Course Title: STRENGTH OF MATERIALS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	15CV32	I.A. Marks	20
Number of Lecture Hours/Week	04	Exam. Marks	80
Total Number of Lecture Hours	50	Exam. Hours	03

CREDITS – 04

Course objectives: This course will enable students;

1. To understand the basic concepts of the stresses and strains for different materials and strength of structural elements.
2. To know the development of internal forces and resistance mechanism for one dimensional and two dimensional structural elements.
3. To analyse and understand different internal forces and stresses induced due to representative loads on structural elements.
4. To analyse and understand principal stresses due to the combination of two dimensional stresses on an element and failure mechanisms in materials.
5. To evaluate the behavior of torsional members, columns and struts.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1:		
Simple Stresses and Strain: Introduction, Definition and concept and of stress and strain. Hooke's law, Stress-Strain diagrams for ferrous and non-ferrous materials, factor of safety, Elongation of tapering bars of circular and rectangular cross sections, Elongation due to self-weight. Saint Venant's principle, Compound bars, Temperature stresses, Compound section subjected to temperature stresses, state of simple shear, Elastic constants and their relationship.	**10 Hours**	**L2,L3**
Module -2:		
Compound Stresses: Introduction, state of stress at a point, General two dimensional stress system, Principal stresses and principal planes. Mohr's circle of stresses	**5 Hours**	**L2,L4**
Thin and Thick Cylinders: Introduction, Thin cylinders subjected to internal pressure; Hoop stresses, Longitudinal stress and change in volume. Thick cylinders subjected to both internal and external pressure; Lame's equation, radial and hoop stress distribution.	**5 Hours**	**L2,L4**
Module-3:		

Shear Force and Bending Moment in Beams: Introduction to types of beams, supports and loadings. Definition of bending moment and shear force, Sign conventions, relationship between load intensity, bending moment and shear force. Shear force and bending moment diagrams for statically determinate beams subjected to points load, uniformly distributed loads, uniformly varying loads, couple and their combinations.	**10 Hours**	**L2,L4**
Module -4:		
Bending and Shear Stresses in Beams: Introduction, pure bending theory, Assumptions, derivation of bending equation, modulus of rupture, section modulus, flexural rigidity. Expression for transverse shear stress in beams, Bending and shear stress distribution diagrams for circular, rectangular, 'I', and 'T' sections. Shear centre(only concept)	**6 Hours**	**L2.L4**
Columns and Struts: Introduction, short and long columns. Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory. Rankine-Gordon's formula for columns.	**4 Hours**	**L2,L4**
Module -5:		
Torsion in Circular Shaft: Introduction, pure torsion, Assumptions, derivation of torsion equation for circular shafts, torsional rigidity and polar modulus Power transmitted by a shaft, combined bending and torsion.	**7 Hours**	**L2,L4**
Theories of Failure: Introduction, maximum principal stress theory (Rankine's theory), Maximum shearing stress theory (Tresca's theory), Strain energy theory (Beltrami and Haigh), and maximum strain theory (St. Venant's theory).	**3 Hours**	**L1,L2**

Course outcomes:

After studying this course, students will be able;

1. To evaluate the strength of various structural elements internal forces such as compression, tension, shear, bending and torsion.
2. To suggest suitable material from among the available in the field of construction and manufacturing.
3. To evaluate the behavior and strength of structural elements under the action of compound stresses and thus understand failure concepts.
4. To understand the basic concept of analysis and design of members subjected to torsion.
5. To understand the basic concept of analysis and design of structural elements such as columns and struts.

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*
- *Interpretation of data.*

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- ***The students shall answer Five full questions selecting one full question from each module.***
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. B.S. Basavarajaiah, P.Mahadevappa "Strength of Materials" in SI Units, University Press (India) Pvt. Ltd., 3rd Edition, 2010
2. Ferdinand P. Beer, E. Russell Johnston and Jr.John T. DeWolf "Mechanics of Materials", Tata McGraw-Hill, Third Edition, SI Units

Reference Books:

1. D.H. Young, S.P. Timoshenko " Elements of Strength of Materials" East West Press Pvt. Ltd., 5th Edition (Reprint 2014)
2. R K Bansal, "A Textbook of Strength of Materials", 4th Edition, Laxmi Publications, 2010
3. S.S. Rattan " Strength of Materials" McGraw Hill Education (India) Pvt. Ltd., 2nd Edition (Sixth reprint 2013)
4. Vazirani, V N, Ratwani M M. and S K Duggal "Analysis of Structures Vol. I", 17th Edition, Khanna Publishers, New Delhi.

Course Title: FLUIDS MECHANICS

[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – III

Subject Code	15CV33	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

The objectives of this course is to make students to learn:

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

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Fluids & Their Properties: Concept of fluid, Systems of units. Properties of fluid; Mass density, Specific weight, Specific gravity, Specific volume, Viscosity, Cohesion, Adhesion, Surface tension& Capillarity. Fluid as a continuum, Newton's law of viscosity (theory & problems).Capillary rise in a vertical tube and between two plane surfaces (theory & problems). vapor pressure of liquid, compressibility and bulk modulus, capillarity, surface tension, pressure inside a water droplet, pressure inside a soap bubble and liquid jet. Numerical problems	**5 Hours**	**L2,L3**
Fluid Pressure and Its Measurements: Definition of pressure, Pressure at a point, Pascal's law, Variation of pressure with depth. Types of pressure. Measurement of pressure using simple, differential & inclined manometers (theory & problems). Introduction to Mechanical and electronic pressure measuring devices.	**5 Hours**	**L2,L3**

Module -2		
Hydrostatic forces on Surfaces : Definition, Total pressure, centre of pressure, total pressure on horizontal, vertical and inclined plane surface, total pressure on curved surfaces, water pressure on gravity dams, Lock gates. Numerical Problems. **Fundamentals of fluid flow (Kinematics):** Introduction. Methods of describing fluid motion. Velocity and Total acceleration of a fluid particle. Types of fluid flow, Description of flow pattern. Basic principles of fluid flow, three-dimensional continuity equation in Cartesian coordinate system. Derivation for Rotational and irroational motion. Potential function, stream function, orthogonality of streamlines and equipotential lines. Numerical problems on Stream function and velocity potential. Introduction to flow net.	**3 Hours** **7 Hours**	**L2,L4** **L2,L4**
Module -3		
Fluid Dynamics: Introduction. Forces acting on fluid in motion. Euler's equation of motion along a streamline and Bernoulli's equation. Assumptions and limitations of Bernoulli's equation. Modified Bernoulli's equation. Problems on applications of Bernoulli's equation (with and without losses). Vortex motion; forced vortex, free vortex, problems Momentum equation problems on pipe bends. **Applications:** Introduction. Venturimeter, Orificemeter, Pitot tube. Numerical Problems	**10 Hours**	**L2,L4**
Module -4		
Orifice and Mouthpiece: Introduction, classification, flow through orifice, hydraulic coefficients, Numerical problems. Mouthpiece, classification, Borda's Mouthpiece (No problems). **Notches and Weirs**: Introduction. Classification, discharge over rectangular, triangular, trapezoidal notches, Cippoletti notch, broad crested weirs. Numerical problems. Ventilation of weirs, submerged weirs.	**3 Hours** **7 Hours**	**L1,L2** **L2,L4**

Module -5		
Flow through Pipes: Introduction. Major and minor losses in pipe flow. Darcy-Weisbach equation for head loss due to friction in a pipe. Pipes in series, pipes in parallel, equivalent pipe-problems. Minor losses in pipe flow, equation for head loss due to sudden expansion. Numerical problems. Hydraulic gradient line, energy gradient line. Pipe Networks, Hardy Cross method, Numerical problems.	**7 Hours**	**L2,L4**
Surge Analysis in Pipes: Water hammer in pipes, equations for pressure rise due to gradual valve closure and sudden closure for rigid and elastic pipes. Problems	**3 Hours**	**L2,L4**

Course outcomes:

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

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

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*
- *Interpretation of data.*

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum Three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- The students shall answer Five full questions selecting one full question from each module.
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. P N Modi and S M Seth, "Hydraulics and Fluid Mechanics, including Hydraulic Machines", 20th edition, 2015, Standard Book House, New Delhi
2. R.K. Bansal, "A Text book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi
3. S K SOM and G Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill,New Delhi

Reference Books:

1. Victor L Streeter, Benjamin Wylie E and Keith W Bedford, "Fluid Mechanics", Tata McGraw Hill Publishing Co Ltd., New Delhi, 2008(Ed)
2. K Subramanya, "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Publishing Co. Ltd.
3. K Subramanya, "Fluid Mechanics and Hydraulic Machines-problems and solutions", Tata McGraw Hill Publishing Co. Ltd.
4. J. F. Douglas, J. M. Gasoriek, John Swaffield, Lynne Jack, "Fluid Mechanics", Pearson, Fifth Edition
5. Mohd.Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press

Course Title: BASIC SURVEYING [As per Choice Based Credit System (CBCS) scheme] SEMESTER – III			
Subject Code	15CV34	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS – 04			

Course objectives:

This course will enable students to;

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

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Introduction: Definition of surveying, Objectives and importance of surveying. Classification of surveys. Principles of surveying. Units of measurements, Surveying measurements and errors, types of errors, precision and accuracy. Classification of maps, map scale, conventional symbols, topographic maps, map layout, Survey of India Map numbering systems. **Measurement of Horizontal Distances:** Measuring tape and types. Measurement using tapes, Taping on level ground and sloping ground. Errors and corrections in tape measurements, ranging of lines, direct and indirect methods of ranging, Electronic distance measurement, basic principle. Booking of tape survey work, Field book, entries, Conventional symbols, Obstacles in tape survey, Numerical problems.	**6 Hours** **4 Hours**	**L1, L2** **L1, L2**

Module -2		
Measurement of Directions and Angles: **Compass survey:** Basic definitions; meridians, bearings, magnetic and True bearings. Prismatic and surveyor's compasses, temporary adjustments, declination. Quadrantal bearings, whole circle bearings, local attraction and related problems	**5 Hours**	**L2,L3**
Theodolite Survey and Instrument Adjustment: Theodolite and types, Fundamental axes and parts of Transit theodolite, uses of theodolite, Temporary adjustments of transit theodolite, measurement of horizontal and vertical angles, step by step procedure for obtaining permanent adjustment of Transit theodolite	**5 Hours**	**L2,L3**
Module -3		
Traversing: Traverse Survey and Computations: Latitudes and departures, rectangular coordinates, Traverse adjustments, Bowditch rule and transit rule, Numerical Problems	**5 Hours**	**L1, L2**
Tacheometry: basic principle, types of tacheometry, distance equation for horizontal and inclined line of sight in fixed hair method, problems	**5 Hours**	**L1, L2**
Module -4		
Leveling: Basic terms and definitions, Methods of leveling, Dumpy level, auto level, digital and laser levels. Curvature and refraction corrections. Booking and reduction of levels. Differential leveling, profile leveling, fly leveling, check leveling, reciprocal leveling, trigonometric leveling (heights and distances-single plane and double plane methods.	**10Hours**	**L3,L4**
Module -5:		
Areas and Volumes: Measurement of area – by dividing the area into geometrical figures, area from offsets, mid ordinate rule, trapezoidal and Simpson's one third rule, area from co-ordinates, introduction to planimeter, digital planimeter. Measurement of volumes-trapezoidal and prismoidal formula.	**8Hours**	**L2,L3**
Contouring Contours, Methods of contouring, Interpolation of contours, contour gradient, characteristics of contours and uses.	**2 Hours**	**L2,L3**

Course outcomes:

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

1. Posses a sound ***knowledge*** of fundamental principles Geodetics[L1][PO1]
2. *Measurement of vertical and horizontal plane, linear and angular dimensions to arrive at solutions to basic surveying problems.[L2][L3][PO3]*
3. *Capture geodetic data to process and perform analysis for survey problems [L4]*[PO2]
4. *Analyse the obtained spatial data and compute areas and volumes. Represent 3D data on plane figures as contours [L4] [PO2]*

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*
- *Interpretation of data.*

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum Three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- The students shall answer Five full questions selecting one full question from each module.
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. B.C. Punmia, "Surveying Vol.1", Laxmi Publications pvt. Ltd., New Delhi – 2009.
2. Kanetkar T P and S V Kulkarni , Surveying and Leveling Part I, Pune Vidyarthi Griha Prakashan, 1988

Reference Books:

1. S.K. Duggal, "Surveying Vol.1", Tata McGraw Hill Publishing Co. Ltd. New Delhi. – 2009.
2. K.R. Arora, "Surveying Vol. 1" Standard Book House, New Delhi. – 2010
3. R Subramanian, Surveying and Leveling, Second edition, Oxford University Press, New Delhi
4. A. Bannister, S. Raymond , R. Baker, "Surveying", Pearson, 7th ed., New Delhi

Course Title: ENGINEERING GEOLOGY [As per Choice Based Credit System (CBCS) scheme] SEMESTER – III			
Subject Code	15CV35	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS – 04			

Course objectives:

This course will enable students;

1. To understand the internal structure and composition of the earth.
2. To comprehend the properties, occurrence and uses of minerals in various industries.
3. To learn about geo-morphological agents such as river, wind, sea waves, and their implications in implementing civil engineering projects.
4. To gain knowledge about the structures of the rocks and their considerations in the selection of site for dams, tunnels, bridges and highways.
5. To learn the application of Topographic maps, remote sensing and GIS in Civil engineering practices and natural resource management.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Introduction: Application of Earth Science in Civil Engineering Practices, Understanding the earth, internal structure and composition. **Mineralogy:** Mineral properties, composition and their use in the manufacture of construction materials - Quartz Group (Glass); Feldspar Group (Ceramic wares and Flooring tiles); Kaolin (Paper, paint and textile); Asbestos (AC sheets); Carbonate Group (Cement) ; Gypsum (POP, gypsum sheets, cement); Mica Group (Electrical industries); Ore minerals - Iron ores (Steel); Chromite (Alloy); Bauxite (aluminum); Chalcopyrite (copper)	**10 Hours**	**L1,L2**

Module -2		
Petrology: Formation, Classification and Engineering Properties. Rock as construction material, concrete aggregate, railway ballast, roofing, flooring, cladding and foundation. Deformation of rocks, Development of Joints, Folds, Faults and Unconformities. Their impact in the selection of sites for Dams, Reservoirs, Tunnels, Highways and Bridges, Rock Quality Determination (RQD), Rock Structure Rating (RSR),: Igneous Rocks - Granite, Gabbro, Dolerite, Basalt; Sedimentary rocks - Sandstone, Shale, Limestone, Laterite; Metamorphic rocks - Gneiss, Quartzite, Slate, Charnockite: Decorative stones - Porphyries, Marble and Quartzite.	**10 Hours**	**L2,L3**
Module -3		
Geomorphology and Seismology: Landforms – Classification, Rock weathering, types and its effects on Civil Engineering Projects. Study of Geo-morphological aspects in the selection of sites for Dams, Reservoirs, Tunnels, Highways and Bridges. Watershed management, Floods and their control, River valley, Drainage pattern – parameters and development; Coastlines and their engineering considerations. Earthquake - Causes and Effects,, Seismic waves, Engineering problems related to Earthquakes, Earthquake intensity, Richter Scale, Seismograph, Seismic zones- World and India, Tsunami – causes and effects. Early warning system. Reservoir Induced Seismicity; Landslides – causes and their control.	**12 Hours**	**L2, L3, L5**
Module -4		
Hydrogeology: Hydrological cycle, Occurrence of Groundwater in different terrains -Weathered, Hard and Stratified rocks; Determination of Quality aspects - SAR, RSC and TH of Groundwater. Groundwater Pollution, Groundwater Exploration- Electrical Resistivity and Seismic methods, Resistivity curves, Water Bearing Formations, Aquifer types and parameters - Porosity, Specific yield and retention, Permeability, Transmissibility and Storage Coefficient. Springs and Artesian Wells, Artificial Recharging of Groundwater, Sea water intrusion and remedies.	**8 Hours**	**L4,L5**

Module -5:		
Geodesy: Study of Topographic maps and Contour maps; Remote Sensing – Concept, Application and its Limitations; Geographic Information System (GIS) and Global Positioning System (GPS) – Concept and their use resource mapping. LANDSAT Imagery – Definition and its use. Impact of Mining, Quarrying and Reservoirs on Environment. Natural Disasters and their mitigation.	**10 Hours**	**L2,L3, L5**

Course outcomes:

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

1. Students will able to apply the knowledge of geology and its role in Civil Engineering
2. Students will effectively utilize earth's materials such as mineral, rocks and water in civil engineering practices.
3. Analyze the natural disasters and their mitigation.
4. Assess various structural features and geological tools in ground water exploration,
   Natural resource estimation and solving civil engineering problems.
5. Apply and asses use of building materials in construction and asses their properties

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*
- *Interpretation of data.*

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum Three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- The students shall answer Five full questions selecting one full question from each module.
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. P.K. Mukerjee, "A Text Book of Geology", World Press Pvt., Ltd. Kolkatta.
2. Parbin Singh, "Text Book of Engineering and General Geology", Published by S.K. Kataria and Sons, New Dehli

Reference Books:

1. Earthquake Tips - Learning Earthquake Design and Construction - C V R Murthy Published by National Information Centre of Earthquake Engineering, Indian Institute of Technology, Kanpur.
2. Dimitri P Krynine and William R Judd, “Principles of Engineering Geology and Geotechnics”, CBS Publishers and Distributors, New Delhi.
3. K V G K Gokhale, “Principles of Engineering Geology”, BS Publications, Hyderabad.
4. M Anji Reddy, “Text book of Remote Sensing and Geographical Information System”, BS Publications, Hyderabad.
5. Ground water Assessment, development and Management by K.R. Karanth, Tata Mc Graw Hills
6. K. Todd, “Groundwater Hydrology”, Tata Mac Grow Hill, New Delhi.
7. D. Venkata Reddy, “Engineering Geology”, New Age International Publications, New Delhi.
8. S.K Duggal, H.K Pandey and N Rawal, “Engineering Geology”, McGraw Hill Education (India) Pvt, Ltd. New Delhi.
9. M.P Billings, “Structural Geology”, CBS Publishers and Distributors, New Delhi.
10. K. S. Valdiya, “ Environmental Geology”,, Tata Mc Grew Hills.
11. M. B. Ramachandra Rao, “Outlines of Geophysical Prospecting- A Manual for Geologists”, Prasaranga, University of Mysore, Myso

Course Title: Building Materials and Construction

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	15CV36	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives:

This course will develop a student;

1. In recognizing the good materials to be used for the construction work
2. In investigation of soil condition, Deciding and design of suitable foundation for different structures
3. In supervision of different types of masonry
4. In selection of materials, design and supervision of suitable type of floor and roof.
5. To gain knowledge about doors, windows, plastering, painting, damp proofing, scaffolding, shoring, underpinning and to take suitable engineering measures.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Building Materials: Stone as building material; Requirement of good building stones, Dressing of stones, Deterioration and Preservation of stone work. Bricks; Classification, Manufacturing of clay bricks, Requirement of good bricks. Field and laboratory tests on bricks; compressive strength, water absorption, efflorescence, dimension and warpage. Cement Concrete blocks, Stabilized Mud Blocks, Sizes, requirement of good blocks. Mortar: types and requirements. Timber as construction material Fine aggregate: Natural and manufactured: Sieve analysis, zoning, specify gravity, bulking, moisture content, deleterious materials. Coarse aggregate: Natural and manufactured: Importance of size, shape and texture. Grading of aggregates, Sieve analysis, specific gravity, Flakiness and elongation index, crushing, impact and abrasion tests.	10 Hours	L1 L2
Module -2		

Foundation: Preliminary investigation of soil, safe bearing capacity of soil, Function and requirements of good foundation , types of foundation , introduction to spread, combined , strap, mat and pile foundation **Masonry:** Definition and terms used in masonry. Brick masonry, characteristics and requirements of good brick masonry, Bonds in brick work, Header, Stretcher, English, Flemish bond, Stone masonry, Requirements of good stone masonry, Classification, characteristics of different stone masonry, Joints in stone masonry. Types of walls; load bearing, partition walls, cavitywalls	**10Hours**	**L1,L2**
Module -3		
Lintels and Arches: Definition, function and classification of lintels, Balconies, chejja and canopy. Arches; Elements and Stability of an Arch. **Floors and roofs:** Floors; Requirement of good floor, Components of ground floor, Selection of flooring material, Laying of Concrete, Mosaic, Marble, Granite, Tile flooring, Cladding of tiles. Roof;-Requirement of good roof, Types of roof, Elements of a pitched roof, Trussed roof, King post Truss, Queen Post Truss, Steel Truss, Different roofing materials, R.C.C.Roof.	**10 hours**	L3
Module -4:		
Doors, Windows and Ventilators: Location of doors and windows, technical terms, Materials for doors and windows, Paneled door, Flush door, Collapsible door, Rolling shutter, PVC Door, Paneled and glazed Window, Bay Window, French window. Ventilators. Sizes as per IS recommendations **Stairs:** Definitions, technical terms and types of stairs, Requirements of good stairs. Geometrical design of RCC doglegged and open-well stairs. **Formwork:** Introduction to form work, scaffolding, shoring, under pinning.	10 Hours	L2 L3 L5
Module -5		
Plastering and Pointing : purpose, materials and methods of plastering and pointing, defects in plastering-Stucco plastering, lathe plastering **Damp proofing**- causes, effects and methods. **Paints**- Purpose, types, ingredients and defects,	10 Hours	L4 L5

Preparation and applications of paints to new and old plastered surfaces, wooden and steel surfaces.		

Course outcomes:

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

1. Select suitable materials for buildings and adopt suitable construction techniques.
2. Adopt suitable repair and maintenance work to enhance durability of buildings.

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*
- *Interpretation of data.*

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum Three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- The students shall answer Five full questions selecting one full question from each module.
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. Sushil Kumar “Building Materials and construction”, 20th edition, reprint 2015, Standard Publishers
2. Dr. B.C.Punmia, Ashok kumar Jain, Arun Kumar Jain, “Building Construction, Laxmi Publications (P) ltd., New Delhi.
3. Rangawala S. C. “Engineering Materials”, Charter Publishing House, Anand, India.

Reference Books:

1. S.K.Duggal, “Building Materials”, (Fourth Edition)New Age International (P) Limited, 2016
2. National Building Code(NBC) of India
3. P C Vergese, “Buliding Materials”, PHI Learning Pvt. Ltd
4. Building Materials and Components, CBRI, 1990, India
5. Jagadish.K.S, “Alternative Building Materials Technology”, New Age International, 2007.
6. M. S. Shetty, “Concrete Technology”, S. Chand & Co. New Delhi.

Course Title: MATERIALS TESTING LABORATORY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	15CVL37	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	42	Exam Hours	03

CREDITS – 02

Course objectives:

The objectives of this course is to make students to learn:

1. Ability to apply knowledge of mathematics and engineering in calculating the mechanical properties of structural materials.
2. Ability to function on multi-disciplinary teams in the area of materials testing.
3. Ability to use the techniques, skills and modern engineering tools necessary for engineering.
4. Understanding of professional and ethical responsibility in the areas of material testing.
5. 5. Ability to communicate effectively the mechanical properties of materials.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
1. Tension test on mild steel and HYSD bars.	**03 Hours**	**L_2, L_3, L_5**
2. Compression test on mild steel, cast iron and wood.	**03 Hours**	**L_1, L_2, L_3, L_5**
3. Torsion test on mild steel circular sections.	**03 Hours**	**L_1, L_2, L_3, L_5**
4. Bending Test on Wood Under two point loading	**03 Hours**	**L_1, L_2, L_3, L_5**
5. Shear Test on Mild steel- single and double shear	**03 Hours**	**L_1, L_2, L_3, L_5**
6. Impact test on Mild Steel (Charpy & Izod)	**03 Hours**	**L_1, L_2, L_3, L_5**
7. Hardness tests on ferrous and non-ferrous metals – Brinell's, Rockwell and Vicker's	**06 Hours**	**L_1, L_2, L_3, L_5**
8. Tests on Bricks and Tiles	**03 Hours**	**L_1, L_2, L_3, L_5**
9. Tests on Fine aggregates – Moisture content, Specific gravity, Bulk density, Sieve analysis and Bulking	**06 Hours**	**L_1, L_2, L_3, L_5**
10. Tests on Coarse aggregates – Absorption, Moisture content, specific gravity, Bulk density and Sieve analysis	**06 Hours**	**L_1, L_2, L_3, L_5**
11. Demonstration of Strain gauges and Strain indicators *NOTE: All tests to be carried out as per relevant latest BIS Codes*	**03 Hours**	**L_1, L_2, L_3, L_5**

Course outcomes:

After successful completion of the course, the students will be able to:

1. Reproduce the basic knowledge of mathematics and engineering in finding the strength in tension, compression, shear and torsion.
2. Identify, formulate and solve engineering problems of structural elements subjected to flexure.
3. Evaluate the impact of engineering solutions on the society and also will be aware of contemporary issues regarding failure of structures due to unsuitable materials.

Program Objectives (as per NBA)

1. *Engineering Knowledge.*
2. *Evaluation of mechanical properties of structural materials.*
3. *Interpretation of test results.*

Question paper pattern:

- Group experiments - Tension test, compression test, torsion test and bending test.
- Individual Experiments - Remaining tests.
- Two questions are to be set - One from group experiments and the other as individual experiment.
- Instructions as printed on the cover page of answer script for split up of marks to be strictly followed.
- All exercises are to be included for practical examination.

Reference Books:

1. Davis, Troxell and Hawk, "Testing of Engineering Materials", International Student Edition – McGraw Hill Book Co. New Delhi.
2. M L Gambhir and Neha Jamwal, "Building and construction materials-Testing and quality control", McGraw Hill education(India)Pvt. Ltd., 2014
3. Fenner, " Mechanical Testing of Materials", George Newnes Ltd. London.
4. Holes K A, "Experimental Strength of Materials", English Universities Press Ltd. London.
5. Suryanarayana A K, "Testing of Metallic Materials", Prentice Hall of India Pvt. Ltd. New Delhi.
6. Kukreja C B, Kishore K. and Ravi Chawla "Material Testing Laboratory Manual", Standard Publishers & Distributors 1996.
7. Relevant IS Codes

Course Title: BASIC SURVEYING PRACTICE

[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – III

Subject Code	15CVL38	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	42	Exam Hours	03

CREDITS – 02

Course objectives: This course will enable students to

The objectives of this course is to make students to learn:

1. *Apply the basic principles of engineering surveying and measurements*
2. *Follow effectively field procedures required for a professional surveyor*
3. *Use techniques, skills and conventional surveying instruments necessary for engineering practice..*

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
1. a) Measurements of distances using tape along with horizontal planes and slopes, direct ranging. b) Setting out perpendiculars. Use of cross staff, optical square.	03	**L3, L4**
2. Obstacles in chaining and ranging – Chaining but not ranging, ranging but not chaining, both ranging and chaining.	03	**L3**
3. Measurements of bearings / directions using prismatic compass, setting of geometrical figures using prismatic compass.	03	**L3**
4. Measurement of bearings of sides of a closed traverse and adjustment of closing error by Bowditch method.	03	**L3**
5. Determination of distance between two inaccessible points using compass and accessories	03	**L4**
6. Determination of reduced levels of points using dumpy level/auto level (simple leveling)	03	**L4**
7. Determination of reduced levels of points using dumpy level/auto level (differential leveling and inverted leveling)	03	**L4**
8. To determine the difference in elevation between two points using Reciprocal leveling and to determine the collimation error	03	**L4**
9. To conduct profile leveling, cross sectioning and block leveling. Plotting profile and cross sectioning in excel. Block contour on graph paper to scale	03	**L3**
10. Measurement of horizontal angle by repetition and reiteration methods and Measurement of vertical angles using theodolite.	03	**L4**

11. Determination of horizontal distance and vertical height to a base inaccessible object using theodolite by single plane and double plane method.	03	**L4**
12. To determine distance and elevation using tachometric surveying with horizontal and inclined line of sight.	03	**L3**
13. Closed traverse surveying using Theodolite and applying corrections for error of closure by transit rule.	03	**L3**
14. Demonstration of Minor instruments like Clinometer, Ceylon Ghat tracer, Box sextant, Hand level, Planimeter, nautical sextant and Pentagraph.	03	**L3**

Course outcomes:

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

1. Apply the basic principles of engineering surveying and for linear and angular measurements.
2. comprehend effectively field procedures required for a professional surveyor.
3. Use techniques, skills and conventional surveying instruments necessary for engineering practice.[L3,L4][PO5]

Program Objectives (as per NBA)

1. *Engineering Knowledge.*
2. *Problem Analysis.*
3. *Interpretation of data.*

Question paper pattern:

- All are individual experiments.
- Instructions as printed on the cover page of answer script for split up of marks to be strictly followed.
- All exercises are to be included for practical examination.

Text Books:

1. B.C. Punmia, **"Surveying Vol.1"**, Laxmi Publications pvt. Ltd., New Delhi – 2009.
2. Kanetkar T P and S V Kulkarni , **Surveying and Levelling Part I**, Pune VidyarthiGrihaPrakashan, 1988

Reference Books:

1. S.K. Duggal, **"Surveying Vol.1"**, Tata McGraw Hill Publishing Co. Ltd. New Delhi. – 2009.
2. K.R. Arora, **"Surveying Vol. 1"** Standard Book House, New Delhi. – 2010

Course Title: Analysis of Determinate Structures

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	15CV42	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Apply knowledge of mathematics and engineering in calculating slope and deflections
2. Identify, formulate and solve engineering problems
3. Analyse structural systems and interpret data
4. Engage in lifelong learning with the advances in Structural Engineering

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Introduction and Analysis of Plane Trusses Structural forms, Conditions of equilibrium, Compatibility conditions, Degree of freedom, Linear and non linear analysis, Static and kinematic indeterminacies of structural systems, Types of trusses, Assumptions in analysis, Analysis of determinate trusses by method of joints and method of sections.	**10 Hours**	**L2,L4,L5**
Module -2		
Deflection of Beams Definition of slope, Deflection and curvature, Sign conventions, Derivation of moment-curvature equation. Double integration method and Macaulay's method: Slope and deflection for standard loading cases and for determinate prismatic beams subjected to point loads, UDL, UVL and couple. Moment area method: Derivation, Mohr's theorems, Sign conventions, Application of moment area method for determinate prismatic beams, Beams of varying section, Use of moment diagram by parts. Conjugate beam method: Real beam and conjugate beam, conjugate beam theorems, Application of conjugate beam method of determinate beams of variable cross sections.	**10 Hours**	**L2,L4,L5**
Module -3		
Energy Principles and Energy Theorems Principle of virtual displacements, Principle of virtual forces, Strain energy and complimentary energy, Strain energy due to axial force, bending, shear and torsion, Deflection of determinate beams and trusses using total strain energy, Deflection at the point of application of single load, Castigliano's theorems and its application to estimate the deflections of trusses, bent frames, Special applications-Dummy unit load method.	**10 Hours**	**L2,L4,L5**

Module -4		
Arches and Cable Structures Three hinged parabolic arches with supports at the same and different levels. Determination of normal thrust, radial shear and bending moment. Analysis of cables under point loads and UDL. Length of cables for supports at same and at different levels- Stiffening trusses for suspension cables.	**10 Hours**	**L2, L4, L5**
Module -5		
Influence Lines and Moving Loads Concepts of influence lines-ILD for reactions, SF and BM for determinate beams-ILD for axial forces in determinate trusses-Reactions, BM and SF in determinate beams using rolling loads concepts.	**10 Hours**	**L2, L4, L6**

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

1. Evaluate the forces in determinate trusses by method of joints and sections.
2. Evaluate the deflection of cantilever, simply supported and overhanging beams by different methods
3. Understand the energy principles and energy theorems and its applications to determine the deflections of trusses and bent frames.
4. Determine the stress resultants in arches and cables.
5. Understand the concept of influence lines and construct the ILD diagram for the moving loads.

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*
- *Interpretation of Data.*

Question paper pattern:

- The question paper will have ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum Three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- The students shall answer five full questions selecting one full question from each module.
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. Reddy C S, Basic Structural Analysis, Tata McGraw Hill, New Delhi.
2. Muthu K U. etal, Basic Structural Analysis, 2nd edition, IK International Pvt. Ltd., New Delhi,2015.
3. Bhavikatti, Structual Analysis, Vikas Publishing House Pvt. Ltd, New Delhi, 2002.

Reference Books:

1. Hibbeler R C, Structural Analysis, Prentice Hall, 9th edition, 2014
2. Devadoss Menon, Structural Analysis, Narosa Publishing House, New Delhi, 2008.
3. Prakash Rao D S, Structural Analysis, University Press Pvt. Ltd, 2007.

Course Title: Applied Hydraulics

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	15CV43	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

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

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

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module 1: Dimensional and Model analysis	**10**	
Dimensional analysis Dimensional analysis and similitude: Dimensional homogeneity, Non Dimensional parameter, Rayleigh methods and Buckingham π theorem, dimensional analysis, choice of variables, examples on various applications.	**03**	**L1, L2, L3**
Model analysis: Model analysis, similitude, types of similarities, force ratios, similarity laws, model classification, Reynolds model, Froude's model, Euler's Model, Webber's model, Mach model, scale effects, Distorted models. Numerical problems on Reynold's, and Froude's Model.	**04**	**L1, L2, L3**
Buoyancy and Flotation Buoyancy, Force and Centre of Buoyancy, Metacentre and Metacentric height, Stability of submerged and floating bodies, Determination of Metacentric height, Experimental and theoretical method, Numerical problems	**03**	**L1, L2, L3,L4**
Module 2: Open Channel Flow Hydraulics	**10**	
Uniform Flow Introduction, Classification of flow through channels, Chezy's and Manning's equation for flow through open channel, Most economical channel sections, Uniform flow through Open channels, Numerical Problems.	**06**	**L3,L4**
Specific Energy and Specific energy curve, Critical flow and corresponding critical parameters, Metering flumes, Numerical Problems	**04**	**L2, L3**
Module 3: Non-Uniform Flow	**10**	
Hydraulic Jump, Expressions for conjugate depths and Energy loss, Numerical Problems	**03**	**L2,L3,L4**
Gradually varied flow, Equation, Back water curve and afflux, Description of water curves or profiles, Mild, steep, critical,	**04** **03**	**L2,L3**

horizontal and adverse slope profiles, Numerical problems, Control sections		
Module 4: Hydraulic Machines	**10**	
Introduction, Impulse-Momentum equation. Direct impact of a jet on a stationary and moving curved vanes, Introduction to concept of velocity triangles, impact of jet on a series of curved vanes- Problems	**05**	**L2,L3**
Turbines – Impulse Turbines		
Introduction to turbines, General lay out of a hydro-electric plant, Heads and Efficiencies, classification of turbines. Pelton wheel-components, working principle and velocity triangles. Maximum power, efficiency, working proportions – Numerical problems	**05**	**L1, L2, L3,L4**
Module 5: Reaction Turbines and Pumps	**10**	
Radial flow reaction turbines: (i) Francis turbine- Descriptions, working proportions and design, Numerical problems. (ii) Kaplan turbine- Descriptions, working proportions and design, Numerical problems. Draft tube theory and unit quantities. (No problems) Centrifugal pumps: Components and Working of centrifugal pumps, Types of centrifugal pumps, Work done by the impeller, Heads and Efficiencies, Minimum starting speed of centrifugal pump, Numerical problems, Multi-stage pumps.	**06** **04**	**L1,L2, L3,L4**

COURSE OUTCOMES:

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

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

Program Objectives

1. PO1: Engineering Knowledge
2. PO2: Problem analysis
3. PO3: Analyse and development of Solutions

Question Paper Pattern:

- Total number of Questions to be set is 10. Two full questions are to be set from each module.
- Not more than 3 sub questions are to be set under any main question
- Questions are to be set such that the entire module is covered and further, should be answerable for the set marks.
- Each question should be set for 16 marks
- Students should answer 5 full questions selecting at least 1 from each module.

Text Books:

1. P N Modi and S M Seth, "Hydraulics and Fluid Mechanics, including Hydraulic Machines", 20th edition, 2015, Standard Book House, New Delhi
2. R.K. Bansal, "A Text book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi
3. S K SOM and G Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill,New Delhi

Reference Books:

1. K Subramanya, "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Publishing Co. Ltd.
2. Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press
3. C.S.P. Ojha, R. Berndtsson, and P.N. Chandramouli, *"Fluid Mechanics and Machinery"*, Oxford University Publication – 2010
4. J.B. Evett, and C. Liu, *"Fluid Mechanics and Hydraulics*", McGraw-Hill Book Company.- 2009.

Course Title: Concrete Technology

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	15CV44	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

1. Recognize the importance of material characteristics and their contributions to strength development in Concrete
2. Proportion ingredients of Concrete to arrive at most desirable mechanical properties of Concrete.
3. Ascertain and measure engineering properties of concrete in fresh and hardened state which meet the requirement of real time structures.

Contents	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module-1: Concrete Ingredients		
Cement – Cement manufacturing process, steps to reduce carbon footprint, chemical composition and their importance, hydration of cement, types of cement. Testing of cement. Fine aggregate: Functions, requirement, Alternatives to River sand, M-sand introduction and manufacturing. Coarse aggregate: Importance of size, shape and texture. Grading and blending of aggregate. Testing on aggregate, requirement. Recycled aggregates Water – qualities of water. Chemical admixtures – plasticizers, accelerators, retarders and air entraining agents. Mineral admixtures – Pozzolanic and cementitious materials, Fly ash, GGBS, silica fumes, Metakaolin and rice husk ash.	10 Hours	L1, L2, L3
Module -2: Fresh Concrete		
Workability-factors affecting workability. Measurement of workability–slump, Compaction factor and Vee-Bee Consistometer tests, flow tests. Segregation and bleeding. Process of manufacturing of concrete- Batching, Mixing, Transporting, Placing and Compaction. Curing – Methods of curing – Water curing, membrane curing, steam curing, accelerated curing, self-curing. Good and Bad practices of making and using fresh concrete and Effect of heat of hydration during mass concreting at project sites.	10 Hours	L1, L2, L3
Module -3: Hardened Concrete		
Factors influencing strength, W/C ratio, gel/space ratio, Maturity concept, Testing of hardened concrete, Creep –factors affecting creep. Shrinkage of concrete – plastic shrinking and drying shrinkage, Factors affecting shrinkage. Definition and significance of durability. Internal and external factors influencing durability, Mechanisms- Sulphate attack – chloride attack, carbonation, freezing and thawing. Corrosion, Durability requirements as per	10 Hours	L1, L2, L3

IS-456, Insitu testing of concrete- Penetration and pull out test, rebound hammer test, ultrasonic pulse velocity, core extraction – Principal, applications and limitations.		
Module -4: Concrete Mix Proportioning		
Concept of Mix Design with and without admixtures, variables in proportioning and Exposure conditions, Selection criteria of ingredients used for mix design, Procedure of mix proportioning. Numerical Examples of Mix Proportioning using IS-10262	10 Hours	L1, L2, L3, L4
Module -5: Special Concretes		
RMC- manufacture and requirement as per QCI-RMCPCS, properties, advantages and disadvantages. Self-Compacting concrete- concept, materials, tests, properties, application and typical mix Fiber reinforced concrete - Fibers types, properties, application of FRC. Light weight concrete-material properties and types. Typical light weight concrete mix and applications	10 hours	L1, L2, L3, L4

Course Outcomes:

After studying this course, students will be able to:

CO1: Relate material characteristics and their influence on microstructure of concrete. (L2,L3)(PO1)

CO 2: Distinguish concrete behaviour based on its fresh and hardened properties. [L2, L4] (PO1, PO2)

CO 3: Illustrate proportioning of different types of concrete mixes for required fresh and hardened properties using professional codes. [L3] (PO1, PO2, PO3)

Program Objectives (as per NBA):

- Engineering Knowledge (PO1)
- Problem Analysis (PO2)
- Design / development of solutions (PO3)

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Neville A.M. “Properties of Concrete”-4th Ed., Longman.
2. M.S. Shetty, Concrete Technology - Theory and Practice Published by S. Chand and Company, New Delhi.
3. Kumar Mehta. P and Paulo J.M. Monteiro “Concrete-Microstructure, Property and Materials”, 4th Edition, McGraw Hill Education, 2014
4. A.R. Santha Kumar, “Concrete Technology”, Oxford University Press, New Delhi (New Edition)

Reference Books:

1. M L Gambir, “Concrete Technology”, McGraw Hill Education, 2014.
2. N. V. Nayak, A. K. Jain Handbook on Advanced Concrete Technology, ISBN: 978-81-8487-186-9
3. Job Thomas, “Concrete Technology”, CENGAGE Learning, 2015
4. IS 4926 (2003): Code of Practice Ready-Mixed Concrete [CED 2: Cement and Concrete]

5. Criteria for RMC Production Control, Basic Level Certification for Production Control of Ready Mixed Concrete-BMTPC
6. Specification and Guidelines for Self-Compacting Concrete, EFNARC, Association House

Course Title: Basic Geotechnical Engineering
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – IV

Subject Code	15CV45	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students

- To appreciate basic concepts of soil mechanics as an integral part in the knowledge of civil engineering. Also to become familiar broadly with geotechnical engineering problems such as, foundation engineering, flow of water through soil medium and terminologies associated with geotechnical engineering.
- To know the basic engineering properties and the mechanical behaviour of different types of soil. This includes strength-deformation characteristics under shearing stresses. Also consolidation properties of clayey soils.
- To determine the improvement in mechanical behaviour by densification of soil deposits using compaction.
- To know how the properties of soils that can be measured in the lab

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1: Introduction: Introduction, origin and formation of soil, Phase Diagram, phase relationships, definitions and their inter relationships. Determination of Index properties-Specific gravity, water content, in-situ density and particle size analysis (sieve and sedimentation analysis) Atterberg's Limits, consistency indices, relative density, activity of clay, Plasticity chart, unified and BIS soil classification.	**10 Hours**	**L1, L2**
Module -2 : Soil Structure and Clay Mineralogy		
Single grained, honey combed, flocculent and dispersed structures, Valence bonds, Soil-Water system, Electrical diffuse double layer, adsorbed water, base-exchange capacity, Isomorphous substitution. Common clay minerals in soil and their structures- Kaolinite, Illite and Montmorillonite and their application in Engineering **Compaction of Soils:** Definition, Principle of compaction, Standard and Modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, Field compaction control - compactive effort & method of compaction, lift thickness and number of passes, Proctor's needle, Compacting equipments and their suitability.	**10 Hours**	**L1, L2**
Module -3: Flow through Soils:		
Darcy's law- assumption and validity, coefficient of permeability and its determination (laboratory and field), factors affecting permeability, permeability of stratified soils, Seepage velocity,	**10 Hours**	**L1, L2, L3**

superficial velocity and coefficient of percolation, Capillary Phenomena **Seepage Analysis:** Laplace equation, assumptions, limitations and its derivation. Flow nets- characteristics and applications. Flow nets for sheet piles and below the dam section. Unconfined flow, phreatic line (Casagrande's method –with and without toe filter), flow through dams, design of dam filters. **Effective Stress Analysis**: Geostatic stresses, Effective stress concept-total stress, effective stress and Neutral stress and impact of the effective stress in construction of structures, quick sand phenomena		
Module -4: Consolidation of Soil:		
Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory - assumption and limitations. Derivation of Governing differential Equation Pre-consolidation pressure and its determination by Casagrande's method. Over consolidation ratio, normally consolidated, under consolidated and over consolidated soils. Consolidation characteristics of soil (C_c, a_v, m_v and $C_{v.}$ Laboratory one dimensional consolidation test, characteristics of e-log(σ') curve, Determination of consolidation characteristics of soils-compression index and coefficient of consolidation (square root of time fitting method, logarithmic time fitting method). Primary and secondary consolidation.	**10 Hours**	**L1, L2, L3, L4**
Module -5: Shear Strength of Soil:		
Concept of shear strength, Mohr–Coulomb Failure Criterion, Modified Mohr–Coulomb Criterion Concept of pore pressure, Total and effective shear strength parameters, factors affecting shear strength of soils. Thixotrophy and sensitivity, Measurement of shear strength parameters - Direct shear test, unconfined compression test, triaxial compression test and field Vane shear test, Test under different drainage conditions. Total and effective stress paths.	**10 Hours**	**L2, L3**

Course outcomes:

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

1. Will acquire an understanding of the procedures to determine index properties of any type of soil, classify the soil based on its index properties
2. Will be able to determine compaction characteristics of soil and apply that knowledge to assess field compaction procedures
3. Will be able to determine permeability property of soils and acquires conceptual knowledge about stresses due to seepage and effective stress; Also acquire ability to estimate seepage losses across hydraulic structure
4. Will be able to estimate shear strength parameters of different types of soils using the data of different shear tests and comprehend Mohr-Coulomb failure theory.
5. Ability to solve practical problems related to estimation of consolidation settlement of soil deposits also time required for the same.

Program Objectives (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- Interpretation of data.

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Gopal Ranjan and Rao A.S.R., Basic and Applied Soil Mechanics- (2000), New Age International (P) Ltd., Newe Delhi.
2. Punmia B C, Soil Mechanics and Foundation Engineering- (2012) , Laxmi Pulications.
3. Murthy V.N.S., Principles of Soil Mechanics and Foundation Engineering- (1996), 4th Edition, UBS Publishers and Distributors, New Delhi.
4. Braja, M. Das, Geotechnical Engineering; (2002), Fifth Edition, Thomson Business Information India (P) Ltd., India

Reference Books:

1. T.W. Lambe and R.V. Whitman, Soil Mechanics, John Wiley & Sons, 1969.
2. Donold P Coduto, Geotechnical Engineering- Phi Learning Private Limited, New Delhi
3. Shashi K. Gulathi & Manoj Datta, Geotechnical Engineering-. (2009), "Tata Mc Graw Hill.
4. Narasimha Rao A. V. & Venkatrahmaiah C, Numerical Problems, Examples and objective questions in Geotechnical Engineering-. (2000), Universities Press., Hyderabad.
5. Muni Budhu ,Soil Mechanics and Foundation Engg.- (2010), 3rd Edition, John Wiely & Sons

Course Title: **Advanced Surveying** [As per Choice Based Credit System (CBCS) scheme] SEMESTER – IV			
Subject Code	15CV46	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS – 04			

Course objectives: This course will enable students to:

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

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1: Curve Surveying		
Curves – Necessity – Types, Simple curves, Elements, Designation of curves, Setting out simple curves by linear methods (numerical problems on offsets from long chord & chord produced method), Setting out curves by Rankines deflection angle method (numerical problems). Compound curves, Elements, Design of compound curves, Setting out of compound curves (numerical problems). Reverse curve between two parallel straights (numerical problems on Equal radius and unequal radius). Transition curves Characteristics , numerical problems on Length of Transition curve, 7.5 Vertical curves –Types – (theory).	**10 Hours**	**L1,L3,L5**
Module -2: Geodetic Surveying and Theory of Errors		
Geodetic Surveying: Principle and Classification of triangulation system, Selection of base line and stations, Orders of triangulation, Triangulation figures, Reduction to Centre, Selection and marking of stations Theory of Errors: Introduction, types of errors, definitions, laws of accidental errors, laws of weights, theory of least squares, rules for giving weights and distribution of errors to the field observations, determination of the most probable values of quantities.	**10 Hours**	**L1,L2, L3**
Module -3: Introduction to Field Astronomy:		
Earth, celestial sphere, earth and celestial coordinate systems, spherical triangle, astronomical triangle, Napier's rule	**10 Hours**	**L4,L5**
Module -4: Aerial Photogrammetry		
Introduction, Uses, Aerial photographs, Definitions, Scale of vertical and tilted photograph (simple problems), Ground Co-ordinates (simple problems), Relief Displacements (Derivation), Ground control, Procedure of aerial survey, overlaps and mosaics,	**10 Hours**	**L2,L3, L5**

Stereoscopes, Derivation Parallax(Derivation) .		
Module -5: Modern Surveying Instruments		
Introduction, Electromagnetic spectrum, Electromagnetic distance measurement, Total station, Lidar scanners for topographical survey. Remote Sensing: Introduction, Principles of energy interaction in atmosphere and earth surface features, Image interpretation techniques, visual interpretation. Digital image processing, Global Positioning system Geographical Information System: Definition of GIS, Key Components of GIS, Functions of GIS, Spatial data, spatial information system Geospatial analysis, Integration of Remote sensing and GIS and Applications in Civil Engineering(transportation, town planning).	**10 Hours**	**L2,L3, L5**

Course outcomes:

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

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

Program Objectives (as per NBA)

- Engineering Knowledge.
- Problem Analysis.
- Interpretation of data.

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum Three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- The students shall answer Five full questions selecting one full question from each module.
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. B.C. Punmia, “Surveying Vol.2”, Laxmi Publications pvt. Ltd., New Delhi.
2. Kanetkar T P and S V Kulkarni , Surveying and Levelling Part 2, Pune Vidyarthi Griha Prakashan,
3. K.R. Arora, “Surveying Vol. 1” Standard Book House, New Delhi.
4. Sateesh Gopi, Global Positioning System, Tata McGraw Hill Publishing Co. Ltd. New Delhi

Reference Books:

1. S.K. Duggal, “Surveying Vol.I & II”, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
2. R Subramanian, Surveying and Leveling, Second edition, Oxford University Press, New Delhi.
3. David Clerk, Plane and Geodetic Surveying Vol1 and Vol2, CBS publishers
4. B Bhatia, Remote Sensing and GIS , Oxford University Press, New Delhi.
5. T.M Lillesand,. R.W Kiefer,. and J.W Chipman, Remote sensing and Image interpretation , 5th edition, John Wiley and Sons India

6. James M Anderson and Adward M Mikhail, Surveying theory and practice, 7th Edition, Tata McGraw Hill Publication.
7. Kang-tsung Chang, Introduction to geographic information systems, McGraw Hill Higher Education

Course Title: Fluid Mechanics and Hydraulic Machines Laboratory (0:1:2)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	15CVL47	IA Marks	20
Number of Lecture Hours/Week	03 (1hr tutorial + 2hr laboratory)	Exam Marks	80
Total Number of Lecture Hours	42	Exam Hours	03

CREDITS – 02

Course objectives: This course will enable students to;

1. calibrate flow measuring devices
2. determine the force exerted by jet of water on vanes
3. measure discharge and head losses in pipes
4. understand the fluid flow pattern

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
1. Verification of Bernoulli's equation	**3 Hours**	**L1, L2**
2. Determination of C_d for Venturimeter and Orifice meter	**3 Hours**	**L1, L2**
3. Determination of hydraulic coefficients of small vertical orifice	**3 Hours**	**L1, L2**
4. Calibration of Rectangular and Triangular notch	**3 Hours**	**L1, L2**
5. Calibration of Ogee and Broad crested weir	**3 Hours**	**L1, L2**
6. Determination of C_d for Venturiflume	**3 Hours**	**L1, L2**
7. Experimental determination of force exerted by a jet on flat and curved plates (Hemispherical Vane).	**3 Hours**	**L1, L2**
8. Experimental determination of operating characteristics of Pelton turbine	**3 Hours**	**L1, L2**
9. Determination of efficiency of Francis turbine	**3 Hours**	**L1, L2**
10. Determination of efficiency of Kaplan turbine	**3 Hours**	**L1, L2**
11. Determination of efficiency of centrifugal pump.	**3 Hours**	**L1, L2**
12. Determination of Major and Minor Losses in Pipes	**3 Hours**	**L1, L2**
13. Demonstration Experiments: a. Reynold's experiment to understand laminar and turbulent flow b. Flow Visualization c. Calibration of Sutro-weir	**6 Hours**	**L1, L2**

Course outcomes:

During the course of study students will develop understanding:

- Properties of fluids and the use of various instruments for fluid flow measurement.
- Working of hydraulic machines under various conditions of working and their characteristics.

Program Objectives (as per NBA):

- Engineering Knowledge.

- Problem Analysis.
- Design / development of solutions (partly).
- Interpretation of data.

Question paper pattern:

- All experiments are to be included in the examination except demonstration exercises.
- Candidate to perform experiment assigned to him
- Marks are to be allotted as per the split up of marks shown on the cover page of answer script

Text Books:

1. Sarbjit Singh , *Experiments in Fluid Mechanics* - PHI Pvt. Ltd.- New Delhi
2. Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press

Reference Books:

1. Hydraulics and Fluid Mechanics' – Dr. P.N. Modi & Dr S.M. Seth, Standard Book House- New Delhi. 2009 Edition

Course Title: Engineering Geology Laboratory (0:1:2)

[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – IV

Subject Code	**15CVL48**	IA Marks	20
Number of Lecture Hours/Week	03 (1hr tutorial + 2hr laboratory)	Exam Marks	80
Total Number of Lecture Hours	42	Exam Hours	03

CREDITS – 02

Course objectives: This course will enable students

1. To identify the minerals and rocks based on their inherent properties and uses in civil engineering
2. To interpret the geological maps related to civil engineering projects.
3. To learn the dip and strike, borehole problems, thickness of geological formation related to foundation, tunnels, reservoirs and mining.
4. To understand subsurface geological conditions through a geophysical techniques and watershed management.
5. To visit the civil engineering projects like dams, reservoirs, tunnels, quarry sites etc.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
1. Identification of minerals as mentioned in theory, their properties, uses and manufacturing of construction materials.	**6 Hours**	L1, L2
2. Identification of rocks as mentioned in theory, their engineering properties and uses in construction and decorative purposes	**6 Hours**	L2, L3
3. Dip and Strike problems: Determination of dip and strike direction in Civil Engineering projects (Railway lines, tunnels, dams, reservoirs) –graphical or any other method.	**6 Hours**	L4
4. Bore hole problems: Determination of subsurface behavior of rocks, their attitude related to foundation, tunnels, reservoirs and mining. Triangular and Square land, assuming ground is horizontal.	**6 Hours**	L3, L4, L5
5. Calculation of Vertical, True thickness and width of the outcrops.	**6 Hours**	L4, L5
6. Interpretation of Electrical resistivity curves to find out subsurface information such as thickness of soil, weathered zone, depth of hard rock and saturated zone	**4 Hours**	L3, L4
7. Interpretation of Toposheets and geological maps related to Civil Engineering projects.	**8 Hours**	L5, L6

Course outcomes:

During this course, students will develop expertise in;

1. Identifying the minerals and rocks and utilize them effectively in civil engineering practices.
2. Understanding and interpreting the geological conditions of the area for the

implementation of civil engineering projects.

3. Interpreting subsurface information such as thickness of soil, weathered zone, depth of hard rock and saturated zone by using geophysical methods.
4. The techniques of drawing the curves of electrical resistivity data and its interpretation for geotechnical and aquifer boundaries

Program Objectives (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- Interpretation of data.

Question paper pattern:

- All are individual experiments
- Instructions as printed on the cover page of answer script for split up of marks to be strictly followed.
- All exercises are to be included for practical examination.

Question Paper Pattern		
Qn. No.	**EXPERIMENT**	**MARKS (80)**
1	Identification of Minerals by giving their physical properties and civil engineering applications (5 minerals)	**20 (5 x 4)**
2	Identification of rocks by giving their physical properties, classification and their civil engineering applications (5 rocks)	**20 (5 x 4)**
3	Dip and strike problems	**6**
4	Bore hole problems (3 point method)	**10**
5	Thickness of strata problems including calculation of vertical, true thickness and its width of out crop.	**4**
6	Electrical resistivity curves drawing and its interpretation for Geotechnical and Aquifer investigations.	**6**
7	Interpretation of Toposheets	**5**
8	Geological maps, their cross sections and description	**10**
9	Viva voce	**5**

Note:
1) Question nos. 1,2,4,5.7, 8 & 9 are compulsory.
2) Among question no. 3 &6 any one shall be given.
3) Internal Assessment Marks=20: By conducing at least one test for 10 marks and remaining 10 marks for record.

Reference Books:

1. M P Billings, Structural Geology , CBS Publishers and Distributors, New Delhi
2. B.S.Satyanarayana Swamy , Engineering Geology Laboratory Manual , Dhanpat Rai Sons, New Delhi.
3. L R A Narayan, Remote sensing and its applications, University Press.
4. P.K.MUKERJEE, Text book of Geology , World Press Pvt. Ltd., Kolkatta
5. John I Platt and John Challinor, Simple Geological Structures, Thomas Murthy & Co, London

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM

CHOICE BASED CREDIT SYSTEM (CBCS)

CIVIL ENGINEERING BOARD

SCHEME OF TEACHING AND EXAMINATION

General Notes:

1. ***The teaching learning process should be as per the Choice Based Credit System***
2. ***All Civil Engineering Departments should have a "Civil Engineering Museum" with collections related to civil engineering like models, charts, material samples, fixtures and fittings etc. which assist effective teaching learning process.***
3. ***The teaching learning process may be planned to develop capabilities, competencies and skills required for career development based on course beginning and course end surveys.***
4. ***Course objectives, course outcomes and program objectives given under each course are broad and indicative.***
5. ***The course coordinator/teacher/instructors are informed to deliberate in the faculty meeting with module coordinator, program coordinator along with the stake holders to develop the respective course plans.***
6. ***The department advisory board may make suitable changes to the course objectives, course outcomes and program objectives according to their finalized course plans.***
7. ***The faculty should complement the teaching with case studies and field visits wherever required.***
8. ***One faculty development program to be conducted to compliment teaching learning process by the department in a year***

Faculty can send the valid comments with justification

on or before 10-07-2017

To:

1. Registrar VTU at registrar@vtu.ac.in
2. Chairman BOS at aswathmu@yahoo.com

Course Title: Design of RC Structural Elements [As per Choice Based Credit System (CBCS) scheme] SEMESTER:V			
Subject Code	15CV51	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS – 04		**Total Marks-100**	

Course objectives: This course will enable students to

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

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Introduction to Limit State Design and Serviceability: Introduction to working stress method, Difference between Working stress and Limit State Method of design, Modular Ratio and Factor of Safety. Philosophy and principle of limit state design with assumptions. Partial Safety factors, Characteristic load and strength. Stress block parameters, concept of balanced section, under reinforced and over reinforced section. Limiting deflection, short term deflection, long term deflection, Calculation of deflection of singly reinforced beam only. Cracking in reinforced concrete members, calculation of crack width of singly reinforced beam. Side face reinforcement, slender limits of beams for stability.	12 hours	L_1, L_2
Module -2		
Limit State Analysis of Beams: Analysis of singly reinforced, doubly reinforced and flanged beams for flexure and shear	8 Hours	L_2, L_4
Module -3		
Limit State Design of Beams: Design of singly and doubly reinforced beams, Design of flanged beams for shear, design for combined bending and torsion as per IS-456	10 Hours	L_2, L_4
Module -4		
Limit State Design of Slabs and Stairs: Introduction to one way and two way slabs, Design of cantilever, simply supported and one way continuous slab. Design of two way slabs for different boundary conditions. Design of dog legged and open well staircases. Importance of bond, anchorage length and lap length.	10 Hours	L_2, L_4

Module -5		
Limit State Deign of Columns and Footings: Analysis and design of short axially loaded RC column. Design of columns with uniaxial and biaxial moments, Design concepts of the footings. Design of Rectangular and square column footings with axial load and also for axial load & moment	10 Hours	L_2, L_4

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

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

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question paper pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.
- The designs are as per IS-456 and SP (16) relevant charts to be provided in the question paper

Text Books:

1. Unnikrishnan Pillai and Devdas Menon, "**Reinforced Concrete Design"**, McGraw Hill, New Delhi
2. Subramanian, "**Design of Concrete structures"**, Oxford university Press
3. H J Shah, **"Reinforced Concrete Vol 1 (Elementary Reinforced Concrete)"**, Charotar Publishing House Pvt. Ltd.

Reference Books:

1. P C Varghese, "Limit State design of reinforced concrete" , PHI, New Delhi
2. W H Mosley, R Husle, J H Bungey, "Reinforced Concrete Design", MacMillan Education, Palgrave publishers
3. Kong and Evans, "Reinforced and Pre-Stressed Concrete", Springer Publications
4. A W Beeby and Narayan R S, "Introduction to Design for Civil Engineers", CRC Press
5. Robert Park and Thomas Paulay, "Reinforced Concrete Structures", John Wiley & Sons, Inc.

Course Title: Analysis of Indeterminate Structures

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER:V

Subject Code	15CV52	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
	CREDITS – 04	**Total Marks-100**	

Course objectives: This course will enable students to

1. Ability to apply knowledge of mathematics and engineering in calculating slope, deflection, bending moment and shear force using slope deflection, moment distribution method and Kani's method.
2. Ability to identify, formulate and solve problems in structural analysis.
3. Ability to analyze structural system and interpret data.
4. Ability to use the techniques, such as stiffness and flexibility methods to solve engineering problems
5. Ability to communicate effectively in design of structural elements

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Slope Deflection Method: Introduction, sign convention, development of slope deflection equation, analysis of continuous beams including settlements, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy ≤ 3	10 hours	L_2, L_4,L_5
Module -2		
Moment Distribution Method: Introduction, Definition of terms, Development of method, Analysis of continuous beams with support yielding, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy ≤ 3	08 Hours	L_2, L_4,L_5
Module -3		
Kani's Method: Introduction, Concept, Relationships between bending moment and deformations, Analysis of continuous beams with and without settlements, Analysis of frames with and without sway	08 Hours	L_2, L_4,L_5
Module -4		
Matrix Method of Analysis (Flexibility Method) : Introduction, Axes and coordinates, Flexibility matrix, Analysis of continuous beams and plane trusses using system approach, Analysis of simple orthogonal rigid frames using system approach with static indeterminacy ≤ 3	12 Hours	L_2, L_4,L_5
Module -5		
Matrix Method of Analysis (Stiffness Method): Introduction, Stiffness matrix, Analysis of continuous beams and plane trusses using system approach, Analysis of simple orthogonal rigid frames using system approach with kinematic indeterminacy ≤ 3	12 Hours	L_2, L_4,L_5

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

1. Determine the moment in indeterminate beams and frames having variable moment of inertia and subsidence using slope defection method
2. Determine the moment in indeterminate beams and frames of no sway and sway using moment distribution method.
3. Construct the bending moment diagram for beams and frames by Kani's method.
4. Construct the bending moment diagram for beams and frames using flexibility method
5. Analyze the beams and indeterminate frames by system stiffness method.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question paper pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. Hibbeler R C, " Structural Analysis", Pearson Publication
2. L S Negi and R S Jangid, **"Structural Analysis",** *Tata McGraw-Hill* Publishing Company Ltd.
3. D S Prakash Rao, **"Structural Analysis: A Unified Approach"**, Universities Press
4. K.U. Muthu, H.Narendra etal, **"Indeterminate Structural Analysis",** IK International Publishing Pvt. Ltd.

Reference Books:

1. Reddy C S, "Basic Structural Analysis", *Tata McGraw-Hill* Publishing Company Ltd.
2. Gupta S P, G S Pundit and R Gupta, "Theory of Structures Vol II", Tata McGraw Hill Publications company Ltd.
3. V N Vazirani and M M Ratwani, "Analysis Of Structures Vol 2", Khanna Publishers
4. Wang C K, "Intermediate Structural Analysis", McGraw Hill, International Students Edition.
5. S.Rajasekaran and G. Sankarasubramanian, Computational Structural Mechanics, PHI Learning Pvt. Ltd.,

Course Title: Applied Geotechnical Engineering

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER:V

Subject Code	15CV53	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
	CREDITS – 04	**Total Marks-100**	

Course objectives: This course will enable students to

1. Appreciate basic concepts of soil mechanics as an integral part in the knowledge of Civil Engineering. Also to become familiar with foundation engineering terminology and understand how the principles of Geotechnology are applied in the design of foundations
2. Learn introductory concepts of Geotechnical investigations required for civil engineering projects emphasizing in-situ investigations
3. Conceptually learn various theories related to bearing capacity of soil and their application in the design of shallow foundations and estimation of load carrying capacity of pile foundation
4. Estimate internal stresses in the soil mass and application of this knowledge in proportioning of shallow and deep foundation fulfilling settlement criteria
5. Study about assessing stability of slopes and earth pressure on rigid retaining structures

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Soil Exploration: Introduction, Objectives and Importance, Stages and Methods of exploration- Test pits, Borings, Geophysical methods, stabilization of boreholes, Sampling techniques, Undisturbed, disturbed and representative samples, Geophysical exploration and Bore hole log. Drainage and Dewatering methods, estimation of depth of GWT (Hvorslev's method).	**10 Hours**	**L1,L2,L3**
Module -2		
Stress in Soils: Introduction, Boussinesq's and Westergaard's theory - concentrated load, circular and rectangular load, equivalent point load method, pressure distribution diagrams and contact pressure, Newmark's chart Foundation Settlement - Approximate method for stress distribution on a horizontal plane, Types of settlements and importance, Computation of immediate and consolidation settlement	**10 Hours**	**L2,L3,L4**
Module -3		
Lateral Earth Pressure: Active, Passive and earth pressure at rest, Rankine's theory for cohesionless and cohesive soils, Coulomb's theory, Rebhann's and Culmann's graphical construction. **Stability of Slopes :** Assumptions, infinite and finite slopes, factor of safety, use of Taylor's stability charts, Swedish slip circle method for C and C-ϕ (Method of slices) soils, Fellineous method for critical slip circle	**10 Hours**	**L2,L4,L5**

Module -4		
Bearing Capacity of Shallow Foundation: Types of foundations, determination of bearing capacity by Terzaghi's and BIS method (IS: 6403), Effect of water table and eccentricity, field methods - plate load test and SPT Proportioning of shallow foundations- isolated and combined footings (only two columns)	**10 Hours**	**L2,L4,L5,L6**
Module -5		
Pile Foundations: Types and classification of piles, single loaded pile capacity in cohesionless and cohesive soils by static formula, efficiency of file group, group capacity of piles in cohesionless and cohesive soils, negative skin friction, pile load tests, Settlement of piles, under reamed piles (only introductory concepts – no derivation)	**10 Hours**	**L2,L3,L4**

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

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

Program Objectives

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.
- Use of IS: 6403 shall be permitted.

Text Books:

1. Gopal Ranjan and Rao A.S.R., Basic and Applied Soil Mechanics, New Age International (P) Ltd., New Delhi.
2. Punmia B C, Soil Mechanics and Foundation Engineering, Laxmi Publications co., New Delhi.
3. Murthy V.N.S., Principles of Soil Mechanics and Foundation Engineering, UBS Publishers and Distributors, New Delhi.
4. Braja, M. Das, Geotechnical Engineering; Thomson Business Information India (P) Ltd., India

Reference Books:

1. T.W. Lambe and R.V. Whitman, Soil Mechanics-, John Wiley & Sons
2. Donald P Coduto, Geotechnical Engineering- Phi Learning Private Limited, New Delhi
3. Shashi K. Gulathi & Manoj Datta, Geotechnical Engineering-. , Tata McGraw Hill Publications
4. Debashis Moitra, “Geotechnical Engineering” , Universities Press.,
5. Malcolm D Bolton, “ A Guide to soil mechanics”, Universities Press.,
6. Bowles J E , Foundation analysis and design, McGraw- Hill Publications

Course Title: Computer Aided Building Planning and Drawing

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER: V

Subject Code	15CVL54	IA Marks	20
Number of Lecture Hours/Week	04 (1hr Instructions + 3hr Drawing)	Exam Marks	80
Total Number of Lecture/Practice Hours	50	Exam Hours	03
	CREDITS – 04	**Total Marks-100**	

Course objectives: Provide students with a basic understanding

- Achieve skill sets to prepare computer aided engineering drawings
- Understand the details of construction of different building elements.
- Visualize the completed form of the building and the intricacies of construction based on the engineering drawings.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module:1		
Drawing Basics: Selection of scales for various drawings, thickness of lines, dimensioning, abbreviations and conventional representations as per IS: 962 simple engineering drawings with CAD 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, Customising toolbars, Working with multiple drawings	**12 Hours**	**L1,L2**
Module:2		
Drawings Related To Different Building Elements: Following drawings are to be prepared for the data given using CAD Software a) Cross section of Foundation, masonry wall, RCC columns with isolated & combined footings. b) Different types of bonds in brick masonry c) Different types of staircases – Dog legged, Open well d) Lintel and chajja e) RCC slabs and beams f) Cross section of a pavement g) Septic Tank and sedimentation Tank	**12 Hours**	**L2,L3,L4,L5,L6**

h) Layout plan of Rainwater recharging and harvesting system i) Cross sectional details of a road for a Residential area with provision for all services j) Steel truss (connections Bolted) *Note: Students should sketch to dimension the above in a sketch book before doing the computer drawing*		
Module -3:		
Building Drawings: Principles of planning, Planning regulations and building bye-laws, factors affecting site selection, Functional planning of residential and public buildings, design aspects for different public buildings. Recommendations of NBC. Drawing of Plan, elevation and sectional elevation including electrical, plumbing and sanitary services *using CAD software* for: 1. Single and Double story residential building 2. Hostel building 3. Hospital building 4. School building 5. *Submission drawing (sanction drawing) of two storied residential building with access to terrace including all details and statements as per the local bye-laws* **Note:** • Students should sketch to dimension the above in a sketch book before doing the computer drawing • *One compulsory field visit/exercise to be carried out.* • Single line diagrams *to be given in the examination.*	**26 Hours**	**L2,L3,L4,L5,L6**
Course Outcomes: After studying this course, students will be able to 1. Gain a broad understanding of planning and designing of buildings 2. Prepare, read and interpret the drawings in a professional set up. 3. Know the procedures of submission of drawings and Develop working and submission drawings for building 4. Plan and design a residential or public building as per the given requirements		
Program Objectives • Engineering knowledge • Problem analysis • Interpretation of data		
Question paper pattern: • There will be two full questions with sub divisions if necessary from Module 2 with each full question carrying ***thirty*** marks. Students have to answer one question. • There will be two full questions from Module 3 with each full question carrying ***fifty*** marks. Students have to answer one question.		

Text book:

1. MG Shah, CM Kale, SY Patki, **"Building drawing with an integrated approach to Built Environment Drawing"**, Tata Mc Graw Hill Publishing co. Ltd., New Delhi
2. Gurucharan Singh, **"Building Construction",** Standard Publishers, & distributors, New Delhi.
3. Malik R S and Meo G S, **"Civil Engineering Drawing"**, Asian Publishers/Computech Publications Pvt Ltd.

Reference Books:

1. Time Saver Standard by Dodge F. W., F. W. Dodge Corp.,
2. IS: 962-1989 (Code of practice for architectural and building drawing)
3. **National Building Code**, BIS, New Delhi.

Course Title: Air Pollution and Control

Professional Elective-1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER:V

Subject Code	15CV551	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
	CREDITS – 03	**Total Marks-100**	

Course Objectives: This course will enable students to

- Study the sources and effects of air pollution
- Learn the meteorological factors influencing air pollution.
- Analyze air pollutant dispersion models
- Illustrate particular and gaseous pollution control methods.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Introduction: Definition, Sources, classification and characterization of air pollutants. Effects of air pollution on health, vegetation & materials. Types of inversion, photochemical smog.	8 hours	L1,L2
Module -2		
Meteorology: Temperature lapse rate & stability, wind velocity & turbulence, plume behavior, measurement of meteorological variables, wind rose diagrams, Plume Rise, estimation of effective stack height and mixing depths. Development of air quality models-Gaussian dispersion model	8 Hours	L1,L2,L3
Module -3		
Sampling: Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution), Monitoring and analysis of air pollutants ($PM_{2.5}$, PM_{10}, SO_X, NO_X, CO, NH_3)	8 Hours	L2,L3,L4
Module -4		
Control Techniques: Particulate matter and gaseous pollutants- settling chambers, cyclone separators, scrubbers, filters & ESP.	8 Hours	L3,L4
Module -5		
Air pollution due to automobiles, standards and control methods. Noise pollution-causes, effects and control, noise standards. Environmental issues, global episodes, laws, acts, protocols	8 Hours	L3,L4,L5,L6

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

1. Identify the major sources of air pollution and understand their effects on health and environment.
2. Evaluate the dispersion of air pollutants in the atmosphere and to develop air quality models.
3. Ascertain and evaluate sampling techniques for atmospheric and stack pollutants.
4. Choose and design control techniques for particulate and gaseous emissions.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question Paper Pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. M. N. Rao and H V N Rao, "Air pollution", Tata Mc-Graw Hill Publication.
2. H. C. Perkins, "Air pollution". Tata McGraw Hill Publication
3. Mackenzie Davis and David Cornwell, "Introduction to Environmental Engineering" McGraw-Hill Co.

Reference Books:

1. Noel De Nevers, "Air Pollution Control Engineering", Waveland Pr Inc.
2. Anjaneyulu Y, "Text book of Air Pollution and Control Technologies", Allied Publishers

Course Title: Railways, Harbour, Tunneling and Airports

Professional Elective-1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER:V

Subject Code	15CV552	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
	CREDITS – 03	**Total Marks-100**	

Course Objectives: This course will enable students to

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

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Railway Planning: Significance of Road, Rail, Air and Water transports – Coordination of all modes to achieve sustainability – Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, – Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys, conventional and modern methods- – Soil suitability analysis – Geometric design of railways, gradient, super elevation, widening of gauge on curves- Points and Crossings.	8 hours	L1,L2,L3
Module -2		
Railway Construction and Maintenance: Earthwork – Stabilization of track on poor soil, Calculation of Materials required for track laying – Construction and maintenance of tracks – Modern methods of construction & maintenance – Railway stations and yards and passenger amenities- Urban rail – Infrastructure for Metro, Mono and underground railways.	8 Hours	L2, L3
Module -3		
Harbour and Tunnel Engineering: Definition of Basic Terms: Planning and Design of Harbours: Requirements, Classification, Location and Design Principles – Harbour Layout and Terminal Facilities, Coastal Structures, Inland Water Transport – Wave action on Coastal Structures and Coastal Protection Works. Tunneling: Introduction, size and shape of the tunnel, tunneling methods in soils, tunnel lining, tunnel drainage and ventilation.	8 Hours	L1,L2,L3

Module -4		
Airport Planning: Air transport characteristics, airport classification, air port planning: objectives, components, layout characteristics, socio-economic characteristics of the catchment area, criteria for airport site selection and ICAO stipulations, typical airport layouts, Parking and circulation area.	8 Hours	L1,L2,L3
Module -5		
Airport Design : Runway Design: Orientation, Wind Rose Diagram, Runway length, Problems on basic and Actual Length, Geometric design of runways, Configuration and Pavement Design Principles, Elements of Taxiway Design, Airport Zones, Passenger Facilities and Services, Runway and Taxiway Markings and lighting.	8 Hours	L1,L2,L3

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

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

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question Paper Pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. Saxena Subhash C and Satyapal Arora, “A Course in Railway Engineering”, Dhanpat Rai and Sons, Delhi, 2003
2. Satish Chandra and Agarwal M.M, “Railway Engineering”, 2nd Edition, Oxford University Press, New Delhi, 2013.
3. Khanna S K, Arora M G and Jain S S, “Airport Planning and Design”, Nemchand and Brothers, Roorkee, 2012.
4. Bindra S P, “A Course in Docks and Harbour Engineering”, Dhanpat Rai and Sons, New Delhi, 2013

Reference Books:

1. Oza.H.P. and Oza.G.H., “A course in Docks & Harbour Engineering”. Charotar Publishing Co., 2013
2. Mundrey J.S. “A course in Railway Track Engineering”. Tata McGraw Hill, 2007.
3. Srinivasan R. Harbour, “Dock and Tunnel Engineering”, 26th Edition 2013

Course Title: Masonry Structures

Professional Elective-1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER:V

Subject Code	15CV553	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
	CREDITS – 03	**Total Marks-100**	

Course Objectives: This course will enable students to

1. Understand properties of masonry units, strength and factors affecting strength.
2. Understand design criteria of various types of wall subjected to different load system.
3. Impart the culture of following the codes for strength, serviceability and durability as an ethics.
4. Provide knowledge in analysis and design of masonry elements for the success in competitive examinations.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Masonry Units, Materials, types and masonry construction: Bricks, Stone and Block masonry units- strength, modulus of elasticity and water absorption of masonry materials – classification and properties of mortars. Defects and Errors in masonry construction – cracks in masonry, types, reason for cracking, methods of avoiding cracks. **Strength and Stability:** Strength and stability of axially loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of curing, effect of ageing, workmanship. Compressive strength formulae based on elastic theory and empirical formulae.	8 hours	L1,L2,L3
Module -2		
Permissible stresses: Types of walls, permissible compressive stress, stress reduction and shape modification factors, increase in permissible stresses for eccentric vertical and lateral load, permissible tensile stress and shear stresses. **Design Considerations:** Effective height of walls and columns, openings in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action in lintels. Problems on design considerations for solid walls, cavity walls, wall with pillars.	8 Hours	L1,L2,L3
Module -3		
Load considerations and design of Masonry subjected to axial loads: Design criteria, design examples of walls under UDL, solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers.	8 Hours	L1,L2,L3

Module -4		
Design of walls subjected to concentrated axial loads: Solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers, design of wall with openings. **Design of walls subjected to eccentric loads**: Design criteria – stress distribution under eccentric loads – problems on eccentrically loaded solid walls, cavity walls, walls with piers.	8 Hours	L2,L3,L4,L5
Module -5		
Design of Laterally and transversely loaded walls: Design criteria, design of solid wall under wind loading, design of shear wall – design of compound walls. Introduction to reinforced brick masonry, lintels and slabs. **In-filled frames**: Types – modes of failures – design criteria of masonry retaining walls.	8 Hours	L2,L3,L4,L5

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

1. Explain engineering properties and uses of masonry units, defects and crack in masonry and its remedial measures.
2. Summarize various formulae's for finding compressive strength of masonry units.
3. Explain permissible stresses and design criteria as per IS: 1905 and SP-20.
4. Design different types of masonry walls for different load considerations.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question Paper Pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- The students shall answer Five full questions selecting one full question from each module.
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.
- Use of **IS 1905–1987** "Code of practice for structural use of un-reinforced masonry" may be permitted.

Text Books:

1. Henry, A.W., "**Structural Masonry"**, Macmillan Education Ltd., 1990.

2. Dayaratnam P, **"Brick and Reinforced Brick Structures",** Oxford & IBH, 1987.

3. M. L. Gambhir, "**Building and Construction Materials",** Mc Graw Hill education Pvt. Ltd.

Reference Books:

1. IS 1905–1987 "Code of practice for structural use of un-reinforced masonry- (3rd revision) BIS, New Delhi.

2. SP 20 (S&T) – 1991, "Hand book on masonry design and construction (1^{st} revision) BIS, New Delhi.

Course Title: Theory of Elasticity

Professional Elective-1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER:V

Subject Code	15CV554	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
	CREDITS – 03	**Total Marks-100**	

Course Objectives: This course will enable students to

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

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Concepts of continuum, Stress at a point, Components of stress, Differential equations of equilibrium, Stress transformation, Principal stresses, Maximum shear stress, Stress invariants. Strain at a point, Infinitesimal strain, Strain-displacement relations, Components of strain, Compatibility Equations, Strain transformation, Principal strains, Strain invariants, Measurement of surface strains, strain rosettes	08 hours	L1, L2, L3
Module -2		
Generalized Hooke's Law, Stress-strain relationships, Equilibrium equations in terms of displacements and Compatibility equations in terms of stresses, Plane stress and plane strain problems, St. Venant's principle, Principle of superposition, Uniqueness theorem, Airy's stress function, Stress polynomials (Two Dimensional cases only)**.**	08 Hours	L1, L2, L3
Module -3		
Two-dimensional problems in rectangular coordinates, bending of a cantilever beam subjected to concentrated load at free end, effect of shear deformation in beams, Simply supported beam subjected to Uniformly distributed load. Two-dimensional problems in polar coordinates, strain-displacement relations, equations of equilibrium, compatibility equation, stress function.	08 Hours	L3, L4
Module -4		
Axisymmetric stress distribution - Rotating discs, Lame's equation for thick cylinder, Effect of circular hole on stress distribution in plates subjected to tension, compression and shear, stress concentration factor.	08 Hours	L3, L4

Module -5		
Torsion: Inverse and Semi-inverse methods, stress function, torsion of circular, elliptical, triangular sections	08 Hours	L3, L4

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

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

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question Paper Pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. S P Timoshenko and J N Goodier, “Theory of Elasticity”, McGraw-Hill International Edition, 1970.
2. Sadhu Singh, “Theory of Elasticity”, Khanna Publishers, 2012
3. S Valliappan, “Continuum Mechanics - Fundamentals”, Oxford & IBH Pub. Co. Ltd., 1981.
4. L S Srinath, “Advanced Mechanics of Solids”, Tata - McGraw-Hill Pub., New Delhi, 2003

Reference Books:

1. C. T. Wang, “Applied Elasticity”, Mc-Graw Hill Book Company, New York, 1953
2. G. W. Housner and T. Vreeland, Jr., “The Analysis of Stress and Deformation”, California Institute of Tech., CA, 2012. [Download as per user policy from http://resolver.caltech.edu/CaltechBOOK:1965.001]
3. A. C. Ugural and Saul K. Fenster, “Advanced Strength and Applied Elasticity”, Prentice Hall, 2003.
4. Abdel-Rahman Ragab and Salah Eldinin Bayoumi, “Engineering Solid Mechanics: Fundamentals and Applications”, CRC Press, 1998

Course Title: Traffic Engineering

Open Elective-1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER:V

Subject Code	15CV561	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
	CREDITS – 03	**Total Marks-100**	

Course Objectives: This course will enable students to

1. Understand fundamental knowledge of traffic engineering, scope and its importance.
2. describe basic techniques for collecting and analysing traffic data, diagnosing problems, designing appropriate remedial treatment, and assessing its effectiveness.
3. Apply probabilistic and queuing theory techniques for the analysis of traffic flow situations and emphasis the interaction of flow efficiency and traffic safety.
4. understand and analyse traffic issues including safety, planning, design, operation and control.
5. Apply intelligent transport system and its applications in the present traffic scenario.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Traffic Planning and Characteristics: Road Characteristics-Road user characteristics, PIEV theory, Vehicle Performance characteristics, Fundamentals of Traffic Flow, Urban Traffic problems in India, Integrated planning of town, country, regional and all urban infrastructures, Sustainable approach- land use & transport and modal integration.	8 hours	L1,L2,L3
Module -2		
Traffic Surveys: Traffic Surveys- Speed, journey time and delay surveys, Vehicles Volume Survey including non-motorized transports, Methods and interpretation, Origin Destination Survey, Methods and presentation, Parking Survey, Accident analyses-Methods, interpretation and presentation, Statistical applications in traffic studies and traffic forecasting, Level of service- Concept, applications and significance.	8 Hours	L1,L2,L3,L4,L5
Module -3		
Traffic Design and Visual Aids: Intersection Design- channelization, Rotary intersection design, Signal design, Coordination of signals, Grade separation, Traffic signs including VMS and road markings, Significant roles of traffic control personnel, Networking pedestrian facilities & cycle tracks.	8 Hours	L1,L2,L3,L4

Module -4		
Traffic Safety and Environment: Road accidents, Causes, effect, prevention, and cost, Street lighting, Traffic and environment hazards, Air and Noise Pollution, causes, abatement measures, Promotion and integration of public transportation, Promotion of non-motorized transport.	8 Hours	L1,L2,L3
Module -5		
Traffic Management: Area Traffic Management System, Traffic System Management (TSM) with IRC standards, Traffic Regulatory Measures, Travel Demand Management (TDM), Direct and indirect methods, Congestion and parking pricing, All segregation methods- Coordination among different agencies, Intelligent Transport System for traffic management, enforcement and education.	8 Hours	L1,L2,L3,L4

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

1. Understand the human factors and vehicular factors in traffic engineering design.
2. Conduct different types of traffic surveys and analysis of collected data using statistical concepts.
3. Use an appropriate traffic flow theory and to comprehend the capacity & signalized intersection analysis.
4. Understand the basic knowledge of Intelligent Transportation System.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question Paper Pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. Kadiyali.L.R. **"Traffic Engineering and Transport Planning**", Khanna Publishers, Delhi, 2013
2. S K Khanna and CEG Justo and A Veeraragavan, **"Highway Engineering**", Nem Chand and Bros.
3. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management.
4. Salter. R.I and Hounsell N.B, "**Highway Traffic Analysis and design**", Macmillan Press Ltd.1996.

Reference Books:

1. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, Principles of Highway Engineering and Traffic Analysis, Wiley India Pvt. Ltd., New Delhi, 2011
2. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi, 2010
3. SP:43-1994, IRC Specification, "Guidelines on Low-cost Traffic Management Techniques" for Urban Areas, 1994
4. John E Tyworth, "Traffic Management Planning, Operations and control", Addison Wesly Publishing Company, 1996
5. Hobbs.F.D. "Traffic Planning and Engineering", University of Brimingham, Peragamon Press Ltd, 2005

Course Title: Sustainability Concepts in Engineering

Open Elective 1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER:V

Subject Code	15CV562	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
	CREDITS – 03	**Total Marks-100**	

Course Objectives: This course will enable students to

1. Learn about the principles, indicators and general concept of sustainability.
2. Apprehend the local, regional and global impacts of unsustainable designs, products and processes.
3. Student shall be able to apply the sustainability concepts in engineering
4. Know built environment frameworks and their use
5. Understand how building and design is judged and valued by clients and stakeholders and how to implement sustainability.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Introduction: Sustainability - Introduction, Need and concept of sustainability, Social-environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Environmental legislations in India - Water Act, Air Act.	8 hours	L1,L2,L3
Module -2		
Global Environmental Issue: Resource degradation, Climate change, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print Carbon sequestration – Carbon capture and storage (CCS). Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking	8 Hours	L1,L2,L3
Module -3		
Sustainable Design: Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification- GRIHA & IGBC Certification for buildings, Energy efficient building design- Passive solar design technique, Thermal storage, Cooling strategies, high performance insulation. Sustainable cities, Sustainable transport.	8 Hours	L1,L2,L3,L4

Module -4		
Clean Technology and Energy: Energy sources: Basic concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy. Rainwater harvesting	8 Hours	L1,L2,L3
Module -5		
Green Engineering: Green Engineering concepts, Sustainable Urbanization, industrialization and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis.	8 Hours	L1,L2,L3

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

1. Learn the sustainability concepts, understand the role and responsibility of engineers in sustainable development
2. Quantify sustainability, and resource availability, Rationalize the sustainability based on scientific merits
3. Understand and apply sustainability concepts in construction practices, designs, product developments and processes across various engineering disciplines
4. Make a decision in applying green engineering concepts and become a lifelong advocate of sustainability in society

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question Paper Pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning

Reference Books:

1. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication
2. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
3. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
4. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
5. Malcolm Dowden, Climate Change and Sustainable Development: Law, Policy and Practice
6. Daniel A. Vallero and Chris Brasier, " Sustainable Design: The Science of Sustainability and Green Engineering", Wiley-Blackwell
7. Sustainable Engineering Practice: An Introduction, Committee on Sustainability, American Society of Civil Engineers

Course Title: Remote Sensing and GIS

Open Elective 1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER:V

Subject Code	15CV563	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
	CREDITS – 03	**Total Marks-100**	

Course Objectives: This course will enable students to

1. Understand the basic concepts of remote sensing
2. Analyze satellite imagery and extract the required units.
3. Extract the GIS data and prepare the thematic maps
4. Use the thematic maps for various applications

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Remote Sensing:-Basic concept of Remote sensing, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features(soil, water, vegetation),Indian Satellites and Sensors characteristics, Resolution, Map and Image and False color composite, introduction to digital data, elements of visual interpretation techniques.	8 hours	L1, L2,L3
Module -2		
Remote Sensing Platforms, Sensors and Properties of Digital Data, Data Formats: Introduction, platforms- IRS, Landsat, SPOT, Cartosat, Ikonos, Envisat etc. Sensors-active and passive, MSS, AVHRR, LISS, TM, PAN, WIFS, microwave sensors, sensor resolutions (spatial, spectral, radiometric and temporal). Basics of digital image processing- radiometric and geometric corrections. Image enhancements, image transforms based on arithmetic operations, image filtering.	8 Hours	L2,L3,L4
Module -3		
Geographic Information System: Introduction to GIS; components of a GIS ; Geo spatial Data: Spatial Data- Attribute data-Joining Spatial and attribute data; GIS Operations: Spatial Data Input – Attribute data Management -Data display Data Exploration – Data Analysis. Coordinate Systems: Geographic coordinate System: approximation of the Earth, Datum; Map Projections: Types of Map Projections – Map projection parameters – Commonly used Map Projections- Projected coordinate Systems.	8 Hours	L2,L3,L4

Module -4		
Vector and Raster Data Model: Vector data model: Representation of simple features – Topology and its importance; coverage and its data structure, Shape file; Data models for composite feature Objects based Vector Data Model. Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data conversion, Integration of Raster and Vector data.	8 Hours	L3,L4,L5
Module -5		
Integrated Applications of Remote sensing and GIS: Applications in land use land cover analysis, change detection, water resources, urban planning, environmental planning, Natural resource management and Traffic management.	8 Hours	L3,L4,L5,L6

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

1. Collect data and delineate various elements from the satellite imagery using their spectral signature.
2. Analyze different features of ground information to create raster or vector data.
3. Perform digital classification and create different thematic maps for solving specific problems
4. Make decision based on the GIS analysis on thematic maps.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question paper pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. Narayan Panigrahi, **"Geographical Information Science**", ISBN 10: 8173716285 / ISBN 13: 9788173716287, University Press 2008.
2. Basudeb Bhatta, **"Remote sensing and GIS"**, ISBN:9780198072393, Oxford University Press 2011
3. Kang – Tsurg Chang, **"Introduction to Geographic Information System".** Tata McGraw Hill Eduction Private Limited 2015.
4. Lillesand, Kiefer, Chipman, "Remote Sensing and Image Interpretation", Wiley 2011.

Reference Books:

1. Chor Pang Lo and Albert K.W Yeung, "Concepts & Techniques of GIS", PHI, 2006
2. John R. Jensen, "Remote sensing of the environment", An earth resources perspective – 2nd edition – by Pearson Education 2007.
3. Anji Reddy M., "Remote sensing and Geograperhical information system", B.S. Publications 2008.
4. Peter A. Burrough, Rachael A. McDonnell, and Christopher D. Lloyd, "Principals of Geo physical Information system", Oxford Publications 2004.
5. S Kumar, "Basics of remote sensing & GIS", Laxmi publications 2005.

Course Title: Occupational Health and Safety

Open Elective 1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER:V

Subject Code	15CV564	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
	CREDITS – 03	**Total Marks-100**	

Course Objectives: This course will enable students to

1. Gain an historical, economic, and organizational perspective of occupational safety and health;
2. Investigate current occupational safety and health problems and solutions.
3. Identify the forces that influence occupational safety and health.
4. Demonstrate the knowledge and skills needed to identify workplace problems and safe work practice

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Occupational Hazard and Control Principles: Safety, History and development, National Safety Policy. Occupational safety and Health Act (OSHA), Occupational Health and Safety administration - Laws governing OSHA and right to know. **Accident –** causation, investigation, investigation plan, Methods of acquiring accident facts, Supervisory role in accident investigation	8 hours	L1,L2,L3
Module -2		
Ergonomics at Work Place: Ergonomics Task analysis, Preventing Ergonomic Hazards, Work space Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs. **Hazard cognition and Analysis,** Human Error Analysis – Fault Tree Analysis – Emergency Response - Decision for action – purpose and considerations	8 Hours	L2,L3,L4,L5
Module -3		
Fire Prevention and Protection: Fire Triangle, Fire Development and its severity, Effect of Enclosures, early detection of Fire, Classification of fire and Fire Extinguishers. **Electrical Safety, Product Safety:** Technical Requirements of Product safety.	8 Hours	L2,L3,L4,L5
Module -4		
Health Considerations at Work Place: types of diseases and their spread, Health Emergency. **Personal Protective Equipment (PPE)** – types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste. Environment management plans (EMP) for safety and sustainability	8 Hours	L2,L3,L4,L5

Module -5		
Occupational Health and Safety Considerations: Water and wastewater treatment plants, Handling of chemical and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing industries like cement plants, RMC Plants, precast plants and construction sites. Policies, roles and responsibilities of workers, managers and supervisors	8 Hours	L3,L4,L5.L6

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

1. Identify hazards in the workplace that pose a danger or threat to their safety or health, or that of others.
2. Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.
3. Present a coherent analysis of a potential safety or health hazard both verbally and in writing, citing the occupational Health and Safety Regulations as well as supported legislation.
4. Discuss the role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors.
5. Identify the decisions required to maintain protection of the environment, workplace as well as personal health and safety.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question Paper Pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. Goetsch D.L., (1999), “Occupational Safety and Health for Technologists, Engineers and Managers”, Prentice Hall.
2. Heinrich H.W., (2007), “Industrial Accident Prevention - A Scientific Approach”, McGraw-Hill Book Company
3. National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991), “Industrial Safety and Pollution Control Handbook

Reference Books:

1. Colling D.A., (1990), “Industrial Safety Management and Technology”, Prentice Hall, New Delhi.
2. Della D.E., and Giustina, (1996), “Safety and Environmental Management”, Van Nostrand Reinhold International Thomson Publishing Inc.

Course Title: Geotechnical Engineering Lab

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER: V

Subject Code	15CVL57	IA Marks	20
Number of Lecture Hours/Week	03 (1hr tutorial + 2hr laboratory)	Exam Marks	80
Total Number of Lecture Hours	42	Exam Hours	03
	CREDITS – 02	**Total Marks-100**	

Course Objectives: Provide students with a basic understanding

- To carry out laboratory tests and to identify soil as per IS codal procedures
- To perform laboratory tests to determine index properties of soil
- To perform tests to determine shear strength and consolidation characteristics of soils

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
1. Visual soil classification. Water content determination by oven drying method and infrared moisture method. Specific gravity test (pycnometer and density bottle method).	**6 Hours**	**L1, L2**
2. Grain size analysis i. Sieve analysis ii. Hydrometer analysis	**3 Hours**	**L1, L2**
3. In-situ density tests i. Core-cutter method ii. Sand replacement method	**3 Hours**	**L1, L2**
4. Consistency limits i. Liquid limit test (by Casagrande's and cone penetration method) ii. Plastic limit test iii. Shrinkage limit test	**3 Hours**	**L1, L2**
5. Standard compaction test (light and heavy compaction)	**3 Hours**	**L1, L2**
6. Co-efficient of permeability test i. Constant head test ii. Variable head test	**3 Hours**	**L1, L2**
7. Shear strength tests i. Unconfined compression test ii. Direct shear test iii. Triaxial test (undrained unconsolidated)	**9 Hours**	**L1, L2**

8. Consolidation test : Determination of compression index and co-efficient of consolidation	**3 Hours**	**L1, L2**
9. Laboratory vane shear test	**3 Hours**	**L1, L2**
10. Demonstration of Swell pressure test, Standard penetration test and boring equipment	**6 Hours**	**L1, L2**

Course Outcomes: Students will be able to conduct appropriate laboratory/field experiments and interpret the results to determine

1. Physical and index properties of the soil
2. Classify based on index properties and field identification
3. To determine OMC and MDD, plan and assess field compaction program
4. Shear strength and consolidation parameters to assess strength and deformation characteristics
5. In-situ shear strength characteristics (SPT- Demonstration)

Reference Books:

1. Punmia B C, Soil Mechanics and Foundation Engineering- (2017), 16th Edition, Laxmi Publications co., New Delhi.
2. Lambe T.W., "Soil Testing for Engineers", Wiley Eastern Ltd., New Delhi.
3. Head K.H., "Manual of Soil Laboratory Testing" Vol. I, II, III, Princeton Press
4. Bowles J.E., "Engineering Properties of Soil and Their Measurements",- McGraw Hill Book Co. New York.
5. Relevant BIS Codes of Practice: 2720(Part-3/Sec. 1) – 1987; IS 2720 (Part – 2)- 1973; IS 2720 (Part – 4) – 1985; IS 2720 (Part – 5) – 1985; IS 2720 (Part – 6) – 1972; IS 2720 (Part – 7) – 1980; IS 2720 (Part – 8) – 1983; IS 2720 (Part – 17) – 1986; IS 2720 (Part - 10) – 1973; IS 2720 (Part – 13) – 1986; IS2720 (Part 11) – 1971; IS2720 (Part 15) – 1986; IS 2720 (Part 30) – 1987; IS 2720 (Part 14) – 1977; IS 2720 (Part – 14) – 1983; IS 2720 (Part – 28) – 1974; IS 2720 (Part – 29) – 1966, IS 2720 (Part-60) 1965.

Course Title: Concrete and Highway materials Laboratory

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER: V

Subject Code	15CVL58	IA Marks	20
Number of Lecture Hours/Week	03 (1hr tutorial + 2hr laboratory)	Exam Marks	80
Total Number of Lecture Hours	42	Exam Hours	03
	CREDITS – 02	**Total Marks-100**	

Course objectives:

- To learn the principles and procedures of testing Concrete and Highway materials and to get hands on experience by conducting the tests and evolving inferences.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Part A: Concrete Lab		
1. Tests on Cement: a. Normal Consistency b. setting time c. compressive strength d. fineness by air permeability test e. specific gravity	**6 Hours**	**L1, L2**
2. Tests on Concrete: a. Design of concrete mix as per IS-10262 b. Tests on fresh concrete: i. slump, ii. compaction factor and iii. Vee Bee test c. Tests on hardened concrete: i. compressive strength test, ii. split tensile strength test, iii. flexural strength test d. NDT tests by rebound hammer and pulse velocity test.	**9 Hours**	L2,L3
3. Tests on Self Compacting Concrete: a. Design of self compacting concrete, b. slump flow test, c. V-funnel test, d. J-Ring test, e. U Box test and f. L Box test	**3 Hours**	L2,L3

Part B: High way materials Lab		
1. Tests on Aggregates a. Aggregate Crushing value b. Los Angeles abrasion test c. Aggregate impact test d. Aggregate shape tests (combined index and angularity number)	**3 Hours**	**L1, L2**
2. Tests on Bituminous Materials a. Penetration test b. Ductility test c. Softening point test d. Specific gravity test e. Viscosity test by tar viscometer f. Bituminous Mix Design by Marshall Method (Demonstration only)	**9 Hours**	**L1, L2,L3**
3. Tests on Soil a. Wet sieve analysis b. CBR test	**6 Hours**	**L1, L2**

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

1. Conduct appropriate laboratory experiments and interpret the results
2. Determine the quality and suitability of cement
3. Design appropriate concrete mix
4. Determine strength and quality of concrete
5. Test the road aggregates and bitumen for their suitability as road material.
6. Test the soil for its suitability as sub grade soil for pavements.

Reference Books:

1. M.L.Gambir, **"Concrete Manual",** Danpat Rai and sons, New Delhi
2. Shetty M.S, **"Concrete Technology"**, S. Chand & Co. Ltd, New Delhi.
3. Mehta P.K, **"Properties of Concrete",** Tata McGraw Hill Publications, New Delhi.
4. Neville AM, **"Properties of Concrete",** ELBS Publications, London.
5. Relevant BIS codes.
6. S K Khanna, C E G Justo and A Veeraragavan, **"Highway Materials Testing Laboratory Manual**", Nem Chand Bros, Roorkee
7. L R Kadiyali, **"Highway Engineering**", Khanna Publishers, New Delhi
8. Relevant IRC Codes
9. Specifications for Roads and Bridges-MoRT&H, IRC, New Delhi

Course Title: Construction Management and Entrepreneurship
As per Choice Based Credit System (CBCS) scheme]
SEMESTER:VI

Subject Code	15CV61	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS –04		**Total Marks - 100**	

Course Objectives: This course will enable students to

1. Understand the concept of planning, scheduling, cost and quality control, safety during construction, organization and use of project information necessary for construction project.
2. Inculcate Human values to grow as responsible human beings with proper personality.
3. Keep up ethical conduct and discharge professional duties.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Management: Characteristics of management, functions of management, importance and purpose of planning process, types of plans **Construction Project Formulation:** Introduction to construction management, project organization, management functions, management styles **Construction Planning and Scheduling:** Introduction, types of project plans, work breakdown structure, Grant Chart, preparation of network diagram- event and activity based and its critical path-critical path method, concept of activity on arrow and activity on node.	10 hours	L1,L2,L3
Module -2		
Resource Management: Basic concepts of resource management, class of labour, Wages & statutory requirement, Labour Production rate or Productivity, Factors affecting labour output or productivity. **Construction Equipments:** classification of construction equipment, estimation of productivity for: excavator, dozer, compactors, graders and dumpers. Estimation of ownership cost, operational and maintenance cost of construction equipments. Selection of construction equipment and basic concept on equipment maintenance **Materials:** material management functions, inventory management.	10 Hours	L1,L2,L3
Module -3		
Construction Quality , safety and Human Values: Construction quality process, inspection, quality control and quality assurance, cost of quality, ISO standards. Introduction to concept of Total Quality Management **HSE:** Introduction to concepts of HSE as applicable to Construction. Importance of safety in construction , Safety measures to be taken during Excavation , Explosives , drilling and blasting , hot bituminous works , scaffolds / platforms / ladder , form work and equipment operation. Storage of materials. Safety through legislation, safety campaign. Insurances. **Ethics :** Morals, values and ethics, integrity, trustworthiness , work ethics, need of engineering ethics, Professional Duties, Professional and Individual Rights, Confidential and Proprietary Information, Conflict of Interest Confidentiality, Gifts and Bribes, Price Fixing, Whistle Blowing.	10 Hours	L1,L2,L3
Module -4		
Introduction to engineering economy : Principles of engineering economics, concept on Micro and macro analysis, problem solving and decision making. **Interest and time value of money:** concept of simple and compound interest, interest formula for: single payment, equal payment and uniform gradient series. Nominal and effective interest rates, deferred annuities, capitalized cost. **Comparison of alternatives :** Present worth, annual equivalent , capitalized and rate of return methods , Minimum Cost analysis and break even analysis	10 Hours	L1,L2,L3

Module -5

Entrepreneurship: Evolution of the concept, functions of an entrepreneur, concepts of entrepreneurship, stages in entrepreneurial process, different sources of finance for entrepreneur, central and state level financial institutions. **Micro, Small & Medium Enterprises (MSME):** definition, characteristics, objectives, scope, role of MSME in economic development, advantages of MSME, Introduction to different schemes: TECKSOK, KIADB, KSSIDC, DIC, Single Window Agency: SISI, NSIC, SIDBI, KSFC **Business Planning Process:** Business planning process, marketing plan, financial plan, project report and feasibility study, guidelines for preparation of model project report for starting a new venture. Introduction to international entrepreneurship opportunities , entry into international business , exporting , direct foreign investment , venture capital	10 Hours	L1,L2,L3

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

1. Understand the construction management process.
2. Understand and solve variety of issues that are encountered by every professional in discharging professional duties.
3. Fulfill the professional obligations effectively with global outlook

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question Paper Pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. P C Tripathi and P N Reddy, “Principles of Management”, Tata McGraw-Hill Education
2. Chitkara, K.K, “Construction Project Management: Planning Scheduling and Control”, Tata McGraw-Hill Publishing Company, New Delhi.
3. Poornima M. Charantimath , “Entrepreneurship Development and Small Business Enterprise”, Dorling Kindersley (India) Pvt. Ltd., Licensees of Pearson Education
4. Dr. U.K. Shrivastava “Construction Planning and Management”, Galgotia publications Pvt. Ltd. New Delhi.
5. Bureau of Indian standards – IS 7272 (Part-1)- 1974 : Recommendations for labour output constant for building works :

Reference Books:

1. Robert L Peurifoy, Clifford J. Schexnayder, Aviad Shapira, Robert Schmitt, “Construction Planning, Equipment, and Methods (Civil Engineering), McGraw-Hill Education
2. Harold Koontz, Heinz Weihrich, “Essentials of Management: An International, Innovation, and Leadership perspective”, T.M.H. Edition, New Delhi
3. Frank Harris, Ronald McCaffer with Francis Edum-Fotwe, “ Modern Construction Management”, Wiley-Blackwell
4. Mike Martin, Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill Education
5. Chris Hendrickson and Tung Au, “Project Management for Construction - Fundamentals Concepts for Owners, Engineers, Architects and Builders”, Prentice Hall, Pitsburgh
6. James L.Riggs , David D. Bedworth , Sabah U. Randhawa “ Engineerng Economics” 4 ed tata Mc Graw hill.
7. S.C Sharma –“Construction Equipments and its management” – Khanna publishers

Course Title: Design of Steel Structural Elements
As per Choice Based Credit System (CBCS) scheme]
SEMESTER:VI

Subject Code	15CV62	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS –04		**Total Marks- 100**	

Course Objectives: This course will enable students to

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

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Introduction: Advantages and Disadvantages of Steel Structures, Limit state method Limit State of Strength, Structural Stability, Serviceability Limit states, Failure Criteria of steel, Design Consideration, Loading and load combinations, IS code provisions, Specification and Section classification. **Plastic Behaviour of Structural Steel:** Introduction, Plastic theory, Plastic Hinge Concept, Plastic collapse load, load factor, Shape factor, Theorem of plastic collapse, Methods of Plastic analysis, Plastic analysis of Continuous Beams.	10 hours	L1,L2,L3
Module -2		
Bolted Connections: Introduction, Types of Bolts, Behaviour of bolted joints, Design of High Strength friction Grip(HSFG) bolts, Design of Simple bolted Connections (Lap and Butt joints) **Welded Connections:** Introduction, Types and properties of welds, Effective areas of welds, Weld Defects, Simple welded joints for truss member, Advantages and Disadvantages of Bolted and Welded Connections.	10 Hours	L1,L2,L3
Module -3		
Design of Compression Members: Introduction, Failure modes, Behaviour of compression members, Sections used for compression members, Effective length of compression members, Design of compression members and built up Compression members, Design of Laced and Battened Systems.	10 Hours	L1,L2,L3
Module -4		
Design of Tension Members: Introduction, Types of Tension members, Slenderness ratio, Modes of Failure, Factors affecting the strength of tension members, Design of Tension members and Lug angles, Splices, Gussets. **Design of Column Bases:** Design of Simple Slab Base and Gusseted Base.	10 Hours	L1,L2,L3
Module -5		
Design of Beams: Introduction, Beam types, Lateral Stability of beams, factors affecting lateral stability, Behaviour of Beams in Bending, Design strength of laterally supported beams in Bending, Design of Laterally unsupported Beams [No Numerical Problems], Shear Strength of Steel Beams. Beam to Beam Connections, Beam to Column Connection and Column Splices [No Numerical Problems]	10 Hours	L1,L2,L3

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

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

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question Paper Pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. N Subramanian., "Design of Steel Structures" (2016), Oxford University Press, New Delhi.
2. Duggal S K., "Limit State Method of Design of Steel Structures", Tata McGraw Hill, New Delhi

Reference Books:

1. Dayarathnam P, "Design of Steel Structures", S Chand and Company Ltd., New Delhi.
2. Kazim S M A and Jindal R S, "Design of Steel Structures", Prentice Hall of India, New Delhi.
3. IS 800-2007: General Construction in Steel Code Practice (Third revision), Bureau of Indian Standards, New Delhi.

Course Title: Highway Engineering

As per Choice Based Credit System (CBCS) scheme]

SEMESTER:VI

Subject Code	15CV63	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS –04		**Total Marks- 100**	

Course objectives: This course will enable students to;

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

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Principles of Transportation Engineering: Importance of transportation, Different modes of transportation and comparison, Characteristics of road transport Jayakar committee recommendations, and implementation – Central Road Fund, Indian Roads Congress, Central Road Research Institute **Highway Development and Planning:** Road types and classification, road patterns, planning surveys, master plan – saturation system of road planning, phasing road development in India, problems on best alignment among alternate proposals Salient Features of 3rd and 4thtwenty year road development plans and Policies, Present scenario of road development in India (NHDP & PMGSY) and in Karnataka (KSHIP & KRDCL) Road development plan - vision 2021.	10 hours	L1,L2
Module -2		
Highway Alignment and Surveys: Ideal Alignment, Factors affecting the alignment, Engineering surveys-Map study, Reconnaissance, Preliminary and Final location & detailed survey, Reports and drawings for new and re-aligned projects **Highway Geometric Design:** Cross sectional elements–width, surface, camber, Sight distances–SSD, OSD, ISD, HSD, Design of horizontal and vertical alignment–curves, super-elevation, widening, gradients, summit and valley curves	10 Hours	L2,L3,L4
Module -3		
Pavement Materials: Subgrade soil - desirable properties-HRB soil classification-determination of CBR and modulus of subgrade reaction with Problems Aggregates- Desirable properties and tests, Bituminous materials-Explanation on Tar, bitumen, cutback and emulsion-tests on bituminous material **Pavement Design:** Pavement types, component parts of flexible and rigid pavements and their functions, ESWL and its determination (Graphical method only)-Examples	10 Hours	L3,L4,L5
Module -4		
Pavement Construction: Design of soil aggregate mixes by Rothfuch's method. Uses and properties of bituminous mixes and cement concrete in pavement construction. Earthwork; cutting and Filling, Preparation of subgrade, Specification and construction of i) Granular Sub base, ii) WBM Base, iii) WMM base, iv) Bituminous Macadam, v) Dense Bituminous Macadam vi) Bituminous Concrete, vii) Dry Lean Concrete sub base and PQC viii) concrete roads	10 Hours	L2,L3,L4

Module -5		
Highway Drainage: Significance and requirements, Surface drainage system and design-Examples, sub surface drainage system, design of filter materials, Types of cross drainage structures, their choice and location **Highway Economics:** Highway user benefits, VOC using charts only-Examples, Economic analysis - annual cost method-Benefit Cost Ratio method-NPV-IRR methods- Examples, Highway financing-BOT-BOOT concepts	10 Hours	L1,L2,L3

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

1. Acquire the capability of proposing a new alignment or re-alignment of existing roads, conduct necessary field investigation for generation of required data.
2. Evaluate the engineering properties of the materials and suggest the suitability of the same for pavement construction.
3. Design road geometrics, structural components of pavement and drainage.
4. Evaluate the highway economics by few select methods and also will have a basic knowledge of various highway financing concepts.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question Paper Pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. S K Khanna and C E G Justo, " Highway Engineering", Nem Chand Bros, Roorkee
2. L R Kadiyali, "Highway Engineering", Khanna Publishers, New Delhi.
3. R Srinivasa Kumar, "Highway Engineering", University Press.
4. K.P.subramanium, "Transportation Engineering", SciTech Publications, Chennai.

Reference Books:

1. Relevant IRC Codes
2. Specifications for Roads and Bridges-MoRT&H, IRC, New Delhi.
3. C. JotinKhisty, B. Kent lal, "Transportation Engineering", PHI Learning Pvt. Ltd. New Delhi.

Course Title: Water Supply and Treatment Engineering As per Choice Based Credit System (CBCS) scheme] SEMESTER:VI			
Subject Code	15CV64	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS –04		**Total Marks- 100**	

Course objectives: This course will enable students to

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

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Introduction: Need for protected water supply. Demand of Water: Types of water demands -domestic demand, industrial, institutional and commercial, public use, fire demand, Factors affecting per capita demand, Variations in demand of water, Peak factor, Design period and factors governing design period. Different methods of population forecasting -with merits and demerits. Numerical Problems.	10 hours	L1,L2,L3
Module -2		
Water Treatment: Objectives, Treatment flow chart – significance of each unit Sources and Characteristics: surface and subsurface sources -suitability with regard to quality and quantity. Sampling - Objectives, methods, Preservation techniques. Water quality characteristics: Physical, Chemical and Microbiological.	10 Hours	L1,L2,L3
Module -3		
Sedimentation -theory, settling tanks, types, design. Concept of Plate and Tube settlers. Coagulation aided sedimentation-types of coagulants, chemical feeding, flash mixing, Clarriflocculators . Filtration: mechanism -theory of filtration, types of filters, slow sand, rapid sand and pressure filters including construction, operation, cleaning. Operational problems in filters. Design of slow and rapid sand filter without under drainage system. Ultra and micro filtration: Basic principles, membrane materials, pore size, flux, normalizing permeability, fouling mechanism, Overview of ultra and micro filtration elements and systems, Fouling in MF/UF systems, fouling control and pre treatment.	10 Hours	L1,L2,L3
Module -4		
Softening: Overview of Lime soda, Zeolite process, RO and Nano filtration: Basic principles, Flux, Salt passage, rejection and concentration polarization. Overview of RO and nano filtration membranes and elements, Conventional pre treatment techniques for RO and nano filtration. Disinfection: Methods of disinfection with merits and demerits, Theory of disinfection, emphasis on treatment of water for community bathing. (melas and fairs) Fluoridation and De-fluoridation.	10 Hours	L1,L2,L3
Module -5		
Collection and Conveyance of water: Intake structures - types of intakes –Factors to be considered in selection of intake structures. Pumps: Types of pumps with working principles. Numerical Problems. Pipes: Design of the economical diameter for the rising main; Numerical Problems. Pipe appurtenances, Valves, Fire hydrants Pipe materials: Different materials with advantages and disadvantages. Factors affecting selection of pipe material. Distribution system: Methods- Gravity, Pumping, Combined gravity and pumping system, Service reservoirs and their capacity determination. Visit to Intake structure, Water treatment plant and report working of each unit Design of water treatment plant units and distribution system with population forecasting for the given city	10 Hours	L1,L2,L3

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

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

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question Paper Pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. S.K.Garg, Environmental Engineering vol-I, Water supply Engineering – M/s Khanna Publishers, New Delhi 2010
2. Mark.J Hammer, Water & Waste Water Technology, John Wiley & Sons Inc., New York, 2008.

Reference Books:

1. B.C. Punmia and Ashok Jain, Environmental Engineering I-Water Supply Engineering, Laxmi Publications (P)Ltd., New Delhi 2010.
2. Howard S. Peavy, Donald R. Rowe, George T , Environmental Engineering - McGraw Hill International Edition. New York, 2000
3. CPHEEO Manual on water supply and treatment engineering, Ministry of Urban Development, Government of India, New Delhi.

Course Title: Solid Waste Management

As per Choice Based Credit System (CBCS) scheme]

SEMESTER:VI

Subject Code	15CV651	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
CREDITS –03		**Total Marks- 100**	

Course objectives: This course will enable students to

1. Study the present methods of solid waste management system and to analyze their draw backs comparing with statutory rules.
2. Understand different elements of solid waste management from generation of solid waste to disposal.
3. Analyze different processing technologies and to study conversion of municipal solid waste to compost or biogas.
4. Evaluate landfill site and to study the sanitary landfill reactions.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Sources: Sources of Solid waste, Types of solid waste, Physical and Chemical composition of municipal solid waste. Generation rate, Numerical Problems. Collection: Collection of solid waste- services and systems, equipments, Transportation: Need of transfer operation, transfer station, transport means and methods, route optimization. Solid waste management 2000 rules with, 2016 amendments.	8 hours	L1,L2,L3
Module -2		
Processing techniques: Purpose of processing, Chemical volume reduction (incineration) – Process description, 3T's, principal components in the design of municipal incinerators, Air pollution control ,Mechanical volume reduction (compaction), Mechanical size reduction (shredding), component separation (manual and mechanical methods).	8 Hours	L1,L2,L3
Module -3		
Composting Aerobic and anaerobic method - process description, process microbiology, design consideration, Mechanical composting, Vermicomposting, Numerical Problems. Sanitary landfilling: Definition, advantages and disadvantages, site selection, methods, reaction occurring in landfill- Gas and Leachate movement, Control of gas and leachate movement, Design of sanitary landfill. Numerical Problems	8 Hours	L1,L2,L3
Module -4		
Sources, collection, treatment and disposal of :- Biomedical waste ,E-waste ,Hazardous waste and construction waste	8 Hours	L1,L2,L3
Module -5		
Incineration -3Ts factor affecting incineration ,types of incinerations , Pyrolsis ,design criteria for incineration Energy recovery technique from solid waste management	8 Hours	L1,L2,L3

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

1. Analyse existing solid waste management system and to identify their drawbacks.
2. Evaluate different elements of solid waste management system.
3. Suggest suitable scientific methods for solid waste management elements.
4. Design suitable processing system and evaluate disposal sites.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question Paper Pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. George Tchobanoglous, Hilary Theisen , Samuel A Vigil, “Integrated Solid Waste Management : Engineering principles and management issues”, M/c Graw hill Education . Indian edition
2. Howard S Peavy, Donald R Rowe and George Tchobanoglous, “Environmental Engineering”, Tata Mcgraw Hill Publishing Co ltd.,

Reference Books:

1. Municipal Solid Wastes (Management and Handling) Rules, 2000.Ministry of Environment and Forests Notification, New Delhi, the 25th September, 2000. Amendment – 1357(E) – 08-04-2016
2. Municipal Solid waste management manual, Part II published under Swachh Bharat Mission, Central Public Health And Environmental Engineering Organization (CPHEEO), 2016, Ministry of Urban Development, Government of India.
3. Handbook of Solidwaste management, second edition, George Tchobanoglous, Frank Kreith, published by M/c Graw hill Education, 2002, ISBN-13 978-0071356237 ISBN -10 0071356231

Course Title: Matrix Method of Structural Analysis
As per Choice Based Credit System (CBCS) scheme]
SEMESTER:VI

Subject Code	15CV652	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
CREDITS –03		**Total Marks- 100**	

Course objectives: This course will enable students to

1. Gain basic knowledge of structural systems and application of concepts of flexibility and stiffness matrices for simple elements.
2. Understand flexibility and stiffness matrices to solve problems in beams, frames and trusses.
3. Gain knowledge of direct stiffness method to solve problems in beams, frames and trusses.
4. Gain knowledge of solving problems involving temperature changes and lack of fit.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Introduction: Structural systems, geometric and material non-linearity, principle of superposition, equilibrium and compatibility conditions, static and kinematic indeterminacy, principle of minimum potential energy and minimum complementary energy, concepts of stiffness and flexibility, flexibility and stiffness matrices of beam and truss elements	08 hours	L2, L4,L5
Module -2		
Element Flexibility Method: Force transformation matrix, global flexibility matrix, analysis of continuous beams, rigid frames and trusses.	08 Hours	L2, L4,L5
Module -3		
Element Stiffness Method: Displacement transformation matrix, global stiffness matrix, analysis of continuous beams, rigid frames and trusses.	08 Hours	L2, L4,L5
Module -4		
Effects of Temperature Changes and Lack of Fit: Related numerical problems by flexibility and stiffness method as in Module 2 and Module 3.	08 Hours	L2, L4,L5
Module -5		
Direct Stiffness Method: Local and global coordinates systems, principle of contra gradience, global stiffness matrices of beam and truss elements, analysis of continuous beams and trusses	08 Hours	L2, L4,L5

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

1. Evaluate the structural systems to application of concepts of flexibility and stiffness matrices for simple problems.
2. Identify, formulate and solve engineering problems with respect to flexibility and stiffness matrices as applied to continuous beams, rigid frames and trusses.
3. Identify, formulate and solve engineering problems by application of concepts of direct stiffness method as applied to continuous beams and trusses.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question Paper Pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. Weaver W and Gere J H, **"Matrix Analysis of Framed Structures"**, CBS publications, New Delhi.
2. Rajasekaran S, **"Computational Structural Mechanics"**, PHI, New Delhi.
3. Madhujit Mukhopadhay and Abdul Hamid Sheikh, **"Matrix and Finite Element Analysis of Structures"**, Ane Books Pvt. Ltd.

Reference Books:

1. Godbole P N et.al, “Matrix Method of Structural Analysis”, PHI ltd, New Delhi.
2. Pundit and Gupta, “Theory of Structures Vol II”, TMH publications, New Delhi
3. A K Jain, “Advanced Structural Analysis”, Nemchand Publications, Roorkee.
4. Manikaselvam, “Elements of Matrix Analysis and Stability of Structures”, Khanna Publishers, New Delhi.
5. H C Martin, “Introduction to Matrix Methods in Structural Analysis”, International textbook company, McGraw Hill.

Course Title: Alternative Building Materials
As per Choice Based Credit System (CBCS) scheme]
SEMESTER:VI

Subject Code	15CV653	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
	CREDITS –03	**Total Marks- 100**	

Course objectives: This Course will enable students to:

1. understand environmental issues due to building materials and the energy consumption in manufacturing building materials
2. study the various masonry blocks, masonry mortar and structural behavior of masonry under compression.
3. Study the alternative building materials in the present context.
4. understand the alternative building technologies which are followed in present construction field.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Introduction: Energy in building materials, Environmental issues concerned to building materials, Embodied energy and life-cycle energy, Global warming and construction industry, Green concepts in buildings, Green building ratings – IGBC and LEED manuals – mandatory requirements, Rainwater harvesting & solar passive architecture. Environmental friendly and cost effective building technologies, Requirements for buildings of different climatic regions	8 hours	L1,L2,L3
Module -2		
Elements of Structural Masonry : Elements of Structural Masonry, Masonry materials, requirements of masonry units' characteristics of bricks, stones, clay blocks, concrete blocks, stone boulders, laterite Blocks, Fal- G blocks and Stabilized mud block. Manufacture of stabilized blocks. **Structural Masonry Mortars:** Mortars, cementations materials, sand, natural & manufactured, types of mortars, classification of mortars as per BIS, characteristics and requirements of mortar, selection of mortar. Uses of masonry, masonry bonding, Compressive strength of masonry elements, Factors affecting compressive strength, Strength of Prisms/wallets and walls, Effect of brick bond on strength, Bond strength of masonry: Flexure and shear, Elastic properties of masonry materials and masonry, Design of masonry compression elements subjected to axial load.	8 Hours	L1,L2,L3
Module -3		
Alternative Building Materials: Lime, Pozzolana cements, Raw materials, Manufacturing process, Properties and uses. Fibers- metal and synthetic, Properties and applications. Fiber reinforced plastics, Matrix materials, Fibers organic and synthetic, Properties and applications. Building materials from agro and industrial wastes ,Types of agro wastes, Types of industrial and mine wastes, Properties and applications. Masonry blocks using industrial wastes. Construction and demolition wastes	8 Hours	L1,L2,L3
Module -4		
Alternative Building Technologies: Use of arches in foundation, alternatives for wall constructions, composite masonry, confined masonry, cavity walls, rammed earth, Ferro cement and ferroconcrete building components, Materials and specifications, Properties, Construction methods, Applications. Top down construction, Mivan Construction Technique. **Alternative Roofing Systems:** Concepts, Filler slabs, Composite beam panel roofs, Masonry vaults and domes	8 Hours	L1,L2,L3
Module -5		

Equipment for Production of Alternative Materials: Machines for manufacture of concrete, Equipments for production of stabilized blocks, Moulds and methods of production of precast elements, Cost concepts in buildings, Cost saving techniques in planning, design and construction, Cost analysis: Case studies using alternatives.	8 Hours	L1,L2,L3

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

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

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question paper pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. KS Jagadish, BV Venkatarama Reddy and KS Nanjunda Rao, "Alternative Building Materials and Technologies", New Age International pub.
2. Arnold W Hendry, "Structural Masonry", Macmillan Publishers

Reference Books:

1. RJS Spence and DJ Cook, "Building Materials in Developing Countries", Wiley pub.
2. LEED India, Green Building Rating System, IGBC pub.
3. IGBC Green Homes Rating System, CII pub.
4. Relevant IS Codes.

Course Title: Ground Improvement Techniques
As per Choice Based Credit System (CBCS) scheme]
SEMESTER:VI

Subject Code	15CV654	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
CREDITS –03		**Total Marks- 100**	

Course objectives: This course will enable students to

1. Understand the fundamental concepts of ground improvement techniques
2. Apply knowledge of mathematics, Science and Geotechnical Engineering to solve problems in the field of modification of ground required for construction of civil engineering structures.
3. Understand the concepts of chemical compaction, grouting and other miscellaneous methods.
4. Impart the knowledge of geosynthetics, vibration, grouting and Injection.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Formation and Development of Ground : Introduction, Formation of Rock, soil and soil profile, Soil distribution in India, Alterations of ground after formation, Reclaimed soils, Natural offshore deposits; Ground Improvement Potential – Hazardous ground conditions, poor ground conditions, favourable ground conditions, Alternative Approaches, Geotechnical processes. **Compaction:** Introduction, compaction mechanics, Field procedure, surface compaction, Dynamic Compaction, selection of field compaction procedures, compaction quality control.	8 hours	L1, L2 , L3
Module -2		
Drainage Methods: Introduction, Seepage, filter requirements, ground water and seepage control, methods of dewatering systems, Design of dewatering system including pipe line effects of dewatering. Drains, different types of drains. **Pre-compression and Vertical Drains:** Importance, Vertical drains, Sand drains, Drainage of slopes, Electro kinetic dewatering, Preloading	8 Hours	L1, L2 , L3
Module -3		
Chemical Modification-I: Definition, cement stabilization, sandwich technique, admixtures. Hydration – effect of cement stabilization on permeability, Swelling and shrinkage and strength and deformation characteristics. Criteria for cement stabilization. Stabilization using Fly ash. **Chemical Modification-Ii:** Lime stabilization – suitability, process, criteria for lime stabilization. Other chemicals like chlorides, hydroxides, lignin and hydrofluoric acid. Properties of chemical components, reactions and effects. Bitumen, tar or asphalt in stabilization.	8 Hours	L2, L3 , L4
Module -4		
Vibration Methods: Introduction, Vibro compaction – blasting, vibratory probe, Vibro displacement compaction – displacement piles, vibroflotation, sand compaction piles, stone columns, heavy tamping GROUTING AND INJECTION: Introduction, Effect of grouting. Chemicals and materials used. Types of grouting. Grouting procedure, Applications of grouting	8 Hours	L2 , L3, L5
Module -5		
Geosynthetics: Introduction, Geosynthetic types, properties of Geosynthetics – materials and fibre properties, Geometrical aspects, mechanical properties, Hydraulic properties, Durability ; Applications of Geosynthetics - Separation, Filtration and Fluid Transmission, Reinforcement, **Miscellaneous Methods (Only Concepts & Uses):** Soil reinforcement, Thermal methods, Ground improvement by confinement – Crib walls, Gabions and Mattresses, Anchors, Rock bolts and soil nailing. Stone Column, Micro piles.	8 Hours	L1 , L3, L5

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

1. Give solutions to solve various problems associated with soil formations having less strength.
2. Use effectively the various methods of ground improvement techniques depending upon the requirements.
3. utilize properly the locally available materials and techniques for ground improvement so that economy in the design of foundations of various civil engineering structures

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question Paper Pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. Purushothama Raj P, "Ground Improvement Techniques", Laxmi Publications, New Delhi.
2. Koerner R.M, "Construction and Geotechnical Method in Foundation Engineering", Mc Graw Hill Pub. Co.

Reference Books:

1. Manfred Hausmann , "Engineering principles of ground modification", Mc Graw Hill Pub. Co.,
2. Bell, F.G., "Methods of treatment of unstable ground", Butterworths, London.
3. Nelson J.D. and Miller D.J, "Expansive soils", John Wiley and Sons.
4. Ingles. C.G. and Metcalf J.B , "Soil Stabilization; Principles and Practice", Butterworths

Course Title: Water Resources Management

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER:VI

Subject Code	15CV661	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
	CREDITS – 03	**Total Marks-100**	

Course objectives: This course will enable students to;

1. Judge surface and ground water resources.
2. Address the issues of water resources management.
3. Learn the principles of integrated water resources management.
4. Understand the legal framework of water policy.
5. Know the different methods of water harvesting.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Surface and Ground water Resources: Hydrologic Cycle, Global water resources and Indian Water resources, Surface Water Resources, Water Balance, Available Renewable Water Resources, Water Scarcity, The Water Balance as a Result of Human Interference, Groundwater Resources, Types of Aquifers, Groundwater as a Storage Medium	8 hours	L2, L3
Module -2		
Water Resources Planning and Management: Necessity, System components, planning scales, Approaches, planning and management aspects, Analysis, Models for impact prediction and evaluation, Adaptive Integrated Policies, Post Planning and management Issues.	8 Hours	L2, L3
Module -3		
Integrated Water Resources Management: Definition of IWRM, Principles, Implementation of IWRM, Legislative and Organizational Framework, Types and Forms of Private Sector Involvement.	8 Hours	L3, L4
Module -4		
Water Governance and Water Policy: Legal Framework of Water – Substance of National Water Laws – Other key issues – Changing incentives through Regulation - National Water Policy – National-Level Commissions – Irrigation Management Transfer Policies and Activities – Legal Registration of WUAs – Legal Changes in Water Allocation, – Role of Local Institutions – Community Based Organizations – Water Policy Reforms: India.	8 Hours	L2, L3
Module -5		

Water Harvesting and Conservation: Water Harvesting Techniques – Micro-catchments - Design of Small Water Harvesting Structures – Farm Ponds – Percolation Tanks – Yield from a Catchment, Rain water Harvesting-various techniques related to Rural and Urban area.	8 Hours	L_2, L_3

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

1. Assess the potential of groundwater and surface water resources.
2. Address the issues related to planning and management of water resources.
3. Know how to implement IWRM in different regions.
4. Understand the legal issues of water policy.
5. Select the method for water harvesting based on the area.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question paper pattern:

1. The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
2. There will be two full questions (with a maximum of two subdivisions) from each module.
3. Each full question shall cover the topics as a module
4. The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. K. Subramanya, "Engineering Hydrology", Tata McGraw Hill Publishers, New Delhi.
2. H.M. Raghunath, "Ground Water", Wiley Eastern Publication, New Delhi.
3. Daniel P. Loucks and Eelco van Beek, "Water Resources Systems. Planning and Management", UNESCO Publication.
4. Mollinga, P. et al, "Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.
5. Singh, Chhatrapati "Water Rights in India," Ed: Chhatrapati Singh. Water Law in India: The Indian Law Institute, New Delhi,1992.
6. 6) Dhruva Narayana, G. Sastry, V. S. Patnaik, "Watershed Management", CSWCTRI, Dehradun, ICAR Publications, 1997.

Reference Books:

1. Lal, Ruttan. " Integrated Watershed Management in the Global Ecosystem". CRC Press, New York.
2. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988. John Wiley and Sons, Inc., New York.

Course Title: Environmental Protection and Management

As per Choice Based Credit System (CBCS) scheme]

SEMESTER:VI

Subject Code	15CV662	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
CREDITS –03		**Total Marks- 100**	

Course objectives: This course will enable students to gain knowledge in Environmental protection and Management systems

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 Environmental Management Standards		
Unique Characteristics of Environmental Problems - Systems approach to Corporate environmental management - Classification of Environmental Impact Reduction Efforts -Business Charter for Sustainable Production and Consumption – Tools, Business strategy drivers and Barriers - Evolution of Environmental Stewardship. Environmental Management Principles - National policies on environment, abatement of pollution and conservation of resources - Charter on Corporate responsibility for Environmental protection.	8 hours	L1,L2,L3
Module -2 Environmental Management Objectives		
Environmental quality objectives – Rationale of Environmental standards: Concentration and Mass standards, Effluent and stream standards, Emission and ambient standards, Minimum national standards, environmental performance evaluation: Indicators, benchmarking. Pollution control Vs Pollution Prevention - Opportunities and Barriers – Cleaner production and Clean technology, closing the loops, zero discharge technologies	8 Hours	L1,L2,L3
Module -3 Environmental Management System		
EMAS, ISO 14000 - EMS as per ISO 14001– benefits and barriers of EMS – Concept of continual improvement and pollution prevention - environmental policy – initial environmental review – environmental aspect and impact analysis – legal and other requirements- objectives and targets – environmental management programs – structure and responsibility – training awareness and competence- communication – documentation and document control – operational control – monitoring and measurement – management review.	8 Hours	L1,L2,L3
Module -4 Environmental Audit		
Environmental management system audits as per ISO 19011- – Roles and qualifications of auditors - Environmental performance indicators and their evaluation – Non conformance – Corrective and preventive actions -compliance audits – waste audits and waste minimization planning – Environmental statement (form V) - Due diligence audit	8 Hours	L1,L2,L3
Module -5 Applications		
Applications of EMS , Waste Audits and Pollution Prevention opportunities in Textile , Sugar, Pulp & Paper, Electroplating, , Tanning industry, Dairy, Cement, Chemical industries, etc. Trans boundary movement, disposal, procedures, of hazardous wastes.	8 Hours	L1,L2,L3

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

1. Appreciate the elements of Corporate Environmental Management systems complying to international environmental management system standards
2. Lead pollution prevention assessment team and implement waste minimization options
3. Develop, Implement, maintain and Audit Environmental Management systems for Organisations

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question paper pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module

- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Reference Books:

1. Christopher Sheldon and Mark Yoxon, "Installing Environmental management Systems – a step by step guide" Earthscan Publications Ltd, London, 1999.
2. ISO 14001/14004: Environmental management systems – Requirements and Guidelines – International Organisation for Standardisation, 2004
3. ISO 19011: 2002, "Guidelines for quality and/or Environmental Management System auditing, Bureau of Indian Standards, New Delhi, 2002
4. Paul L Bishop „Pollution Prevention: Fundamentals and Practice", McGraw- Hill International, Boston,2000.
5. Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations, Second Edition, NSF International, Ann Arbor, Michigan, January 2001.

Course Title: Numerical Methods and Applications
As per Choice Based Credit System (CBCS) scheme]
SEMESTER:VI

Subject Code	15CV663	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
CREDITS –03		**Total Marks- 100**	

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

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Solution of Equations and Eigen value Problems: Solution of algebraic and transcendental equations, Fixed point iteration method, Newton Raphson method, Solution of linear system of equations, Gauss elimination method, Pivoting,Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Matrix Inversion by Gauss Jordan method	8 hours	L1,L2,L3
Module -2		
Interpolation and Approximation: Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and backward difference formulae.	8 Hours	L1,L2,L3
Module -3		
Numerical Differentiation and Integration: Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.	8 Hours	L1,L2,L3
Module -4		
Initial Value Problems for Ordinary Differential Equations : Single Step methods - Taylor's series method - Euler's method - Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations - Multi step methods - Milne's and Adams-Bash forth predictor corrector methods for solving first order equations.	8 Hours	L1,L2,L3
Module -5		
Boundary Value Problems in Ordinary and Partial Differential Equations: Finite difference methods for solving two-point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.	8 Hours	L1,L2,L3

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

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question Paper Pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module

Text Books:

1. Grewal. B.S., and Grewal. J.S., "Numerical methods in Engineering and Science", Khanna Publishers, 9th Edition, New Delhi
2. Gerald. C. F., and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi

Reference Books:

1. Chapra. S.C., and Canale.R.P., "Numerical Methods for Engineers, Tata McGraw Hill, New Delhi
2. 2. Brian Bradie. "A friendly introduction to Numerical analysis", Pearson Education, Asia, New Delhi
3. Sankara Rao. K., "Numerical methods for Scientists and Engineers", Prentice Hall of India Private, New Delhi

Course Title: Finite Element Method

As per Choice Based Credit System (CBCS) scheme]

SEMESTER:VI

Subject Code	15CV664	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
CREDITS –03		**Total Marks- 100**	

Course objectives: This course will enable students to;

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

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Theory of elasticity concepts, Energy principles, Rayleigh - Ritz Method, Galerkin method and finite element method, steps in finite element analysis, displacement approach, stiffness matrix and boundary conditions	8 hours	L1,L2
Module -2		
Discritisation; finite representation of infinite bodies and discritisation of very large bodies, Natural Coordinates , Shape functions; polynomial, LaGrange and Serendipity , one dimensional formulations; beam and truss with numerical examples	8 Hours	L1,L2
Module -3		
2D formulations; Constant Strain Triangle, Linear Strain Triangle, 4 and 8 noded quadrilateral elements, Numerical Evaluation of Element Stiffness -Computation of Stresses, Static Condensation of nodes, degradation technique, Axisymmetric Element	8 Hours	L1,L2,L3
Module -4		
Isoparametric concepts; isoparametric, sub parametric and super parametric elements, Jacobian transformation matrix, Stiffness Matrix of Isoparametric Elements, Numerical integration by Gaussian quadrature rule for one, two and three dimensional problems	8 Hours	L1,L2,L3
Module -5		
Techniques to solve nonlinearities in structural systems; material, geometric and combined non linearity, incremental and iterative techniques. Structure of computer program for FEM analysis, description of different modules, exposure to FEM softwares.	8 Hours	L1,L2,L3

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

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question paper pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. Krishnamoorthy C.S., “Finite Element analysis” -Tata McGraw Hill
2. Desai C &Abel J F.," Introduction to Finite element Method" , East West Press Pvt. Ltd.,
3. Cook R D et.al., “Concepts and applications of Finite Element analysis ”, John Wiley

Reference Books:

1. Daryl L Logan,“ A first course on Finite element Method ” , Cengage Learning
2. Bathe K J - “ Finite Element Procedures in Engineering analysis ”- Prentice Hall

Course Title: Software Application Lab

As per Choice Based Credit System (CBCS) scheme]

SEMESTER:VI

Subject Code	15CVL67	IA Marks	20
Number of Lecture Hours/Week	1I+2P	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
CREDITS –02		**Total Marks- 100**	

Course objectives: This course will enable students to

1. Use industry standard software in a professional set up.
2. understand the elements of finite element modeling, specification of loads and boundary condition, performing analysis and interpretation of results for final design
3. Develop customized automation tools

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Use of civil engineering softwares: Use of softwares for: 1. Analysis of plane trusses, continuous beams, portal frames 2. 3D analysis of multistoried frame structures	18 hours	L1,L2,L3
Module -2		
1. **Project Management- Exercise on Project planning and scheduling of a building project using any project management software:** a. Understanding basic features of Project management software b. Constructing Project: create WBS, Activities, and tasks and Computation Time using Excel spread sheet and transferring the same to Project management software. c. Identification of Predecessor and Successor activities with constrain d. Constructing Network diagram (AON Diagram) and analyzing for Critical path, Critical activities and Other non Critical paths, Project duration, Floats. e. Study on various View options available f. Basic understanding about Resource Creation and allocation g. Understanding about Splitting the activity, Linking multiple activity, assigning Constrains, Merging Multiple projects, Creating Baseline Project (9hrs) **1. GIS applications using open source software:** a. To create shape files for point, line and polygon features with a map as reference. b. To create decision maps for specific purpose. (3hrs)	12 hours	L1,L2,L3
Module -3		
Use of EXCEL spread sheets: Design of singly reinforced and doubly reinforced rectangular beams, design of one way and two way slabs, computation of earthwork, Design of horizontal curve by offset method, Design of super elevation	10 Hours	L1,L2,L3

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

use software skills in a professional set up to automate the work and thereby reduce cycle time for completion of the work

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question paper pattern:

- The question paper will have 3 modules comprising of 6 questions.
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- Module-1: 40 Marks, Module-2: 20 Marks, Module-3: 20 Marks
- The students shall answer three full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Reference Books: Training manuals and User manuals and Relevant course reference books

Course Title: Extensive Survey Project /Camp

As per Choice Based Credit System (CBCS) scheme]

SEMESTER:VI

Subject Code	15CVP68	IA Marks	20
Number of Practice Hours/Week	04	Exam Marks	80
Total Number of Practice Hours	50	Exam Hours	03
	CREDITS –04	**Total Marks- 100**	

Course objectives: This course will enable students to

1. Understand the practical applications of Surveying.
2. Use Total station and other Measurement Equipments.
3. Work in teams and learn time management, communication and presentation skills

- To be conducted between 5th & 6th Semester for a period of 2 weeks including training on total station.
- Viva voce conducted along with 6th semester exams
- An extensive project preparation training involving investigation, collection of data is to be conducted. **Use of Total Station is compulsory for minimum of TWO projects.**
- The student shall submit a project report consisting of designs and drawings.
- Drawings should be done using CAD and survey work using total station
- Students should learn data download from total station, generation of contours, block leveling, longitudinal and cross sectional diagrams, and capacity volume calculation by using relevant softwares
- The course coordinators should give exposure and simulate activities to achieve the course outcomes

1. **NEW TANK PROJECTS:** The work shall consist of;
   a. Reconnaissance survey for selection of site and conceptualization of project.
   b. Alignment of center line of the proposed bund, Longitudinal and cross sections of the center line.
   c. Detailed survey required for project execution like Capacity surveys, Details at Waste weir and sluice points, Canal alignment etc. as per requirement
   d. Design and preparation of drawing with report.

2. **WATER SUPPLY AND SANITARY PROJECT:** The work shall consist of;
   a. Reconnaissance survey for selection of site and conceptualization of project.
   b. Examination of sources of water supply, Calculation of quantity of water required based on existing and projected population.
   c. Preparation of village map by using total station.
   d. Survey work required for laying of water supply and UGD
   e. Location of sites for water tank. Selection of type of water tank to be provided. (ground level, overhead and underground)
   f. Design of all elements and preparation of drawing with report.

3. **HIGHWAY PROJECT:** The work shall consist of;
   a. Reconnaissance survey for selection of site and conceptualization of project.
   b. Preliminary and detailed investigations to align a new road (min. 1 to 1.5 km stretch) between two obligatory points. The investigations shall consist of topographic surveying of strip of land for considering alternate routes and for final alignment. Surveying by using total station.
   c. Report should justify the selected alignment with details of all geometric designs for traffic and design speed assumed.
   d. Drawing shall include key plan initial alignment, final alignment, longitudinal section along final alignment, typical cross sections of road.

4. **RESTORATION OF AN EXISTING TANK:** The work shall consist of;
   a. Reconnaissance survey for selection of site and conceptualization of project.
   b. Alignment of center line of the existing bund, Longitudinal and cross sections of the center line.
   c. Detailed survey required for project execution like Capacity surveys, Details at Waste weir and sluice points, Canal alignment etc. as per requirement
   d. Design of all elements and preparation of drawing with report.

5. **TOWN/HOUSING / LAYOUT PLANNING:** The work shall consist of;
   a. Reconnaissance survey for selection of site and conceptualization of project.
   b. Detailed survey required for project execution like contour surveys
   c. Preparation of layout plans as per regulations
   e. Centerline marking-transfer of centre lines from plan to ground
   f. Design of all elements and preparation of drawing with report as per regulations

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

1. Apply Surveying knowledge and tools effectively for the projects
2. Understanding Task environment, Goals, responsibilities, Task focus, working in Teams towards common goals, Organizational performance expectations, technical and behavioral competencies.

3. Application of individual effectiveness skills in team and organizational context, goal setting, time management, communication and presentation skills.
4. Professional etiquettes at workplace, meeting and general
5. Establishing trust based relationships in teams & organizational environment
6. Orientation towards conflicts in team and organizational environment, Understanding sources of conflicts, Conflict resolution styles and techniques

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Reference Books:

Training manuals and User manuals
Relevant course reference books