Semester IV						
S.No	Course Code	Course Name	L	T	P	C
1	CE 202	Surveying and Geomatics	2	1	0	6
2	CE 212	Surveying and Geomatics Laboratory	0	0	3	3
3	CE 205	Structural Analysis	2	1	0	6
4	ME 218	Solid Mechanics Lab	0	0	3	3
5	ME224	Fluid Mechanics Lab	0	0	3	3
6	CE 301	Environmental Studies	3	0	0	6
7	CE 206	Water Resources Engineering	2	1	0	6
		Institute Elective-I	2	1	0	6
		Total Credits				39

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 MGHill, 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)	**Water Resources Engineering** **2-1-0-6**
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**	1. K Subramanya, Engineering Hydrology, Mc-Graw Hill. 2. K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill. 3. K Subramanya, Water Resources Engineering through Objective Questions, Tata Mc-Graw Hill. 4. G L Asawa, Irrigation Engineering, Wiley Eastern 5. L W Mays, Water Resources Engineering, Wiley. 6. J D Zimmerman, Irrigation, John Wiley & Sons 7. C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford.