Semester IV [Second year]

CE(ES)401	**Mechanical Engineering**	2L + 1T	3 Credits
Module 1	Basic Concepts- Basic concepts - concept of continuum, macroscopic approach,Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasistaticprocess, work, modes of work. Zeroth law of thermodynamics, concept of temperature and heat.Concept of ideal and real gases.		4L
Module 2	First Law of Thermodynamics- Concepts of Internal Energy, Specific Heat Capacities,Enthalpy. Energy Balance for Closed and Open Systems, Energy Balance for Steady-Flow Systems.Steady-Flow Engineering Devices. Energy Balance for Unsteady- Flow		4L
Module 3	Second Law of Thermodynamics- Thermal energy reservoirs, heat engines energyconversion, Kelvin's and Clausius statements of second law, the Carnot cycle, the Carnot Theorem,the thermodynamic temperature scale, the Carnot heat engine, efficiency, the Carnot refrigerator andheat pump, COP. Clausius inequality, concept of entropy, principle of increase of entropy – availability, the increase of entropy principle, perpetual-motion machines, reversible and irreversible processes, Entropy change of pure substances, isentropic processes, property diagrams involvingentropy, entropy change of liquids and solids, the entropy change of ideal gases, reversible steadyflowwork, minimizing the compressor work, isentropic efficiencies of steady-flow devices, andentropy balance. Energy - a measure of work potential, including work potential of energy, reversiblework and irreversibility, second-law efficiency, exergy change of a system, energy transfer by heat,work, and mass, the decrease of exergy principle and exergy destruction, energy balance: closedsystems and control volumes energy balance.		10L
Module 4	Properties Of Pure Substance- Properties of pure substances. Thermodynamic propertiesof pure substances in solid, liquid and vapour phases. Phase rule, P-V, P-T, T-V, T-S, H-S diagrams,PVT surfaces. Thermodynamic properties of steam. Calculations of work done and heat transfer innon- flow and flow processes.		6L
Module 5	Power Cycles- Vapour and combined power cycles, including the Carnot vapor cycle,Rankine cycle: the ideal cycle for vapor power, the ideal reheat and regenerative and the second-lawanalysis of vapour power cycles. Gas power cycles, including basic considerations in the analysis ofpower cycles, the Carnot cycle and its value in engineering, an overview of reciprocating engines, airstandard assumptions,gasoline engine Otto cycle, diesel engine cycle, gas-turbine Brayton cycle, andthe second-law analysis of gas power cycles.		6L
Module 6	Ideal and Real Gases and Thermodynamic Relations- Gas mixtures – properties ideal and real gases. Equation of state, Avogadro's Law, Vander Waal's equation of state, Compressibilityfactor, compressibility chart. Dalton's law of partial pressure. Exact differentials, T-D relations,Maxwell's relations. ClausiusClapeyron equations, Joule – Thomson coefficient.		6L
Module 7	Psychrometry and psychrometric charts, property calculations of air vapour mixtures.Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling. Use of standard thermodynamic tables, Mollier diagram,Psychometric chart and Refrigerant property tables. Refrigeration cycles, including refrigerators andheat pumps, the ideal reversed Carnot vapour-compression refrigeration cycle, actual vaporcompressionrefrigeration cycles, heat pump systems, gas refrigeration cycles, and absorptionrefrigeration systems.		6L
Reference	1. Nag. P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi. 2. Cengel, Thermodynamics – An Engineering Approach, Tata McGraw Hill, New Delhi. 3. Sonntag, R. E., Borgnakke, C., &Wylen, G. J. V. Fundamentals of thermodynamics: Wiley. 4. Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. Fundamentals of Engineering 1. Thermodynamics: John Wiley & Sons. 5. Jones, J. B., & Dugan, R. E. Engineering thermodynamics: Prentice Hall. 6. Potter, M. C., & Somerton, C. W. Schaum's Outline of Thermodynamics for Engineers, McGraw-Hill. 7. M.P. Poonia, Basic Mechanical Engineering, Khanna Publishing House (2019) 8. Pravin Kumar, Basic Mechanical Engineering, Pearson		

CE(PC)401	**Instrumentation & Sensor Technologies for Civil Engineering Applications**	1L + 1T	2 Credits
Module 1:	**Fundamentals of Measurement, Sensing and Instrumentation** definition ofmeasurement and instrumentation, physical variables, common types of sensors; Describe thefunction of these sensors; Use appropriate terminology to discuss sensor applications; andqualitatively interpret signals from a known sensor type, types of instrumentation, Sensor Specifics,Permanent installations, Temporary installations;		4L
Module 2	**Sensor Installation and Operation** i) Predict the response of sensors tovarious inputs; ii) Construct a conceptual instrumentation and monitoring program; iii) Describe theorder and methodology for sensor installation; and iv) Differentiate between types of sensors andtheir modes of operation and measurement and v) Approach to Planning Monitoring Programs,Define target, Sensor selection, Sensor siting, Sensor Installation & Configuration, Advanced topic,Sensor design, Measurement uncertainty		6L
Module 3	**Data Analysis and Interpretation** a) Fundamental statistical concepts, b) Datareduction and interpretation, c) Piezometer, Inclinometer, Strain gauge, etc. d) Time domain signalprocessing, e) Discrete signals, Signals and noise and f) a few examples of statistical information tocalculate are: Average value (mean), On average, how much each measurement deviates from themean (standard deviation), Midpoint between the lowest and highest value of the set (median), Mostfrequently occurring value (mode), Span of values over which your data set occurs (range)		6L
Module 4:	Frequency Domain Signal Processing and Analysis covering Explain the need forfrequency domain analysis and its principles; Draw conclusions about physical processes based onanalysis of sensor data; Combine signals in a meaningful way to gain deeper insight into physicalphenomena, Basic concepts in frequency domain signal processing and analysis, Fourier Transform,FFT (Fast Fourier Transform), Example problems: Noise reduction with filters, Leakage, Frequencyresolution		6L
Tutorials	**Tutorials** from the above modules demonstrating clearly the understanding and use for the sensorsand instruments used for the problems posed and inferences drawn from the measurement andobservations made along with evaluation report		6L
Reference	1. Alan S Morris (2001), Measurement and Instrumentation Principles, 3rd/e, Butterworth Hienemann 2. David A. Bell (2007), Electronic Instrumentation and Measurements 2nd/e, Oxford Press 3. S. Tumanski (2006), Principle of Electrical Measurement, Taylor & Francis 4. Ilya Gertsbakh (2010), Measurement Theory for Engineers, Springer 5. J.G. Joshi, Electronic Measurement & Instrumentation, Khanna Publishing House 6. A.K. Sawhney, Electronic Measurement & Instrumentation, Dhanpat Rai Publications		

CE(PC)403	**Introduction to Fluid Mechanics**	2L + 0T	2 Credits
Module 1	Basic Concepts and Definitions – Distinction between a fluid and a solid; Density,Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity withtemperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension,capillarity, Bulk modulus of elasticity, compressibility.		4L
Module 2	Fluid Statics - Fluid Pressure: Pressure at a point, Pascals law, pressure variation withtemperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, UTubeDifferential Manometer, Micromanometers. pressure gauges, Hydrostatic pressure and force:horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.		6L
Module 3	Fluid Kinematics-Classification of fluid flow : steady and unsteady flow; uniform andnon-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line,path line, streak line and stream tube; stream function, velocity potential function. One-, two- andthree -dimensional continuity equations in Cartesian coordinates		9L
Module 4	Fluid Dynamics- Surface and body forces; Equations of motion - Euler's equation;Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation :venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipebend; Vortex Flow – Free and Forced; Dimensional Analysis and Dynamic Similitude – Definitionsof Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number;Buckingham's π-Theorem.		9L
Reference	1. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010 2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House 3. Fluid Mechanics, Sadhu Singh, Khanna Book Publishing Co. (P) Ltd. 4. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill 5. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc Graw Hill. 6. Fluid Mechanics, Hydraulics, K.R. Arora, Standard Publishers, New Delhi		

CE(PC)404	**Introduction to Solid Mechanics**	2L + 0T	2 Credits
Module 1	Simple Stresses and Strains- Concept of stress and strain, St. Venant's principle, stress and strain diagram,Elasticity and plasticity – Types of stresses and strains, Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain Energy – Resilience – Gradual, sudden, impact and shock loadings – simple applications.		4L
Module 2	Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.		4L
Module 3:	Bending moment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.		6L
Module 4:	Flexural Stresses-Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.		4L
Module 5:	Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.		4L
Module 6	Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams.		4L
Module 7	Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.		4L
Module 8	Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.		4L
Reference	1 Elements of Strength of Material S. P. Timoshenko & D. H. Young EWP Pvt. Ltd 2 Engineering Mechanics of Solids E. P. Popov Pearson Education 3 Strength of Materials R. Subramanian OXFORD University Press 4 Strength of Materials, D.S. Bedi, Khanna Publishing House 5 Strength of Material R.K. Bansal, Laxmi Publications 6 Strength of Materials S S Bhavikatti Vikas Publishing House Pvt. Ltd 7 Strength of Material A. Pytel & F. L. Singer AWL Inc 8 Strength of Material Ramamrutham 9 Engineering Mechanics I by J. L. Mariam John Willey 10 Engineering Mechanics I. H. Shames PHI 11 Fundamentals of Strength of Material Nag & Chandra WIE		

CE(PC)405	**Surveying & Geomatics**	1L + 1T	2 Credits
Module 1	**Introduction to Surveying** Principles, Linear, angular and graphical methods,Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying,Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levellingand cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics,methods, uses; areas and volumes. **Triangulation and Trilateration** Theodolite survey: Instruments, Measurement ofhorizontal and vertical angle; Horizontal and vertical control - methods -triangulation -network-Signals. Baseline - choices - instruments and accessories - extension of base lines -corrections -Satellite station - reduction to centre - Intervisibility of height and distances - Trigonometric levelling - Axis single corrections.		10 L
Module 2:	**Curves** Elements of simple and compound curves – Method of setting out–Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve -Vertical curves		5L
Module 3	**Modern Field Survey Systems** Principle of Electronic Distance Measurement,Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station –Accessories –Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems-Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation,accuracy considerations.		8L
Module 4	**Photogrammetry Surveying** Introduction, Basic concepts, perspectivegeometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flightplanning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation,radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereo plotting instruments, mosaics, map substitutes.		6L
Module 5	**Remote Sensing** Introduction –Electromagnetic Spectrum, interaction ofelectromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.		4 L
Reference	1. Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006. 2. Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011 3. Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010 4. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002. 5. Anji Reddy, M., Remote sensing and Geographical information system, B.S. Publications, 2001. 6. Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015. 7. Punamia, Surveying, Vol.-I & II, Laxmi Publications		

CE(PC)406	**Materials, Testing & Evaluation**	1L + 1T	2 Credits
Module 1	**Introduction to Engineering Materials** Cements, M-Sand, Concrete (plain,reinforced and steel fibre/ glass fibre-reinforced, light-weight concrete, High Performance Concrete,Polymer Concrete) Ceramics, and Refractories, Bitumen and asphaltic materials, Timbers, Glass andPlastics, Structural Steel and other Metals, Paints and Varnishes, Acoustical material and geotextiles,rubber and asbestos, laminates and adhesives, Graphene, Carbon composites and otherengineering materials including properties and uses of these		5L
Module 2	**Introduction to Material Testing** What is the "Material Engineering"?;Mechanical behavior and mechanical characteristics; Elasticity – principle and characteristics; Plasticdeformation of metals; Tensile test – standards for different material (brittle, quasi-brittle, elastic andso on) True stress – strain interpretation of tensile test; hardness tests; Bending and torsion test;strength of ceramic; Internal friction, creep – fundaments and characteristics; Brittle fracture of steel– temperature transition approach; Background of fracture mechanics; Discussion of fracturetoughness testing – different materials; concept of fatigue of materials; Structural integrityassessment procedure and fracture mechanics		8L
Module 3	Standard Testing & Evaluation Procedures covering, Laboratory for mechanical testing;Discussion about mechanical testing; Naming systems for various irons, steels and nonferrousmetals; Discussion about elastic deformation; Plastic deformation; Impact test and transitiontemperatures; Fracture mechanics – background; Fracture toughness – different materials; Fatigue ofmaterial; Creep.		8L
Tutorials	**Tutorials** from the above modules covering, understanding i) Tests & testing of bricks, ii) Tests &testing of sand, iii) Tests & testing of concrete, iv) Tests & testing of soils, v) Tests & testing ofbitumen & bituminous mixes, vi) Tests & testing of polymers and polymer based materials, vii)Tests & testing of metals & viii) Tests & testing of other special materials, composites and cementitious materials. Explanation of mechanical behavior of these materials.		7L
Reference	1. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.),R. Butterworth-Heinemann 2. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, ' Highway Materials and Pavement Testing', Nem Chand& Bros, Fifth Edition 3. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materialsused for Civil Engineering applications 4. Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella 5. E.N. Dowling (1993), Mechanical Behaviour of Materials,Prentice Hall International Edition 6. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards (post 2000) 7. Related papers published in international journals		

CE(HS)401	**Civil Engineering - Societal & Global Impact**	2L + 0T	2 Credits
Module 1	Introduction to Course and Overview; Understanding the past to look into the future: Preindustrialrevolution days, Agricultural revolution, first and second industrial revolutions, ITrevolution; Recent major Civil Engineering breakthroughs and innovations; Present day world andfuture projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Globalwarming, its impact and possible causes; Evaluating future requirements for various resources; GISand applications for monitoring systems; Human Development Index and Ecological Footprint ofIndia Vs other countries and analysis;		5L
Module 2	Understanding the importance of Civil Engineering in shaping and impacting the world;The ancient and modern Marvels and Wonders in the field of Civil Engineering; Future Vision forCivil Engineering		4L
Module 3	Infrastructure - Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground,under water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic, Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy); Water provisioning;Telecommunication needs (towers, above-ground and underground cabling); Awareness of variousCodes & Standards governing Infrastructure development; Innovations and methodologies forensuring Sustainability;		8L
Module 4	Environment-Traditional & futuristic methods; Solid waste management, Waterpurification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams,Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warmingphenomena and Pollution Mitigation measures, Stationarity and non-stationarity; EnvironmentalMetrics & Monitoring; Other Sustainability measures; Innovations and methodologies for ensuringSustainability.		8L
Module 5	Built environment–Facilities management, Climate control; Energy efficient builtenvironments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban ArtsCommissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability		7L
Module 6	Civil Engineering Projects – Environmental Impact Analysis procedures; Waste(materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspectsof Civil Engineering Projects; New Project Management paradigms & Systems (Ex. LeanConstruction), contribution of Civil Engineering to GDP, Contribution to employment(projects,facilities management), Quality of products, Health & Safety aspects for stakeholders; Innovationsand methodologies for ensuring Sustainability during Project development;		8L
Reference	1. Žiga Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht 2. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004. 3. Barry M. (2003) Corporate social responsibility – unworkable paradox or sustainable paradigm? Proc ICE Engineering Sustainability 156. Sept Issue ES3 paper 13550. p 129-130 4. Cavill S., Sohail M. (2003) Accountability in the provision of urban services. Proc. ICE. Municipal Engineer 156. Issue ME4 paper 13445, p235-244. 5. Brugnach M., Dewulf A., Pahl-Wostl C., Taillieu T. (2008) Toward a relational concept of uncertainty: about knowing too little, knowing too differently and accepting not to know. Ecology and Society 13 (2): 30		

CE(MC)401	**Management I (Organizational Behaviour)**	3L + 0T	0 Credits
Module 1	Introduction, Foundations of individual behaviour-Ability, Attitudes , Job Satisfaction, Personality, Values , Perception		4L
Module 2	Motivation–Theories, leadership, Foundations of Group behaviour -Group development; Group properties: Roles, norms, status, size and cohesiveness, Group decision making, Techniques, Work teams		10L
Module 3	Organisation Design: Understanding organizations-Basics of an organizational design-Organization and stakeholders-Organizations and environmental influences-Organizational strategy-Organizational design -Alternative structures-Management process - Authority and organizational control mechanisms-Managing organizational culture Technology and organizational design- Organizational decision making and organizational learning & knowledge management-Organizational life cycle and change management- Managing organizational conflict, power and politics		14L
Module 4	Organizational Change and Development: Dynamics of planned change, models and theories of planned change, triggers for change, strategies for implementing organizational change, Conceptual Framework of OD, OCTAPACE model of climate survey. Managing OD Process, Classification of OD interventions, team building Interventions, structural interventions, comprehensive OD interventions, Power and Politics in OD, Issues in Client Consultant Relationship, Interdisciplinary nature of OD		6L
Module 5	Leadership: Roles of a leader, Leadership theory paradigms, analysis of leadership theory; Leadership traits and ethics: Personality traits and leadership, Leadership attitudes, ethical leadership, Leadership behavior and motivation, contingency leadership, Team Leadership, Organizational Leadership, Strategic leadership, Leadership for Creating high performance culture, Leadership development through self-awareness and self-discipline, Development through education, experience and mentoring, Succession, Evaluation of leadership development efforts, Indian cases on leadership		8L
Reference	1. Organisational Behaviour by Inder Jeet Suman Solanki, Edition : 2017 Edition ,ISBN No.:9789386635549, TAXMANN'S 2. Organizational Behavior, , by Stephen P. Robbins, Timothy A Judge, Neharika Vohra, 16/e Sixteenth Edition ,Pearson Publishers 3. Organisational Behaviour (Text and Cases) by Dr. S.S. Khanka, S. Chand. & Company Pvt. Ltd. 4. Premvir Kapoor, Principles and Practices of Management, AICTE		

CE(PC)491	**Instrumentation & Sensor Technologies for Civil Engineering Applications**	0L + 2P	1 Credits
1	Instrumentation of typical civil engineering members/structures/structural elements		
2	Use of different sensors, strain gauges, inclinometers,		
3	Performance characteristics		
4	Errors during the measurement process		
5	Calibration of measuring sensors and instruments		
6	Measurement, noise and signal processing		
7	Analog Signal processing		
8	Digital Signal Processing		
9	Demonstration & use of sensor technologies		

CE(PC)492	**Engineering Geology**	1L + 2P	2 Credits
Theory			
Module 1	Introduction-Branches of geology useful to civil engineering, scope of geological studiesin various civil engineering projects. Department dealing with this subject in India and their scope ofwork- GSI, Granite Dimension Stone Cell, NIRM. Mineralogy-Mineral, Origin and composition.Physical properties of minerals, susceptibility of minerals to alteration, basic of optical mineralogy,SEM, XRD., Rock forming minerals, megascopic identification of common primary & secondaryminerals.		4L
Module 2	Petrology-Rock forming processes. Specific gravity of rocks. Ternary diagram. Igneouspetrology- Volcanic Phenomenon and different materials ejected by volcanoes. Types of volcaniceruption. Concept of Hot spring and Geysers. Characteristics of different types of magma. Divisionof rock on the basis of depth of formation, and their characteristics. Chemical and MineralogicalComposition. Texture and its types. Various forms of rocks. IUGS Classification of phaneritic andvolcanic rock.. Field Classification chart. Structures. Classification of Igneous rocks on the basis ofChemical composition. Detailed study of Acidic Igneous rocks like Granite, Rhyolite or Tuff, Felsite, Pegmatite, Hornfels. Metamorphic Aureole, Kaolinization. Landform as Tors. Engineeringaspect to granite. Basic Igneous rocks Like Gabbro, Dolerite, Basalt. Engineering aspect to Basalt.Sedimentary petrology- mode of formation, Mineralogical Composition. Texture and its types,Structures, Gradation of Clastic rocks. Classification of sedimentary rocks and their characteristics.Detailed study of Conglomerate, Breccia, Sandstone, Mudstone and Shale, Limestone Metamorphicpetrology- Agents and types of metamorphism, metamorphic grades, Mineralogical composition,structures & textures in metamorphic rocks. Important Distinguishing features of rocks as Rockcleavage, Schistosity, Foliation. Classification. Detailed study of Gneiss, Schist, Slate withengineering consideration.		6L
Module 3	Physical Geology- Weathering. Erosion and Denudation. Factors affecting weatheringand product of weathering. Engineering consideration. Superficial deposits and its geotechnicalimportance: Water fall and Gorges, River meandering, Alluvium, Glacial deposits, Laterite(engineering aspects), Desert Landform, Loess, Residual deposits of Clay with flints, Solifluctiondeposits, mudflows, Coastal deposits.		3L
Module 4	Strength Behavior of Rocks- Stress and Strain in rocks. Concept of Rock Deformation &Tectonics. Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Main types ofdiscontinuities according to size. Fold- Types and nomenclature, Criteria for their recognition infield. Faults: Classification, recognition in field, effects on outcrops. Joints & Unconformity; Types,Stresses responsible, geotechnical importance. Importance of structural elements in engineeringoperations. Consequences of failure as land sliding, Earthquake and Subsidence. Strength of Igneousrock structures.		3L
Module 5:	Geological Hazards-Rock Instability and Slope movement: Concept of sliding blocks.Different controlling factors. Instability in vertical rock structures and measures to prevent collapse.Types of landslide. Prevention by surface drainage, slope reinforcement by Rock bolting and Rockanchoring, retaining wall, Slope treatment. Case study on black clay. Ground water: Factorscontrolling water bearing capacity of rock. Pervious & impervious rocks and ground water.Lowering of water table and Subsidence. Earthquake: Magnitude and intensity of earthquake.Seismic sea waves. Revelation from Seismic Records of structure of earth. Case Study on Elevationand Subsidence in Himalayan region in India. Seismic Zone in India.		3L
Module 6	Rock masses as construction material: Definition of Rock masses. Main featuresconstituting rock mass. Main features that affects the quality of rock engineering and design. Basicelement and structures of rock those are relevant in civil engineering areas. Main types of worksconnected to rocks and rock masses. Important variables influencing rock properties and behaviour such as Fresh rock Influence from some minerals. Effect of alteration and weathering. Measurementof velocity of sound in rock. Classification of Rock material strength. Core logging .Rock QualityDesignation. Rock mass description.		3L
Module 7	Geology of dam and reservoir site- Required geological consideration for selecting damand reservoir site. Failure of Reservoir. Favourable & unfavourable conditions in different types of		3L

	rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions, significance of discontinuities on the dam site and treatment giving to such structures.	
Module 8	Rock Mechanics- Sub surface 9nvestigations in rocks and engineering characteristics orrocks masses; Structural geology of rocks. Classification of rocks, Field & laboratory tests on rocks,Stress deformation of rocks, Failure theories and sheer strength of rocks, Bearing capacity of rocks.	3L
Laboratory		
	1. Study of physical properties of minerals. 2. Study of different group of minerals. 3. Study of Crystal and Crystal system. 4. Identification of minerals: Silica group: Quartz, Amethyst, Opal; Feldspar group: Orthoclase, Plagioclase; Cryptocrystalline group: Jasper; Carbonate group: Calcite; Element group: Graphite; Pyroxene group: Talc; Mica group: Muscovite; Amphibole group: Asbestos, Olivine, Hornblende, Magnetite, Hematite, Corundum, Kyanite, Garnet, Galena, Gypsum. 5. Identification of rocks (Igneous Petrology): Acidic Igneous rock: Granite and its varieties, Syenite, Rhyolite, Pumice, Obsidian, Scoria, Pegmatite, Volcanic Tuff. Basic rock: Gabbro, Dolerite, Basalt and its varieties, Trachyte. 6. Identification of rocks (Sedimentary Petrology): Conglomerate, Breccia, Sandstone and its varieties , Laterite, Limestone and its varieties, Shales and its varieties. 7. Identification of rocks (Metamorphic Petrolody): Marble, slate, Gneiss and its varieties, Schist and its varieties. Quartzite, Phyllite. 8. Study of topographical features from Geological maps. Identification of symbols in maps.	
Reference	1. Engineering and General Geology, Parbin Singh, 8th Edition (2010), S K Kataria& Sons. 2. Text Book of Engineering Geology, N. ChennaKesavulu, 2nd Edition (2009), Macmillan Publishers India. 3. Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982).	

CE(PC)493	**Introduction to Fluid Mechanics**	0L + 2P	1 Credits
	1. Measurement of viscosity 2. Study of Pressure Measuring Devices 3. Stability of Floating Body 4. Hydrostatics Force on Flat Surfaces/Curved Surfaces 5. Verification of Bernoulli's Theorem 6. Venturimeter 7. Orifice meter 8. Impacts of jets 9. Flow Visualisation -Ideal Flow 10. Length of establishment of flow 11. Velocity distribution in pipes 12. Laminar Flow		

CE(PC)494	**Surveying & Geomatics**	0L + 2P	1 Credits
	1. Chain surveying: Preparing index plans, Location sketches, Ranging, Preparation of map, Heights of objects using chain and ranging rods, Getting outline of the structures by enclosing them in triangles/quadrilaterals, Distance between inaccessible points, Obstacles in chain survey. 2. Compass surveying: Measurement of bearings, Preparation of map, Distance between two inaccessible points by chain and compass, Chain and compass traverse 3. Plane Table survey: Temporary adjustments of plane table and Radiation method, Intersection, Traversing and Resection methods of plane tabling, Three-point problem 4. Leveling: Temporary adjustment of Dumpy level, Differential leveling, Profile leveling and plotting the profile, Longitudinal and cross sectioning, Gradient of line and setting out grades, Sensitiveness of Bubble tube 4. Contouring Direct contouring, Indirect contouring – Block leveling, Indirect contouring – Radial contouring, Demonstration of minor instruments 5. Traversing by Using Theodolite: Preparation of Gales Table from field data 6. Traversing by using Total Station 7. Use of Total Station for leveling and Contouring 8. Setting out of Simple Curves 9. Interpretation of images using Remote Sensing Softwares		

CE(PC)495	**Materials, Testing & Evaluation**	0L + 2P	1 Credits
	1. Gradation of coarse and fine aggregates 2. Different corresponding tests and need/application of these tests in design and quality control 3. Tensile Strength of materials & concrete composites 4. Compressive strength test on aggregates 5. Tension I - Elastic Behaviour of metals & materials 6. Tension II - Failure of Common Materials 7. Direct Shear - Frictional Behaviour 8. Concrete I - Early Age Properties 9. Concrete II - Compression and Indirect Tension 10. Compression – Directionality 11. Soil Classification 12. Consolidation and Strength Tests 13. Tension III - Heat Treatment 14. Torsion test 15. Hardness tests (Brinnel's and Rockwell) 16. Tests on closely coiled and open coiled springs 17. Theories of Failure and Corroboration with Experiments 18. Tests on unmodified bitumen and modified binders with polymers 19. Bituminous Mix Design and Tests on bituminous mixes - Marshall method 20. Concrete Mix Design as per BIS		