to analyse and design composite beams and composite floor slabs (CO3).
- ability to analyse and design composite columns and composite frames (CO4).

Traffic Engineering and Highway Design

Sub Code : CV756 Contact Hrs : 4/week
Credits : 04: 0:0

Course Objectives:

- To introduce students to the concepts and principles of traffic engineering with emphasis on the safe and efficient operation of highways.
- To introduce students to the concepts and principles of geometric design of highways with emphasis on the safe and efficient operation of highways.
- To describe the criteria, standards and engineering procedures used for the design of various roadway elements.

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1 INTRODUCTION TO TRAFFIC ENGINEERING:
Traffic Engineering – Objectives and Scope, Characteristics of the Driver, the Pedestrian, the vehicle and the road affecting road design and traffic flow.

2 TRAFFIC ENGINEERING STUDIES:
Data collection, Analysis and Interpretation – Classified traffic volume, Spot speed, Speed and delay, Origin and destination and Parking studies. Sampling techniques, Sample size.

3 FUNDAMENTAL PRINCIPLES OF TRAFFIC FLOW AND ROADWAY CAPACITY:
Traffic flow elements, Speed, Flow and Density relationship, Concept of Passenger Car Units (PCU), Capacity and Level of Service of Multilane Highways and Intersections

4 INTRODUCTION TO HIGHWAY GEOMETRIC DESIGN:
Objectives and Scope, Highway Functional classification, Design Controls and Criteria, Design Vehicle Specifications, Design elements – Cross section, Sight distance, Horizontal & Vertical alignment and Intersection elements.

5 INTERSECTIONS:
Importance, Classification, Design principles, Geometric controls. Intersections at Grade – Requirements, forms, Design considerations, Channelization elements, Rotary/Roundabouts. Grade Separated Intersections – Warrants, Types and Layouts, Ramps, Design considerations.

6 OTHER TRAFFIC FACILITIES:
Requirements, Types and General design considerations of Auxiliary Lanes, Parking, Pedestrian, Bicyclists, Underpasses and Overpasses, Railway crossings, Toll plaza facilities

7 TRAFFIC REGULATIONS AND CONTROL:
Regulation on Vehicles, Drivers and Traffic flow, Traffic Control Devices – Types & objectives of Markings, Signs, Signals, Islands, and Delineators. Intersection Control, Design of Signals

Self-Learning Component

- Use of software tools for Traffic analysis, Geometric design and any other specified by course faculty.

Text Books:

1. Khanna S. K., Justo, C. E. G., and Veeraragavan (2014) “Highway Engineering”, Nem Chand and Bros.
2. L.R. Kadiyali L. R. (2011) “Traffic Engineering and Transport Planning”, Khanna Publishers

Reference Books:

1. Relevant IRC codes.
2. Brian Wolshon and Anurag Pande (2016), “Traffic Engineering Handbook”, John Wiley & Sons.
3. AUSTROADS (2016) “Guide to Road Design Part 3: Geometric Design”, Austroads Inc.
4. AASHTO (2011), “A Policy on Geometric Design of Highways and Streets”, American Association of State Highway and Transportation Officials.

Course Outcome:

The student will be able to

- analyze, design, synthesize and explain the collections of data for traffic design purposes (CO1)
- apply knowledge of traffic flow theory and evaluate capacity & level of service of roadways (CO2)
- design, evaluate, analyze, synthesize and explain traffic control systems and highway geometry layouts for safe and efficient management of traffic movements (CO3).

Design Studio

Sub Code : CV76L Contact Hrs : 3/week
Credits : 1:0:1

Course Objectives:

- To develop software skills in solving civil engineering problems.
- To imbibe creativity and innovation skills in the modern work place.

Design Studio Laboratory focuses on problem-based, project-centered activities using software tools in the field of Civil Engineering. It offers a distinctive opportunity for the students to work on a realistic design project. It's about creating and testing ideas to solve real-world problems. It involves devising plans, investigating new methods and materials, developing detailed designs which helps in developing skills in:

- acquiring and applying technical knowledge
- understanding the wider picture that surrounds engineering projects – the issues, the aims, and sometimes the constraints
- creativity and innovation – priceless skills in the modern workplace
- group work
- presenting and arguing the case for formed ideas

They will work on any specified topic involving analysis, design, drafting, estimation, project management etc. using the appropriate software tools available in the laboratory. The following is a list of topics but not limited to

- Structural analysis and design of Residential/Public Building System.
- Designing a highway alignment on a given DTM
- Design of a highway pavement system
- Design of Transportation facilities
- Bridge project
- Designing a water supply scheme for a specified area
- Reservoir project
- Canal alignment project
- Geotechnical Slope stability, Retaining wall projects
- Foundation design

Course Outcome:

The student has the ability to

- carryout comprehensive project assigned using software (CO1).
- prepare comprehensive project report and to present (CO2).

Estimation, Costing & Specifications

Sub Code : CV810 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:
- To introduce the students to the rate analysis of various items of construction.
- To introduce the students to the perform quantity take-offs for various civil engineering works.
- To introduce the students to the fundamentals of contracts and specifications.

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1. **Estimation:** Study of various drawings with estimates, important terms, units of measurement, abstract Methods of taking out quantities and cost – center line method, long and short wall method or crossing method. Preparation of detailed and abstract estimates for the following Civil Engineering works – Buildings – RCC framed structures with flat, sloped RCC roofs with all Building components.

2. **Estimate:** Different type of estimates, approximate methods of estimating buildings, cost of materials. Estimation of wooden joineries such as doors, windows & ventilators.

3. Estimates: Steel truss (Fink and Howe truss), manhole and septic tanks.

4. **Specifications:** Definition of specifications, objective of writing specifications, essentials in specifications, general and detail specifications of common item of works in buildings.

5. **Rate Analysis:** Definition and purpose. Working out quantities and rates for the following standard items of works – earth work in different types of soils, cement concrete of different mixes, bricks and stone masonry, flooring, plastering, RCC works, centering and form work for different RCC items, wood and steel works for doors, windows and ventilators.

6. **Measurement of Earthwork for Roads:** Methods for computation of earthwork – hcross sections – mid section formula or average end area or mean sectional area, trapezoidal & prismoidal formula with and without cross slopes.

7. **Contracts:** Types of contract – essentials of contract agreement – legal aspects, penal provisions on breach of contract. Definition of the terms – Tender, earnest money deposit, security deposit, tender forms, documents and types. Comparative statements, acceptance of contract documents and issue of work orders. Duties and liabilities, termination of contract, completion certificate, quality control, right of contractor, refund of deposit. Administrative approval – Technical sanction. Nominal muster roll, measurement books – procedure for recording and checking measurements – preparation of bills and documents.

Self-Learning:
- Global tenders and e-tenders.
- Software for estimating and casting.

Text Books:
- Quantity Surveying by P.L. Basin S. Chand, New Delhi.
- Estimating & Specification by S.C. Rangwala, Charotar publishing house, Anand.

Reference Books:
- Text book of Estimating & Costing by G.S. Birde, Dhanpath Rai and Sons: New Delhi.
- A text book on Estimating, Costing and Accounts by D.D. Kohli and R.C. Kohli S. Chand: New Delhi.

Course Outcome:
The student has the
- knowledge of principles of estimation and ability to prepare quantity estimates for buildings (CO1).
- ability to calculate the quantity of materials required for other civil engineering works as per specifications (CO2).
- ability to do rate analysis (CO3).
- ability to estimate earthwork for roads (CO4).
- ability to evaluate contracts and trends in constructions practice (CO5).

Bridge, Tunnel and Harbour Engineering

Sub Code : CV820 Contact Hrs : 3/week
Credits : 03:0:0

Course Objectives:

- To introduce the students to the fundamentals of bridge construction and design.
- To introduce the students to the design and construction of tunnels.
- To introduce the students to the design and construction of harbours.

Bridge Engineering

1. Role of Bridges in transportation, Historical development, Components of bridges, Classification of bridges, site selection for bridges.
2. Substructure and Superstructures – Types of Foundations, Abutments, Piers and Wing walls
3. Methods of finding design discharge, natural, artificial and linear water ways, afflux, economic span, Forces to be considered for design, Basic design principles
4. Bridge bearings, joints, approaches, construction and maintenance aspects.
5. Grade separated structures – Types and their choices,

Tunnel Engineering

6. Introduction, types of tunnels, advantages and disadvantages, economics of tunneling, tunnel surveying, transferring centre line and gradient from the earth surface to inside the tunnel working face.
7. Design of shape and size of tunnel. Soil classification and methods of tunneling in soft soil and hard rock - vertical shafts, pilot tunneling, Mucking and methods, drilling and drilling patterns. Tunnel lining, Ventilation and Drainage.

Harbours

8. Introduction, Classification, Harbor layout with component parts, requirement for site selection.
9. Natural phenomenon affecting the design of harbour viz. wind, wave, tide and currents.
10. Breakwaters, wharfs and Quays, Jetties and Piers, Docks, Slipways, Navigational aids, Warehouse and Transit shed.

Self-Learning:

- IRC loading on bridges.
- Modern tunneling equipments.
- Modern facilities in harbours.
- Maintenance of Bridges, Tunnels and Harbours

Text Books:

- Bridge Engineering by Rangawala S C and Rangawala K S, Charotar Publishing House, Anand
- Harbour, Dock and Tunnel Engineering by Srinivasan R, Charotar Publishing House, Anand
- Docks and Harbor Engineering by Oza H P and Oza G H, Charotar Publishing House, Anand

Reference Books:

- Elements of Bridge, Tunnel and Railway Engineering by Bindra S P and Bindra K, Dhanpat Rai and sons publications, New Delhi.
- Essentials of Bridge Engineering by Johnson and victor, Oxford IBH Publications, New Delhi

Course Outcome:

The student has the

- knowledge of bridges, tunnels and harbours - their types, components and maintenance (CO1)
- ability to make hydrological calculations for design of bridges (CO2).
- ability to analyse for the forces acting on bridges (CO3).
- knowledge of tunnel construction processes and the ability to design the shape & size of tunnel (CO4).
- ability to prepare the layout for harbours, the knowledge of various forces affecting the design of harbours and knowledge of various components of a harbour (CO5).

Geographic Information System

Sub Code : CV831 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to GIS, its capabilities, uses and applications.

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1. Geographic Information system concepts and spatial models. Introduction, Spatial information, temporal information, conceptual models of spatial information, representation of geographic information. GIS Functionality – Introduction, data acquisition, preliminary data processing, data storage and retrieval, spatial search and analysis, graphics and interaction.

2. Computer Fundamentals of GIS and Data storage, Fundamentals of computers vector/raster storage character files and binary files, file organization, linked lists, chains, trees. Coordinate systems and map projection : Rectangular polar and spherical coordinates, types of map projections, choosing a map projection.

3. GIS Data Models and Structures – Cartographic map model, Geo-relation model, vector/raster methods, non-spatial data base structure viz., hierarchal network, relational structures.

4. Digitizing Editing and Structuring Map Data – Entering the spatial data (digitizing), the non-spatial, associated attributes, linking spatial and non-spatial data, use of digitizers and scanners of different types.

5. Data Quality and Sources of Error – Sources of errors in GIS data, obvious sources, natural variations and the processing errors and accuracy. Principles of Spatial data access and search, regular and object oriented decomposition, introduction to spatial data analysis, and overlay analysis, raster analysis, network analysis in GIS.

6. GIS and remote sensing data integration techniques in spatial decision support system land suitability and multioriteria evaluation, role based systems, network analysis, special interaction modeling, Virtual GIS.

7. Data base positioning systems, desirable characteristics of data base management systems, components of a data base management system, understanding the data conceptual modeling.

8. Global positioning system, hyper spectral remote sensing, DIP techniques, hardware and software requirements for GIS, overview of GIS software.

Self-Learning:

- GIS in non-engineering uses like Administration, Criminal Investigation, Tourism, Insurance, Real Estate.

Text books:

- Principles of GIS by Peter A Burrough Reachael A Mc. Donnel, Oxford Publications.
- GIS and Computer cartography by Christopher Jones, Longman Publications.

Reference Books:

- Remote sensing and image interpretation by Lillesand,John Wiley and Sons, New York.
- Geographical Information system by Bemhard Sen, Wiley Publications.

Course Outcome:

The student has the knowledge of

- GIS and its components (CO1).
- coordinate systems used in GIS (CO2).
- types of data and methods of collection data used in GIS (CO3).
- applications of GIS (CO4).

Reinforced Earth and Geosynthetics

Sub Code : CV832 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to the concept of reinforced earth structures.
- To introduce the students to the criteria, standards and engineering procedures used in the design of principal elements of reinforced earth structures.
- To introduce the students to the standards and specifications for materials used in reinforced earth structures.

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1 **Basics of Reinforced Earth Construction:** Definition, Historical Background, Components, Mechanism and Concept, Advantages and Disadvantage of reinforced earth Construction.

2 **Geosynthetics and their Functions:** Historical developments, Recent developments, Methods of manufacturing process. Raw materials – polypropylene (polyolefin), Polyethylene (Polyoefin), Polyester, Polyvinyl chloride, Elastomers etc, Classification based on materials type – Metallic and Non-metallic, Natural and Man-made, Geosynthetics – Geotextiles, Geogrids, Geomembranes, Geocomposites, Geonets, Geofoam, Geomats, Geomeshes, Geowebs etc.

3 **Properties and tests on Materials:** Properties, Testing & Evaluation – Physical, Chemical, Mechanical, Hydraulic, Endurance and Degradation requirements.

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

5 **Design of Reinforced Earth Foundations and Embankments:** 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.
Embankments - Concept of Reinforced Embankments, Internal and external stability, Selection of materials, typical design problems

6 **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.

7 **Geosynthetics for 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, anticlogging, survivability and durability.
Landfills – Typical design of Landfills – Landfill liner & cover, EPA Guidelines, Barrier walls for existing landfills and abandoned dumps.

8 **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.

Self-Learning:

- Knowledge of Geo-Cells, Gabions and Natural reinforcing materials.

Text Books:

- Design with Geosynthetics by Koerner. R.M., Prentice Hall Publication, 2005.
- An introduction to Soil Reinforcement and Geosynthetics by Sivakumar Babu G.L., Universities Press, Hyderabad, 2006
- Reinforced Soil and its Engineering Applications by Swami Saran, I. K. International Pvt. Ltd, New Delhi, 2006
- Engineering with Geosynthetics by Venkattappa Rao, G., & Suryanarayana Raju., G. V.S. - Tata Mc Graw Hill publishing Company Limited., New Delhi.

Reference Books:

- Earth reinforcement and Soil structure by Jones CJEP Butterworths, London, 1996.
- Geotextile Hand Book by Ingold, T.S. & Millar, K.S. - Thomas, Telford, London.
- Earth Reinforcement Practices by Hidetoshi Octial, Shigenori Hayshi & Jen Otani -Vol. I, A.A. Balkema, Rotterdam, 1992.
- Ground Engineer's reference Book by Bell F.G. - Butterworths, London, 1987.
- Geosynthetics in Civil Engineering, Editor Sarsby R W, Woodhead Publishing Ltd & CRC Press, 2007

Course Outcome:

The student has the

- knowledge of reinforced earth construction, materials used and their characterisation (CO1)
- ability to analyse and design the reinforced earth foundations and embankments (CO2).
- ability to analyse and design reinforced earth retaining wall (CO3).
- knowledge of geosynthetics and their applications (CO4).
- knowledge of reinforced earth structures used in various stability problems in geotechnical engineering practice (CO5).

Design of Bridges

Sub Code : CV833 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to concept of bridges and their components.
- To introduce the students to the structural behaviour of bridge under various loading conditions.
- To introduce the students to the design and detailing of structural components of bridge as per IRC guidelines.

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1. Introduction: Types and classification of bridges, Components of bridges, Substructure and superstructure, forces to be considered for the design, IRC and Railway loading standards.

2. Design of box culvert and slab culvert bridge for IRC class-AA and class A loading, design of pier.

3. Design of T-beam bridge - proportioning of components, cross girder and main girder design: analysis of interior and cantilever slab for IRC Class-AA and Class A-loading.

4. Design of balanced cantilever bridge: Introduction and proportioning of components, Design of Simply Supported portions and Cantilever portions and design of articulation.

5. Design of Steel Bridges: Design of components and connection details.

6. Case studies on bridge failures.

Self-Learning:

- Design principles for composite bridges.

Text Books:

- Design of Bridges, by N. Krishna Raju, Oxford and IBH publishing co, New Delhi.
- Design of Bridge Structures by Jagadish T.R. and Jayaram M.A. Prentice Hall of India, New-Delhi.

Reference Books:

- Essentials of bridge engineering by Johnson-Victor; oxford IBH publications, New-Delhi.
- Concrete Bridge practices by Raina V.K.; Tata Mc Graw Hill, New-Delhi.
- Bridge Engineering by Ponnuswamy, Tata Mc-Graw Hill, New-Delhi.
- Relevant IRC and BIS codes.

Course Outcome:

The student has the

- knowledge of bridges, classification, components and failures (CO1).
- ability to do the analysis of loads on bridges as per IRC (CO2).
- ability to do the design of box and slab culverts (CO3).
- ability to do the design of T-beam and balanced cantilever bridges (CO4).
- ability to do the design of steel bridges (CO5).
- ability to provide detailing for RC and steel bridges (CO6).

Pavement Evaluation and Management

Sub Code : CV834 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to failures of pavement, causes and remedial measures.
- To introduce the students to the criteria, standards and engineering procedures used to design overlay
- To introduce the students to the maintenance management system for pavements.

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1 **Introduction:** Structural and functional requirements of flexible and rigid pavements, pavement distress, different type of failures and causes.

2 **Pavement Surface Conditions:** Various aspects of surface and their importance, factors affecting the surface condition and measures to improve pavement slipperiness, unevenness, ruts, pot holes, cracks.

3 **Evaluation of Surface Condition:** Methods of pavement surface condition evaluation by physical measurements, their applications, measurement of skid resistance, unevenness, ruts and cracks.

4 **Condition of Pavement Structure:** Factors affecting flexible and rigid pavement structural condition, effects of sub grade soil, pavement layers, moisture, temperature, environment and traffic on structural stability.

5 **Evaluation of Pavement Structural Condition:** Evaluation by non-destructive tests, Benkelman beam rebound deflection, plate load tests, wave propagation method.

6 **Maintenance of Bituminous Surfaces:** Patching, surface treatment, resurfacing and special repairs.

7 **Overlay Design:** Choice of overlay type and pavement materials over existing flexible and rigid pavements with different degrees of distress, design of flexible overlay over flexible pavement by Benkelman beam deflection method and other methods as per IRC guidelines, design of rigid overlays, use of Geosynthetics in pavement overlays.

8 **Pavement Management System:** Components of pavement maintenance management system, pavement maintenance measures, routine maintenance and special repairs in flexible and rigid pavements.

Self-Learning:

- Modern equipments for pavement evaluation.

Text Books:

- Highway Engineering by Khanna, S.K. and Justo, C.E.G., Nem Chand and Bros, Roorkee.
- Principle and practice of Highway Engineering by Kadiyali, L. R. and LAL, N. B., Khanna Publishers, New Delhi.

Reference Books:

- Relevant IRC codes
- Principles of Pavement Design- Yoder and Witzack - 2nd edition, John Wileys and Sons
- Pavement Analysis and Design- Yang H Huang, Prentice Hall, New Jersey
- Specifications for Roads and Bridges by MoRT&H, IRC, New Delhi.

Course Outcome:

The student has the

- knowledge of distress in pavements (CO1).
- ability to evaluate surface and structural conditions of pavements (CO2).
- knowledge of maintenance of bituminous surfaces (CO3).
- ability to do overlay design (CO4).
- knowledge of pavement maintenance management system (CO5).

Finite Element Method

Sub Code : CV835 Contact Hrs : 4/week
Credits : 04:0:0

Course Objectives:

- To introduce the students to the concept of approximate methods of analysis and principles of FEM.
- To introduce the students to the analysis of 1-D problems, continuous beams and plain trusses using FEM.
- To introduce the students to CST and 4-noded quad elements.
- To introduce the students to the basics of modeling considerations in FEM.

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1. Introduction, Historical background, Approximate methods of structural analysis, Principles of virtual displacement and minimum potential energy, Concept of Rayleigh-Ritz method and Galerkin method, Advantages and disadvantages of FEM, Basic procedure of FEM for structural problems.

2. Finite elements for 1-D, 2-D and 3-D problems, Natural coordinates, Displacement and Shape functions for standard elements – Bar elements, Beam elements, Truss elements, Triangular elements, Rectangular elements, Quadrilateral elements – Basic and Higher order Elements. Degree of continuity of shape functions – C^0 and C^1 Continuous functions, Lagrangean, Serendipity, Hermitian Polynomials, Pascal's triangle, Convergence and compatibility requirements, Patch test, Static condensation. Concept of Isoparametric elements, sub and super parametric elements, Convergence requirements for Isoparametric elements.

3. Derivation of element stiffness matrices for Bar, Beam and Truss elements (planar), Linear static analysis of one dimensional problems using Linear and Quadratic bar elements, Treatment of boundary conditions – Elimination approach and Penalty approach. Linear static analysis of continuous beams using beam elements. Linear static analysis of pin jointed plane trusses.

4. Two dimensional problems, Derivation of element stiffness matrices and equivalent nodal force vectors for CST elements, Derivation of element stiffness matrices for 4-noded quadrilateral elements, Numerical Integration – Gauss quadrature.

5. Modelling considerations – Physical behaviour versus element behaviour, Element shapes and interconnection, Boundary conditions, Stress concentrations, Submodels, Common mistakes, Auto mesh generation, Computer Program for FEM – Organisation – basic flowcharts, Desired features of Pre and Post Processors.

Self-Learning:

- Use of FEM software to analyse simple 1-D problems.

Text Books:

- Introduction to Finite Elements in Engineering by Chandraputala, T.R. and Belegundu, A.D., Prentice-Hall of India, Pvt. Ltd., New Delhi, 1996.
- Finite Element Analysis by Krishnamurthy C.S., Theory and Programming" II Edition, TMH 1994.

Reference Books:

- Cook, R.D., Malkus, D.S., and Plesha, M.E., "Concepts and Applications of Finite Element Analysis", 4th Edition Wiley, Singapore Edition, New York, 2003.
- Desai, C.S. and Abel, J.F., "Introduction to Finite Element Method", CBS Publishers and Distributors, New Delhi, 1987.
- Rajashekaran S., "Finite Element Analysis in Engineering Design", S. Chand and Co., 2003.
- Singirsu S. Rao, "The finite element method in Engineering", Fourth edition, Elsevier Inc., New Delhi, 2006.
- Zienkiewicz, O.C., "The Finite Element Method", McGraw - Hill Publishing Co. Ltd., New Delhi, 3rd Edition, 1979.

Course Outcome:

The student has the

- knowledge of approximate methods of structural analysis and fundamentals of FEM (CO1).
- ability to analyse 1-D problems, continuous beams and plain trusses using FEM (CO2).
- ability to handle CST and 4-noded quad elements used in 2-D problems (CO3).
- ability to draw flow charts for models (CO4).

Road Safety Engineering

Sub Code : CV836 Contact Hrs : 4/week
Credits : 4:0:0

Course Objectives:

- To introduce students to the concepts and principles of road safety engineering with emphasis on the safe and efficient operation of highways.
- To describe the criteria, standards and engineering procedures used to achieve road safety.
- To describe the procedures for conducting road safety audit.

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1 INTRODUCTION:
Trends in highway development, Problem of road accidents in India, Characteristics of road accidents, Causes of accidents, Global and Indian road safety scenario, Factors responsible for success stories in road safety, Role of highway professionals in road safety.

2 PLANNING OF ROADS FOR SAFETY:
Land use planning and zoning, Development control and encroachment, Network hierarchy, Route planning through communities, Access control, Traffic segregation, Traffic calming, Designing for safety – road links and junctions, Traffic control devices, Road side facilities, Provisions for vulnerable road users.

3 ACCIDENTS – INVESTIGATION, MONITORING AND EVALUATION:
Accidents as the basis of Safety Analysis, Accident data and its limitations – collection, Analysis and Interpretation, Identification and diagnosis of hazardous locations, Accident reconstruction, Accident prediction model.

4 COUNTERMEASURES:
Engineering and Non-engineering measures, Selection, Economic appraisal and prioritizing, Effectiveness evaluation. Traffic Control Devices, Intersection Controls, Roadside Hazard Management, Roundabouts, Traffic Signals, Parking and Safety, Safety in Residential Streets, Street Lighting, Signs, Markings and Delineation, Education, training and publicity

5 ROAD SAFETY AUDIT:
Concepts, aims and objectives, roles and responsibility, Procedures, Organizing and conducting a road safety audit, Design standards, tasks, various stages of safety audits, Example and commonly identified Issues during RSA, Road safety audit report, Responding to an audit report.

6 TRANSPORTATION SYSTEM MANAGEMENT:
Traffic flow improvements, public transit, ridesharing, mobility rest areas, park-and-ride lots, bus bays, signage, markings; ITS applications - vehicular navigation, crash avoidance system, incident management, traffic management center, highway side communication.

Self-Learning
Interactive Highway Safety Design Model (IHSDM) software analysis tool for evaluating safety and operational effects of geometric design in the highway project development process.
Use of software for Accident reconstruction

Text Books:

3. Highway Design and Traffic Safety Engineering Handbook by Ruediger Lamm, Basil Psarianos, Theodor Mailaender, McGraw Hill Publishing, 1999
4. American Association of State Highway and Transportation Officials (AASHTO), “Highway Safety Manual”, AASHTO, 2010

Reference Books:

5. Relevant IRC codes (IRC: SP-44:1996, IRC:SP-88-2010)
6. Practical Road Safety Auditing by TMS Consultancy, Thomas Telford Limited, 2008
7. Sustainable safe road design - A practical manual by DHV Environment and Transportation, 2005

Course Outcome:

The student will be able to

- understand the role of engineering in road safety (CO1)
- perform accident investigations (CO2)
- conduct the road safety audits (CO3)
- understand some of the technical issues involved in good road safety engineering practice (CO4)

Project Work

Sub Code : CV84P
Credits : 0:0:10

Course Objectives:

- To train the students to do literature survey, coordinated group work, analysis of results.
- To train the students to prepare technical report and to do effective presentation.

- The project batches shall be formed during the 7th semester.
- The students shall form the batches on their own (i.e., group of likeminded students) and shall approach a staff member for his / her consent to guide the project work. The number of students in a batch shall be normally be limited to 4 and in exceptional cases, it may be 5. Under no circumstances, the number of students in a project batch shall be more than 5.
- A faculty member shall guide at least one project batch and shall not guide more than 2 batches, In case of any discrepancy, decision on HOD is final.
- The students of the project batch shall prepare a synopsis of the intended project work and submit the same to the department at the commencement of 8th semester.
- The project evaluation committee♣ of the department shall scrutinise the synopsis submitted by the project batches, shall give suggestions to improve the quality of work (if necessary) and approve the topic. This event shall be done in the 1st week of 8th semester.
- The project work shall have a mid-term evaluation by the project evaluation committee of the department to check the progress of the project work during the 8th week of 8th semester.
- Final evaluation of the project work shall be done by the project evaluation committee after the SEE of 8th semester.
- The weightage for the midterm evaluation and SEE shall be 10% and 90% respectively.

♣ The project evaluation committee shall consist of the Head of the Department or his nominee as the Chairman, the guide and one faculty member identified by the Chairman. If any member is himself / herself the guide, another faculty member shall be co-opted, limiting the total number of the members of the committee to 3.

It is suggested that the project report, as a guideline, may be presented in the following form.

1. Cover page
2. Certificate
3. Abstract
4. Acknowledgement
5. Contents
6. List of Figures (If any)
7. List of Tables (If any)
8. Notations (Optional)
9. Introduction
10. Literature Review
11. Experimental Program/Analytical Modeling/Analysis
12. Results and Discussions
13. Conclusions.
14. References.

The Project Report (both hard and soft copies) shall be submitted in the standard format prescribed by the institution to the department, after the certification of the concerned guide and HOD.

Course Outcome:

The student has the ability to

- do literature survey and select the scope of the work (CO1).
- carry out the selected project work rationally in a group and to analyse the results (CO2).
- prepare project work report and to present (CO3).

Technical Seminar

Sub Code : CV85S

Course Objectives:

- To train the student to select relevant civil engineering topic for seminar presentation.
- To train the student to develop multimedia presentation material.
- To encourage the student to develop communication skills.

- Each student is expected to give a technical seminar on a topic of civil engineering interest (topic other than topic of their project work).
- Each student shall submit the title of the intended topic of seminar to the seminar evaluation committee♣ of the department.
- The seminar evaluation committee shall scrutinise those titles submitted by the students and shall inform the students about the approval or suggestions to be incorporated to the title of the seminar.
- The dates and timings of the technical seminar shall be announced by the seminar evaluation committee.
- Each student shall submit the seminar report conforming to the standards and format decided by the department.
- The students shall give seminar on the topics approved by the seminar evaluation committee.

♣ The seminar evaluation committee shall consist of three members identified by HOD.

Course Outcome:

The student has the ability to

- select appropriate technical topic for presentation (CO1).
- compile the presentation material (CO2)
- develop multimedia presentation and to communicate the topic effectively (CO3).
- prepare the seminar report (CO4).