Semester V [Third year]

CE(PC)501	**Mechanics of Materials**	3L + 0T	3 Credits
Module 1:	**Deformation and Strain covering** description of finite deformation, Infinitesimaldeformation; Analysis of statically determinate trusses; Stability of dams, retaining walls andchimneys; Stress analysis of thin, thick and compound cylinder;		4L
Module 2:	**Generalized state of stress and strain** Stress and strain tensor, Yield criteria and theoriesof failure; Tresca, Von-Mises, Hill criteria, Heigh-Westerguard's stress space.		4L
Module 3:	**Momentum Balance and Stresses** Forces and Moments Transmitted by SlenderMembers, Shear Force and Bending Moment Diagrams, Momentum Balance, Stress States / FailureCriterion		5L
Module 4:	**Mechanics of Deformable Bodies** Force-deformation Relationships and StaticIndeterminacy, Uniaxial Loading and Material Properties, Trusses and Their Deformations,Statically Determinate and Indeterminate Trusses,		6L
Module 5:	**Force-Stress-Equilibrium** Multiaxial Stress and Strain		2L
Module 6:	**Displacement – Strain** Multiaxial Strain and Multiaxial Stress-strainRelationships		3L
Module 7:	**Elasticity and Elasticity Bounds** Stress-strain-temperature Relationships andThin-walled Pressure Vessels, Stress and strain Transformations and Principal Stress, Failure ofMaterials,		4L
Module 8	**Bending: Stress and Strains; Deflections and Torsion** Pure Bending, MomentcurvatureRelationship, Beam Deflection, Symmetry, Superposition, and Statically IndeterminateBeams, Shear and Torsion, Torsion and Twisting, Thermoelasticity, Energy methods, VariationalMethods; Strain energy, elastic, complementary and total strain energy, Strain energy of axiallyloaded bar, Beam in bending, shear and torsion; General energy theorems, Castigliano's theorem,Maxwell Bettie's reciprocal theorem; Virtual work and unit load method for deflection, Applicationto problems of beams and frames.		8L
Module 9	**Structural stability;** Stability of columns, Euler's formula, end conditions and effectivelength factor, Columns with eccentric and lateral load; Plasticity and Yield Design covering 1D Plasticity– An Energy Approach, Plasticity Models, Limit Analysis and Yield Design		6L
Reference	1. Norris, C.H. and Wilber, J. B. and Utku, S. "Elementary Structural Analysis" Mc Graw-Hill, Tokyo, Japan 2. Kazmi, S. M. A., 'Solid Mechanics" TMH, Delhi, India 3. Courtney, T. H. Mechanical Behaviour of Materials. McGraw-Hill, 1990 4. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004		

CE(PC)502	**Hydraulic Engineering**	2L + 0T	2 Credits
Module 1	Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity.		3L
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 toflow of fluid in smooth and rough pipes, Moody's diagram.		4L
Module 3	Boundary Layer Analysis-Assumption and concept of boundary layer theory. Boundary layer thickness, displacement, momentum & energy thickness, laminar and Turbulent boundarylayers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average frictioncoefficients. Separation and Control.		4L
Module 4	Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity, Rayleighmethod, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Modelstudies, Types of models. Application of dimensional analysis and model studies to fluid flowproblem.		4L
Module 5	Introduction to Open Channel Flow-Comparison between open channel flow and pipeflow, geometrical parameters of a channel, classification of open channels, classification of openchannel flow, Velocity Distribution of channel section.		4L
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 Coefficient "n". Most economical section of channel. Computation of Uniform flow, Normal depth.		3L
Module 7	Non-Uniform Flow- Specific energy, Specific energy curve, critical flow, discharge curveSpecific force Specific depth, and Critical depth. Channel Transitions. Measurement of Dischargeand 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, Classificationof surface profile, Characteristics of surface profile. Computation of water surface profile bygraphical, numerical and analytical approaches. Direct Step method, Graphical Integration methodand Direct integration method.		3L
Module 8	Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulicjump in a rectangular Channel, length and height of jump, location of jump, Types,applications andlocation 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 onplates, pipe bends, moments of momentum equation,		3L
Module 9	Flow through Pipes: Loss of head through pipes, Darcy-Weisbach equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes inparallel, 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 controlmeasures, branching of pipes, three reservoir problem.		3L
Module 10	Computational Fluid Dynamics: Basic equations of fluid dynamics, Grid generation,Introduction to in viscid incompressible flow, Boundary layer flow as applicable to C.F.D. Hydroinformatics: Concept of hydro informatics –scope of internet and web based modelling in water resources engineering.		3L
Reference	1. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House 2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill. 3. Open channel Flow, K. Subramanya, Tata McGraw Hill. 4. Open Channel Hydraulics, VenTe Chow, Tata McGraw Hill. 5. Burnside, C.D., "*Electromagnetic Distance Measurement*," Beekman Publishers, 1971.		

CE(PC)503	**Structural Engineering**	3L + 1T	4 Credits
Module 1	Introduction- concepts of energy principles, safety, sustainable development inperformance; what makes a structure; principles of stability, equilibrium; what is a structuralengineer, role of engineer, architect, user, builder; what are the functions' what do the engineers design, first principles of process of design		5L
Module 2	Planning and Design Process; Materials, Loads, and Design Safety; Behaviour and Properties of Concrete and Steel; Wind and Earthquake Loads		5L
Module 3	Materials and Structural Design Criteria: Introduction to the analysis and design of structural systems. Analyses of determinate and indeterminate trusses, beams, and frames, and design philosophies for structural engineering. Laboratory experiments dealing with the analysis of determinate and indeterminate structures		8L
Module 4	Design of Structural Elements; Concrete Elements, Steel Elements, Structural Joints;Theories and concepts of both concrete and steel design and analysis both at the element and system levels. Approximate Analysis Methods as a Basis for Design; Design of Reinforced Concrete Beamsfor Flexure; Design of Reinforced Concrete Beams for Shear; Bond, Anchorage, and Serviceability;Reinforced Concrete Columns; Reinforced Concrete Slabs; Introduction to Steel Design; TensionMembers and Connections; Bending Members; Structural Systems		14L
Module 5	System Design Concepts; Special Topics that may be Covered as Part of the Design Project Discussions; Cable Structures; Prestressed Concrete Bridges; Constructability and Structural Control; Fire Protection		10L
Reference	1. Nilson, A. H. *Design of Concrete Structures.* 13th edition. McGraw Hill, 2004 2. McCormac, J.C., Nelson, J.K. Jr., *Structural Steel Design*. 3rd edition. Prentice Hall, N.J., 2003. 3. Galambos, T.V., Lin, F.J., Johnston, B.G., *Basic Steel Design with LRFD*, Prentice Hall, 1996 4. Segui, W. T., *LRFD Steel Design*, 2nd Ed., PWS Publishing, Boston. 5. Salmon, C.G. and Johnson, J.E., *Steel Structures: Design and Behavior*, 3rd Edition, Harper & Row, Publishers, New York, 1990. 6. MacGregor, J. G., *Reinforced Concrete: Mechanics and Design*, 3rd Edition, Prentice Hall, New Jersey, 1997. 7. Nawy, E. G., *Reinforced Concrete: A Fundamental Approach*, 5th Edition, Prentice Hall, New Jersey. 8. Wang C-K. and Salmon, C. G., *Reinforced Concrete Design*, 6th Edition, Addison Wesley, New York. 9. Nawy, E. G. *Prestressed Concrete: A Fundamental Approach*, Prentice Hall, NJ, (2003). 10. Related Codes of Practice of BIS 11. Smith, J. C., *Structural Analysis*, Harpor and Row, Publishers, New York. 12. W. McGuire, R. H. Gallagher and R. D. Ziemian. "Matrix Structural Analysis", 2nd Edition, John Wiley and Sons, 2000. 13. NBC, *National Building Code*, BIS (2017). 14. ASCE, *Minimum Design Loads for Buildings and Other Structures, ASCE 7-02*, American Society of Civil Engineers, Virginia, 2002.		

CE(PC)504	Geotechnical Engineering	2L + 1T	3 Credits
Module 1	Introduction–Types of soils, their formation and deposition, Soil as three-phase system in terms of weight & volume. Definitions & Relationship: moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, etc. Determination of Moisture content. Specific gravity, Unit weight.		4 L
Module 2	Plasticity Characteristics of Soil - Consistency limits-liquid limit, plastic limit, shrinkage limit. Determination of: liquid limit, plastic limit and shrinkage limit. Classification of Soils- particle size classification, Indian standard soil classification system.		4 L
Module 3	Permeability: Darcy`s law, Determination of co-efficient of permeability, Laboratory method: constant-head method, falling-head method. Field method: pumping. Seepage Analysis-characteristics of flow nets, graphical method to plot flow nets.		4 L
Module 4	Effective Stress Principle - effective stress in soils saturated by capillary action, seepage pressure, quick sand condition.		2 L
Module 5	Compaction of Soil- theory of compaction, laboratory determination of optimum moisture content and maximum dry density. Compaction in field and field control.		2 L
Module 6	Stresses in soils –stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, Newmark's Influence Chart.		4 L
Module 7	Consolidation of Soil - initial, primary & secondary consolidation, Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation.		4 L
Module 8	Shear Strength - Mohr-Coulomb theory, types of shear tests: direct shear test, triaxial compression tests, pore pressure measurement, unconfined compression test, vane shear test.		4 L
Module 9	Earth pressure theories: Earth pressure at rest, Active & passive earth pressure, Rankine's & Coulomb's earth pressure theories.		4 L
Module 10	Stability of Slopes - types of slopes, factor of safety, analysis of finite and infinite slopes, Swedish and friction circle method, Taylor's stability number.		4 L
Module 11	Soil Exploration- methods of site exploration and soil investigation, methods of boring, soil samplers, sampling procedures, penetrometer tests, analysis of borehole logs.		2 L
Module 12	Introduction to Shallow and Deep foundations: Safe & Allowable bearing capacity, Terzaghi's bearing capacity theory, Bearing capacity as per 1S 6403. Pile: Types, Load carrying capacities of piles by static and Dynamic formulae, Pile group: Group efficiency, Negative skin friction.		4 L
Reference	1. An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ 2. Principles of Geotechnical Engineering B. M. Das Thomson Book Store 3. Basic & Applied Soil Mechanics Gopal Ranjan& Willes Eastern Ltd A.S.R.Rao 4. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons 5. Text book of Soil Mechanics & Foundation V.N.S. Murthy CBS Publisher's & Engineering Distributors 6. Essentials of Soil Mechanics and Foundations: Basic Geotechnics by David F. McCarthy 7. Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and GholamrezaMesri. 8. Geotechnical Engineering – Principles and Practice Coduto Pearson Education		

CE(PC)505	**Environmental Engineering**	2L + 1T	3 Credits
Module 1	Water: -Sources of Water and quality issues, water quality requirement for differentbeneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, Need for planned water supply schemes, Water demand industrial and agricultural waterrequirements, Components of water supply system; Transmission of water, Distribution system,Various valves used in W/S systems, service reservoirs and design.Water Treatment: aeration, sedimentation, coagulation flocculation, filtration, disinfection, advancedtreatments like adsorption, ion exchange, membrane processes		12L
Module 2	Sewage- Domestic and Storm water, Quantity of Sewage, Sewage flow variations.Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers,Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small boresystems, Storm Water-Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans, Wastewater treatment, aerobic andanaerobic treatment systems, suspended and attached growth systems, recycling of sewage – qualityrequirements for various purposes.		10L
Module 3	Air - Composition and properties of air, Quantification of air pollutants, Monitoring of airpollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Chemistryof combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Airquality standards, Control measures for Air pollution, construction and limitations		6L
Module 4	Noise- Basic concept, measurement and various control methods.		3L
Module 5	Solid waste management-Municipal solid waste, Composition and various chemical andphysical parameters of MSW, MSW management: Collection, transport, treatment and disposal ofMSW. Special MSW: waste from commercial establishments and other urban areas, solid waste fromconstruction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source,recovery and recycle. Disposal methods- Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.		4L
Module 6	Building Plumbing-Introduction to various types of home plumbing systems for watersupply and waste water disposal, high rise building plumbing, Pressure reducing valves, Breakpressure tanks, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures andfittings used.		4L
Module 7	Government authorities and their roles in water supply, sewerage disposal. Solid wastemanagement and monitoring/control of environmental pollution.		3L
Reference	1. Introduction to Environmental Engineering and Science by Gilbert Masters. Prentice Hall, New Jersey. 2. Introduction to Environmental Engineering by P. AarneVesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008. 3. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw -Hill International Editions, New York 1985. 4. MetCalf and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi. 5. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi. 6. Plumbing Engineering. Theory, Design and Practice, S.M. Patil, 1999 7. Integrated Solid Waste Management, Tchobanoglous, Theissen& Vigil. McGraw Hill Publication 8. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.		

CE(PC)506	**Transportation Engineering**	2L + 0T	2 Credits
Module 1	Highway development and planning-Classification of roads, road development in India, Current road projects in India; highway alignment and project preparation.		4L
Module 2	Geometric design of highways-: Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems		6L
Module 3	Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities;highway lighting; problems		6L
Module 4	Pavement materials- Materials used in Highway Construction- Soils, Stone aggregates,bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirableproperties, tests, requirements for different types of pavements. Problems		6L
Module 5	Design of pavements- Introduction; flexible pavements, factors affecting design andperformance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements components and functions; factors affecting design and performance of CC pavements; stresses in rigidpavements; design of concrete pavements as per IRC; problems		8L
Reference	1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017 2. Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna Publishers. 3. Partha Chakraborty, ' Principles Of Transportation Engineering, PHI Learning, 4. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,' Principles of Highway Engineering and Traffic Analysis', 4th Edition, John Wiley 5. Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011. 6. Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition,2009.		

CE(MC)501	**Constitution of India/ Essence of Indian Knowledge Tradition**	0L + 0T	0 Credits

CE(PC)591	**Hydraulic Engineering**	0L + 2P	1 Credits
	1. Flow Visualization 2. Studies in Wind Tunnel 3. Boundary Layer 4. Flow around an Aerofoil / circular cylinder 5. Uniform Flow 6. Velocity Distribution in Open channel flow 7. Venturi Flume 8. Standing Wave Flume 9. Gradually Varied Flow 10. Hydraulic Jump 11. Flow under Sluice Gate 12. Flow through pipes 13. Turbulent flow through pipes 14. Flow visualization 15. Laminar flow through pipes 16. Major losses / Minor losses in pipe		

CE(PC)592	**Structural Engineering**	0L + 2P	1 Credits
	1. Design and detailing of a (G+4) residential building and its components only for dead load and live load (w/o wind load, and earthquake load) 2. Design and detailing of a factory shed and its components w/o gantry girder and plate girder		

CE(PC)593	**Geotechnical Engineering**	0L + 2P	1 Credits
	1. Field identification of Fine Grained soils and determination of natural moisture content. 2. Determination of Field density by core cutter method & sand replacement method. 3. Determination of specific gravity of soil 4. Grain size distribution of soil by Sieve Analysis and Hydrometer Analysis. 5. Determination of Atterberg's limits (liquid limit, plastic limit & shrinkage limit). 6. Determination of co-efficient of permeability by Constant-head test method & Falling-head method. 7. Determination of compaction characteristics of soil by Standard Proctor test and Modified Proctor test. 8. Determination of compressibility characteristics of soil by Consolidation Test. 9. Determination of Shear parameter of soil by Direct shear test 10. Determination of shear parameter of soil by Triaxial test (UU) 11. Determination of unconfined compressive strength of soil 12. Determination of undrained shear strength of soil by Vane shear test. 13. Determination of Relative density of cohesive soil.		
Reference	1. Soil Testing by T.W. Lamb (John willey) 2. 2. SP-36 (Part I-& Part – II) 3. Soil Mechanics Laboratory Manual by Braja Mohan Das, OXFORD UNIVERSITY PRESS 4. Measurement of Engineering properties of soil by E Saibaba Reddy & K. Rama Sastri. (New age International publication.		

CE(PC)594	**Environmental Engineering**	0L + 2P	1 Credits
	1. Physical Characterization of water: Turbidity, Electrical Conductivity, pH 2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, norganicetc. 3. Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness 4. Analysis of ions: copper, chloride and sulfate 5. Optimum coagulant dose 6. Chemical Oxygen Demand (COD) 7. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD) 8. Break point Chlorination 9. Bacteriological quality measurement: MPN, 10. Ambient Air quality monitoring (TSP, RSPM, SOx, NOx) 11. Ambient noise measurement		

CE(PC)595	**Transportation Engineering**	0L + 2P	1 Credits
	Tests on highway materials – Aggregates- Impact value, Los-Angeles Abrasion value water absorption , Elongation & Flakiness Index. Bitumen & bituminous materials: Specific gravity, penetration value, softening point, loss on heating, Flash & Fire point test. Stripping value test Design of B.C. & S.D.B.C. Mix CBR Test Marshal Stability Test Benkelman beam Test. **References:** BIS codes on Aggregates & Bituminous materials Highway material testing(Laboratory Manual)by S.K. Khanna and CE.G. Justo Relevant IS & I.R.C. codes.		