Civil and Infrastructure Engineering

Semester IV						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CE202T	Surveying and Geomatics	2	1	0	6
2	CE202L	Surveying and Geomatics Laboratory	0	0	3	3
3	CE203T	Structural Analysis	2	1	0	6
4	ME204L	Solid Mechanics Laboratory	0	0	3	3
5	ME202L	Fluid Mechanics Laboratory	0	0	3	3
6	CE207T	Hydraulics and Hydraulic Machinery	3	0	0	6
7	CE204T	Water Resources Engineering	3	0	0	6
		Total Credits				33

Civil and Infrastructure Engineering

1	**Title of the course** (L-T-P-C)	**Surveying and Geomatics** **2-1-0-6**
2	**Pre-requisite courses(s)**	
3	**Course content**	1. Introduction to Plane & Geodetic Surveying, Fundamental Principles, Traversing, Leveling, Instrumentation 2. Digital Levels, Total Station- Basics, Different types of surveying methods, Different sources of errors, Error adjustments 3. GNSS- Basic concepts, Different types of GPS errors, Different types of GNSS based surveying techniques 4. Ground Penetrating RADAR- Basics, Survey techniques, GPR Radargram Interpretation 5. LiDAR concepts- Terrestrial LiDAR, Airborne LiDAR overview 6. Unmanned Aerial System (UAS) Photogrammetry & Remote Sensing overview
4	**Texts/References**	1. B.C. Punmia, A.K. Jain and A.K. Jain, Surveying, Vol. 1 and II, 5th or later editions, Laxmi Publications, New Delhi, 2015. 2. Chandra A. M., Higher Surveying, New Age International Publishers, 2007 3. Chandra A. M., Plane Surveying, New Age International Publ., 2007 4. James, M Anderson & Edward M Mikhail., Surveying Theory and Practice, Tata Mc Graw Hill, 2012 5. Charles D Ghilani, Paul R Wolf., Elementary Surveying, Prentice Hall, 2012 6. Satheesh Gopi, R. Sathikumar, and N. Madhu. Advanced Surveying: Total Station, GIS and Remote Sensing 1st Edition, 2007, Pearson India 7. Charles D. Ghilani, Elementary Surveying: An Introduction to Geomatics (15th Edition) Pearson Publishers. 2017 8. Pinliang Dong, Qi Chen. LiDAR Remote Sensing and Applications, 1st Edition, CRC Press 9. Harry M. Jol. Ground Penetrating Radar Theory and Applications, 1st Edition, 2009, Elsevier publications. 10. Journal articles as informed by the instructor

1	**Title of the course** (L-T-P-C)	**Surveying and Geomatics Laboratory** **0-0-3-3**
2	**Pre-requisite courses(s)**	
3	**Course content**	1. Introduction to Survey Instruments 2. Compass Traverse 3. Theodolite Traverse 4. Differential Levelling 5. Profile and Cross Section Survey 6. Trigonometric Levelling 7. Tacheometric Surveying 8. Total Station Surveying 9. GPS Surveying 10. Surveying & Mapping using Global Navigation Satellite System (GNSS)
4	**Texts/References**	1. B.C. Punmia, Ashok Kumar Jain, Ashok Kr. Jain, Arun Kr. Jain., Surveying I & II, Laxmi Publications, 2015 2. James, M Anderson & Edward M Mikhail., Surveying Theory and Practice, Tata Mc Graw Hill, 2012 3. Charles D. Ghilani, Elementary Surveying: An Introduction to Geomatics (15th Edition) Pearson Publishers. 2017

1	**Title of the course** (L-T-P-C)	**Structural Analysis** **2-1-0-6**
2	**Pre-requisite courses(s)**	NIL
3	**Course content**	1. **Method of consistent deformation**: Indeterminate beams - Propped cantilever, Fixed and Continuous beams - Analysis for shear force and bending moment - Clapeyron's theorem of three moments - Slope and deflection - effect of sinking of supports. 2. **Slope - Deflection Method**: Analysis and application to continuous beams - portal frames (single bay - Single storey). 3. **Moment-Distribution Method**: Analysis of continuous beams and portal frames (single storey single bay). 4. **Analysis of pin jointed frames** (one degree redundancy); Forces in indeterminate pin jointed frames due to temperature variation and lack of fit; 5. **Influence lines and Moving Loads for beams**: Maximum bending moment and shear force diagrams for simply supported spans traversed by single point load - two concentrated loads - Uniformly distributed load, shorter and longer than the span - enveloping parabola and equivalent uniformly distributed load, determination of maximum bending moment and shear force for a system of concentrated loads on simply supported girders - focal length of a girder - counter bracing. 6. **Influence lines and Moving Loads for trusses**: Influence lines for simple trusses, Muller - Breslau Principle, Influence lines for reactions, shear force at a point and bending moment at a section of beams with fixed ends and two span continuous beams.
4	**Texts/References**	**References:** **1.** R.C. Hibbeler, Structural Analysis, 8th Edition, Pearson Education. **2.** Junarkar. S. B and Shah H.J- Mechanics of Structures Vol 1 & Vol.2 – 27th Edition, Charotar Publishers, 2008. **3.** Wang C.K. - Intermediate Structural Analysis – Tata McGraw Hill Publishers, 2010. **4.** L.S. Negi, Theory and Problems in Structural Analysis, Tata McGraw Hill Pub, 1997. **5.** Reddy C.S.- Basic Structural Analysis - Tata McGraw- Hill Publishing Company Ltd.

1	**Title of the course** (L-T-P-C)	**Solid Mechanics Lab** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	**List of Experiments:** ● Calibration of photoelastic material using a disk under diametral compression, a beam under four-point bending and an uni-axial tensile specimen; and SCF evaluation in a circular ring, acrane hook and a plate with hole. ● Stresses in thin pressure vessels using strain gauges; ● Deflection of curved beams – a ring, a semi-circular ring, a quadrant and an angular davit ● Stability of columns – To evaluate the buckling load for different materials (Steel, Copper,Aluminium and Brass) under different end conditions (Hinge-Hinge and Hinge- fixed condition) ● Hardness test – Rockwell, Vickers and Brinell Hardness test ● Impact testing machine: Izod and Charpy test ● Torsion testing machine Tests of UTM: Tension (Ductile and Brittle), compression (brittle and ductile), bending ofbeam, leaf spring characteristics
4	**Texts/References**	S. Crandall, N. Dahl, S. Lardner, An Introduction to Mechanics of Solids, Tata MG Hill, 2012. E.P. Popov, Engineering Mechanics of Solids, Prentice Hall, 2012. Gere abd Goodno, Mechanics of Materials, 7th ed., Cengage Learning India, 2012.Gere and Timoshenko, Mechanical of Materials, CBS Publishers, 1986.

1	**Title of the course** (L-T-P-C)	**Fluid Mechanics Lab** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	Exposure to Fluid Mechanics
3	**Course content**	**List of Experiments:** ● Stability of floating bodies for determining the metacentre and buoyancy ● Reynolds experiment for laminar/turbulent flow visualisation ● Measurement of discharge coefficient for different shaped orifices with varying head ● Demonstration of Bernoulli's principle ● Visualisation of Free and Forced vortices ● Demonstration of linear momentum and impact forces of Jet for different deflection angles ● Pressure loss in pipe friction for laminar/turbulent flow ● Minor losses in Pipe system (fittings: bend, elbow, contraction/expansion) ● Major losses in Pipe system: Effect of pipe material, dimensions ● Fluidized Granular Bed ● Submerged Jet ● Flow Measurement by Venturi-meter, Orifice-meter & Rota-meter ● Heleshaw Apparatus ● Hydraulic Jump ● Course project set-up
4	**Texts/References**	1. Yunus A. Cengel, John M. Cimbala, Fluid Mechanics, Tata McGraw Hill Educati 2011. 2. F.M.White, Fluid Mechanics, Seventh Edition, Tata McGraw Hill Education, 201 3. Philip J.Pritchard, Alan T.Mcdonald,RobertW.Fox, Introduction to Fluid Mechan Wiley, 2009. 4. John F. Douglas, J. M. Gasoriek, Lynne Jack and John Swaffield, Fluid Mechan Pearson, 2008.

1	**Title of the course** (L-T-P-C)	**Hydraulics and Hydraulic Machinery** **3-0-0-6**
2	**Pre-requisite courses(s)**	--
3	**Course content**	● Module 1: Laminar Flow- Laminar flow through: circular pipes, annulus, and parallel plates. Stoke's law, Measurement of viscosity. ● Module 2: Turbulent Flow- Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence, and effect of turbulent flow in pipes. Reynolds stresses semi-empirical theories of turbulence, Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram. ● Module 3: Boundary Layer Theory: Concepts of boundary layer flows, Laminar and turbulent boundary layers, Integral momentum equation for boundary layer flows, Boundary layer separation and control, Drag and lift. ● Module 4: Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problem. ● Module 5: Introduction to Open Channel - Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channelflow, Velocity Distribution of channel section. ● Module 6: Uniform Flow-Continuity Equation, Energy Equation and Momentum Equation, Characteristics of Uniform Flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficien "n". Most economical section of channel. Computation of Uniform flow, Normal depth. ● Module 7: Non-Uniform Flow- Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity-Current meter, Floats, Hot-wire anemometer. Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile by graphical, numerical, and analytical approaches, Direct Step method, Graphical Integration method, and Direct Integration method. ● Module 8: Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length, and height of the jump, location of the jump, Types, applications, and location of hydraulic jump. Energy dissipation and other uses, surge as a moving hydraulic jump. Positive and negative surges. Dynamics of Fluid Flow-Momentum principle, applications: Force on plates, pipe bends, moments of momentum equation, ● Module 9: Flow through Pipes: Loss of head through pipes, Darcy- Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead-end pipes, siphon, power transmission through pipes, nozzles. Analysis of pipe networks: Hardy Cross method, water hammer in pipes and control measures, branching of pipes, three reservoir problems.

		● Module 10: Hydraulic Machinery: Classification of hydraulic machines, Euler's equation of turbo machines, one-dimensional flow analysis and velocity triangles, Concepts of Design of Pelton turbine, Francis turbine, Kaplan turbine, Design of centrifugal pump, axial flow pump, Selection of hydraulic machines.
4	**Texts/References**	References: ● Fluid Mechanics, F M White, Fluid Mechanics, McGraw Hill Education India Private Limited, 2017, 8 th Edition. ● Robert W. Fox, Philip J. Pritchard, Alan T. McDonald, Introduction to Fluid Mechanics, Student Edition Seventh, Wiley India Edition, 2011. ● C. S. P. Ojha, P. N. Chandramouli, R. Berndtsson, Fluid Mechanics and Machinery, C. S. P. Ojha, P. N. Chandramouli, R. Berndtsson, Oxford University Press, 2010. ● Modi P M and S M Seth, Hydraulics and Fluid Mechanics, Standard Book House, 2019 ● K Subramanya Theory and Applications of Fluid Mechanics, Tata McGraw Hill. ● K Subramanya, Open channel Flow, Tata McGraw Hill, 2017 ● V T Chow, Open Channel Hydraulics, McGraw Hill. 2010 ● James A Fay , Introduction to Fluid Mechanics, Prentice Hall of India, 2012

1	**Title of the course** (L-T-P-C)	**Water Resources Engineering** **3-0-0-6**
2	**Pre-requisite courses(s)**	
3	**Course content**	**Module 1:** Introduction - hydrologic cycle, water-budget equation, history of hydrology, world water balance, applications in engineering, sources of data. **Module 2:** Precipitation - forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth-area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India. **Module 3:** Abstractions from precipitation - evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltration indices. **Module 4:** Runoff - runoff volume, SCS-CN method of estimating runoff volume, flow-duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India, environmental flows. **Module 5:** Ground water and well hydrology - forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests. **Module 6:** Water withdrawals and uses – water for energy production, water for agriculture, water for hydroelectric generation; flood control. Analysis of surface water supply, Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation. **Module 7:** Distribution systems - canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels, alluvial channels, Kennedy's and Lacey's theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals, types of lining. Drainage of irrigated lands: necessity, methods. **Module 8:** Dams and spillways - embankment dams: Classification, design considerations, estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Arch and buttress dams. Spillways: components of spillways, types of gates for spillway crests; Reservoirs- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, economic height of dam, selection of suitable site.

4	**Texts/References**	· K Subramanya and Priyank J Sharma, Engineering Hydrology, Mc- Graw Hill, 2024 · G L Asawa, Irrigation and Water Resources Engineering, New Age International Publishers, 2018 · V T Chow, D R Maidment and L W Mays, Applied Hydrology, McGraw Hill, 2016 · Sharad K Jain and V P Singh, Engineering Hydrology, McGrawHill Publications, 2019 · K Subramanya, Water Resources Engineering through Objective Questions, Tata Mc-Graw Hill, 2010 · Larry W Mays, Water Resources Engineering, John Wiley, 2011 C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford. 2015.