B.Tech. Syllabus

(2010 Batch onwards)

CH 101 Chemistry (3-1-0-8)

Structure and Bonding; Origin of quantum theory, postulates of quantum mechanics; Schrodinger wave equation: operators and observables, superposition theorem and expectation values, solutions for particle in a box, harmonic oscillator, rigid rotator, hydrogen atom; Selection rules of microwave and vibrational spectroscopy; Spectroscopic term symbol; Molecular orbitals: LCAO-MO; Huckel theory of conjugated systems; Rotational, vibrational and electronic spectroscopy; Chemical Thermodynamics: The zeroth and first law, Work, heat, energy and enthalpies; The relation between C_v and C_p; Second law: entropy, free energy (the Helmholtz and Gibbs) and chemical potential; Third law; Chemical equilibrium; Chemical kinetics: The rate of reaction, elementary reaction and chain reaction; Surface: The properties of liquid surface, surfactants, colloidal systems, solid surfaces, physisorption and chemisorption; The periodic table of elements; Shapes of inorganic compounds; Chemistry of materials; Coordination compounds: ligand, nomenclature, isomerism, stereochemistry, valence bond, crystal field and molecular orbital theories; Bioinorganic chemistry and organometallic chemistry; Stereo and regio-chemistry of organic compounds, conformers; Pericyclic reactions; Organic photochemistry; Bioorganic chemistry: Amino acids, peptides, proteins, enzymes, carbohydrates, nucleic acids and lipids; Macromolecules (polymers); Modern techniques in structural elucidation of compounds (UV-vis, IR, NMR); Solid phase synthesis and combinatorial chemistry; Green chemical processes.

Texts:

1. P. W. Atkins, *Physical Chemistry*, 5th Ed., ELBS, 1994.
2. C. N. Banwell, and E. M. McCash, *Fundamentals of Molecular Spectroscopy*, 4th Ed., Tata McGraw-Hill, 1962.
3. F. A. Cotton, and G. Wilkinson, *Advanced Inorganic Chemistry*, 3rd Ed., Wiley Eastern Ltd., New Delhi, 1972, reprint in 1988.
4. D. J. Shriver, P. W. Atkins, and C. H. Langford, *Inorganic Chemistry*, 2nd Ed., ELBS ,1994.
5. S. H. Pine, *Organic Chemistry*, McGraw-Hill, 5th Ed., 1987

References:

1. I. A. Levine, *Physical Chemistry*, 4th Ed., McGraw-Hill, 1995.
2. I. A. Levine, *Quantum Chemistry*, EE Ed., prentice Hall, 1994.
3. G. M. Barrow, *Introduction to Molecular Spectroscopy*, International Edition, McGraw-Hill, 1962
4. J. E. Huheey, E. A. Keiter and R. L. Keiter, *Inorganic Chemistry: Principle, structure and reactivity*, 4th Ed., Harper Collins, 1993
5. L. G. Wade (Jr.), *Organic Chemistry*, Prentice Hall, 1987.

CS 101 Introduction to Computing (3-0-0-6)

Introduction: The von Neumann architecture, machine language, assembly language, high level programming languages, compiler, interpreter, loader, linker, text editors, operating systems, flowchart; Basic features of programming (Using C): data types, variables, operators, expressions, statements, control structures, functions; Advanced programming features: arrays and pointers, recursion, records (structures), memory management, files, input/output, standard library functions, programming tools, testing and debugging; Fundamental operations on data: insert, delete, search, traverse and modify; Fundamental data structures: arrays, stacks, queues, linked lists; Searching and sorting: linear search, binary search, insertion-sort, bubble-sort, selection-sort, radix-sort, counting-sort; Introduction to object-oriented programming

Texts:

1. A Kelly and I Pohl, *A Book on C*, 4th Ed., Pearson Education, 1999.
2. A M Tenenbaum, Y Langsam and M J Augenstein, *Data Structures Using C*, Prentice Hall India, 1996.

References:

1. H Schildt, *C: The Complete Reference*, 4th Ed., Tata Mcgraw Hill, 2000
2. B Kernighan and D Ritchie, *The C Programming Language*, 4th Ed., Prentice Hall of India, 1988.

CS 110 Computing Laboratory (0-0-3-3)

Programming Laboratory will be set in consonance with the material covered in CS101. This will include assignments in a programming language

like C.

References:

1. B. Gottfried and J. Chhabra, *Programming With C*, Tata Mcgraw Hill, 2005

MA 102 Mathematics - II (3-1-0-8)

Vector functions of one variable – continuity and differentiability; functions of several variables – continuity, partial derivatives, directional derivatives, gradient, differentiability, chain rule; tangent planes and normals, maxima and minima, Lagrange multiplier method; repeated and multiple integrals with applications to volume, surface area, moments of inertia, change of variables; vector fields, line and surface integrals; Green's, Gauss' and Stokes' theorems and their applications.

First order differential equations – exact differential equations, integrating factors, Bernoulli equations, existence and uniqueness theorem, applications; higher-order linear differential equations – solutions of homogeneous and nonhomogeneous equations, method of variation of parameters, operator method; series solutions of linear differential equations, Legendre equation and Legendre polynomials, Bessel equation and Bessel functions of first and second kinds; systems of first-order equations, phase plane, critical points, stability.

Texts:

1. G. B. Thomas (Jr.) and R. L. Finney, *Calculus and Analytic Geometry*, 9th Ed., Pearson Education India, 1996.
2. S. L. Ross, *Differential Equations*, 3rd Ed., Wiley India, 1984.

References:

1. T. M. Apostol, *Calculus - Vol.2*, 2nd Ed., Wiley India, 2003.
2. W. E. Boyce and R. C. DiPrima, *Elementary Differential Equations and Boundary Value Problems*, 9th Ed., Wiley India, 2009.
3. E. A. Coddington, *An Introduction to Ordinary Differential Equations*, Prentice Hall India, 1995.
4. E. L. Ince, *Ordinary Differential Equations*, Dover Publications, 1958.

ME 101 Engineering Mechanics (3-1-0-8)

Basic principles: Equivalent force system; Equations of equilibrium; Free body diagram; Reaction; Static indeterminacy. Structures: Difference between trusses, frames and beams, Assumptions followed in the analysis of structures; 2D truss; Method of joints; Method of section; Frame; Simple beam; types of loading and supports; Shear Force and bending Moment diagram in beams; Relation among load, shear force and bending moment. Friction: Dry friction; Description and applications of friction in wedges, thrust bearing (disk friction), belt, screw, journal bearing (Axle friction); Rolling resistance. Virtual work and Energy method: Virtual Displacement; Principle of virtual work; Applications of virtual work principle to machines; Mechanical efficiency; Work of a force/couple (springs etc.); Potential energy and equilibrium; stability. Center of Gravity and Moment of Inertia: First and second moment of area; Radius of gyration; Parallel axis theorem; Product of inertia, Rotation of axes and principal moment of inertia; Moment of inertia of simple and composite bodies. Mass moment of inertia. Kinematics of Particles: Rectilinear

motion; Curvilinear motion; Use of Cartesian, polar and spherical coordinate system; Relative and constrained motion; Space curvilinear motion. Kinetics of Particles: Force, mass and acceleration; Work and energy; Impulse and momentum; Impact problems; System of particles. Kinematics and Kinetics of Rigid Bodies: Translation; Fixed axis rotational; General plane motion; Coriolis acceleration; Work-energy; Power; Potential energy; Impulse-momentum and associated conservation principles; Euler equations of motion and its application.

Texts

1. I. H. Shames, *Engineering Mechanics: Statics and Dynamics*, 4th Ed., PHI, 2002.
2. F. P. Beer and E. R. Johnston, *Vector Mechanics for Engineers*, *Vol I - Statics, Vol II – Dynamics*, 3rd Ed., Tata McGraw Hill, 2000.

References

1. J. L. Meriam and L. G. Kraige, *Engineering Mechanics*, *Vol I – Statics, Vol II – Dynamics*, 5th Ed., John Wiley, 2002.
2. R. C. Hibbler, *Engineering Mechanic*s, *Vols. I and II*, Pearson Press, 2002.

PH 102 Physics - II (2-1-0-6)

Vector Calculus: Gradient, Divergence and Curl, Line, Surface, and Volume integrals, Gauss's divergence theorem and Stokes' theorem in Cartesian, Spherical polar, and Cylindrical polar coordinates, Dirac Delta function.

Electrostatics: Gauss's law and its applications, Divergence and Curl of Electrostatic fields, Electrostatic Potential, Boundary conditions, Work and Energy, Conductors, Capacitors, Laplace's equation, Method of images, Boundary value problems in Cartesian Coordinate Systems, Dielectrics, Polarization, Bound Charges, Electric displacement, Boundary conditions in dielectrics, Energy in dielectrics, Forces on dielectrics.

Magnetostatics: Lorentz force, Biot-Savart and Ampere's laws and their applications, Divergence and Curl of Magnetostatic fields, Magnetic vector Potential, Force and torque on a magnetic dipole, Magnetic materials, Magnetization, Bound currents, Boundary conditions.

Electrodynamics: Ohm's law, Motional EMF, Faraday's law, Lenz's law, Self and Mutual inductance, Energy stored in magnetic field, Maxwell's equations, Continuity Equation, Poynting Theorem, Wave solution of Maxwell Equations.

Electromagnetic waves: Polarization, reflection & transmission at oblique incidences.

Texts:

1. D. J. Griffiths, *Introduction to Electrodynamics*, 3rd Ed., Prentice-Hall of India, 2005.
2. A.K.Ghatak, *Optics*, Tata Mcgraw Hill, 2007.

References:

1. N. Ida, *Engineering Electromagnetics*, Springer, 2005.
2. M. N. O. Sadiku, *Elements of Electromagnetics*, Oxford, 2006.
3. R. P. Feynman, R. B. Leighton and M. Sands, *The Feynman Lectures on Physics, Vol.II,* Norosa Publishing House, 1998.
4. I. S. Grant and W. R. Phillips, *Electromagnetism*, John Wiley, 1990.

EE 102 Basic Electronics Laboratory (0-0-3-3)

Experiments using diodes and bipolar junction transistor (BJT): design and analysis of half -wave and full-wave rectifiers, clipping circuits and Zener regulators, BJT characteristics and BJT amplifiers; experiments using operational amplifiers (op-amps): summing amplifier, comparator, precision rectifier, astable and monostable multivibrators and oscillators; experiments using logic gates: combinational circuits such as staircase switch, majority detector, equality detector, multiplexer and demultiplexer; experiments using flip-flops: sequential circuits such as non-overlapping pulse generator, ripple counter, synchronous counter, pulse counter and numerical display.

References:

1. A. P. Malvino, *Electronic Principles*, Tata McGraw-Hill, New Delhi, 1993.
2. R. A. Gayakwad, *Op-Amps and Linear Integrated Circuits*, PHI, New Delhi, 2002.
3. R.J. Tocci, *Digital Systems*, 6th Ed., 2001.

CE 202 SOLID MECHANICS (3 1 0 8)

Force Transmission and Deformation, continuum, isotropy, homogeneity, conservation of linear momentum, angular momentum and mass, Cauchy Axiom and definition of stress tensor, equation of equilibrium, Principal stress and Principal plane, Strain at a Point: Displacement of a point and relative displacement of line segments, Green Lagrange strain tensor and small strain tensor, Compatibility requirements, Constitutive relations,
Relationships between various material constants for linear elastic materials, Boundary Value Problems, Energy Formulation for deformable body: Principle of minimum potential energy, Virtual work method, Failure criteria for materials, Uniaxial tension in bar, thermal stresses. Torsion of right circular section and non-circular section, Bending of Beams, bending moment and shear force diagrams, Stresses due to shear, Shear center, Deflection of beams, Buckling of Columns: Euler's formula, different end conditions and effective length, energy method.

Texts:

1. S.M.A. Kazimi, *Solid mechanics*, Tata McGraw Hill, First revised edition, 2006.
2. E. P. Popov, Engineering Mechanics of Solids, Dorling Kindersley (India) Pvt Ltd, 2nd edition, 2006.

References:

1. L. S. Srinath, *Advanced Solid Mechanics*, Second Edition, Tata McGraw Hill, 2003.
2. J.M. Pitarresi, *Introduction to Solid Mechanics*, Prentice Hall of India, 2000.
3. J. M. Gere and S. P. Timoshenko, *Mechanics of Materials*, CBS Publisher, 4th edition, 1996.

CE 207 ENGINEERING GEOLOGY (3 0 2 8)

The Earth: a system approach; Earth Processes and their consequences: Lithosphere, Hydrosphere, Cryosphere, Atmosphere, Biosphere and

interconnectedness; Earth Materials: rocks, soils, minerals; Engineering and Genetic classification of rocks; Rock mechanics; Strength Properties of Rocks: Rock Mass Strength; Weathering; Structures: Folds, Faults, Joints; Plate Tectonics, Earthquakes: Causes, classification, magnitude, intensity, seismic hazards zoning;; Groundwater: resources and quality; Site Investigation: S. I. Desk Study; Remote sensing, GIS and GPS: Basic principles and applications, Boreholes; Landslides and Subsidence: causes, classification and monitoring; Rock excavation: Cut Slopes in rocks; Criteria and factors for site selection for dams, tunnels, waste/radioactive disposal sites.

Experiments: Rocks and Minerals and their Engineering Properties (UCS, Schmidt Hammer), Identification by Megascopic Hand Specimen studies of Rock and Mineral Samples, Petrological Microscopic Study of Rock Sections and their Properties-1, Exercise on Structural Geologic Maps, Core Loss and RQD, Stereographic projection and contouring, Characterizing Discontinuity Patterns, Engineering Geologic Maps, Resistivity survey to interpret sub-surface geology, Hydrogeological experiment/ exercise, Field Trip.

Texts:

1. K V G K Gokhale, *Principles of Engineering Geology*. B S Publications, Hyderabad, First Edition, 2005.
2. A. C Waltham, *Foundations of Engineering Geology*, Blackie Academic & Professional, Chapman & Hall , First Edition, 1997.

References:

1. K. Allan, *General Geology for Engineers*, Second Edition, Prentice & Hall, 1995.
2. P. Kesavulu, *Engineering Geology*, Oxford University Press, Second Edition, 1999.
3. P. Singh, *Engineering and General Geology*, S. K. Kataria and Sons, Sixth Edition, 1999.

CE 211 CIVIL ENGINEERING MATERIALS (3 0 0 6)

Introduction to structures of solids, ductility, brittleness, strength, stiffness, durability, hardness, toughness; Weakness of materials, Introduction to building materials, Cement: Chemical composition, manufacturing, physical characteristics, hydration, properties of cement compounds, different types of cements, Aggregate: Coarse and fine aggregates, Influence of aggregate on the properties of concrete, aggregate selection. Fresh Concrete: Batching, Mixing, workability, effect of admixture, Hardened Concrete: mechanical properties of hardened concrete, Water-cement ratio, Porosity, Curing of concrete, High performance concrete, Design of concrete mix: IS code recommendation, British code and ACI code, Brick: Raw materials, drying and burning, Strength and durability, mortar for masonry and strength of masonry, Timber, Seasoning and conversions, properties, tests, defects in timbers, Glass: Chemical compositions, mechanical and optical properties, Various types of glasses, Strengthening of glasses, Metals, steel for reinforced concrete and prestressed concrete construction, structural steel sections, Deterioration of building materials:
Corrosion, chloride and sulphate attack on concrete, alkali-aggregate reaction, acid aggregate reactions.

Texts:

1. S. Somayaji, *Civil Engineering Materials*, Prentice Hall, New Jersey, 2001.
2. M. S. Mamlouk and J. P. Zaniewski, *Materials for Civil and Construction Engineers*, Pearson, Prentice Hall, Second edition, 2006.

References:

1. A. M., Neville and J. J. Brooks, *Concrete Technology*, Pearson Education, Fourth Indian reprint, 2004.
2. N. Jackson and R. K. Dhir, *Civil Engineering materials*, Macmillan Fourth edition 1997.
3. M. S. Shetty, *Concrete Technology*, S. Chand and Company Ltd. 2005.

4. P. C. Aitcin, *High Performance Concrete*, E & Fn Spon, 1998.
5. J. F. Shackelford and M. K. Muralidhara, *Introduction to Material science for Engineers*, Pearson Education, Sixth edition, 2007.

CE 212 CIVIL ENGINEERING MATERIALS LAB (0 0 0 3)

Physical tests on cement, fine and coarse aggregate, tests for workability, tests on hardened concrete, compression tests on cubes and cylinders, modulus of rupture test, rebound hammer and UPV test, testing of bricks, efflorescence, water absorption and compressive strength, testing of reinforcement bar in tension.

Texts/ References:

1. M. S. Mamlouk and J. P. Zaniewski, *Materials for Civil and Construction Engineers*, Pearson, Prentice Hall, Second edition, 2006.
2. A. M., Neville and J. J. Brooks, *Concrete Technology*, Pearson Education, Fourth Indian reprint, 2004.
3. S. Somayaji, *Civil Engineering Materials*, Prentice Hall, New Jersey, 2001.
4. M. S. Shetty, *Concrete Technology*, S. Chand and Company Ltd. 2005.

CE 201 SURVEYING (3 0 0 6)

Introduction to surveying; linear measurements; chain surveying; compass surveying; accuracy, precision and errors, leveling; plane table;

contouring, theodolite surveying, tacheomatric survey; trigonometrical surveying; triangulation; curves; advanced survey instruments; Electronic Distance Measurement, Total station and Global Positioning System, Introduction to photogram-metry and remote sensing.

Texts/References:

1. T. P. Kanetkar and S. V. Kulkarni, *Surveying and Levelling, Vol-I and Vol-II,* Pune Vidyarthi Griha Prakshan, 1972.
2. B. C. Punmia, A.K. Jain & A.K. Jain, *Surveying, Vol-I and Vol-II,* Laxmi Publication Pvt., 1996.
3. T.M. Lillesand and R.W. Kiefer, *Remote Sensing and Image Interpretation*, John Wiley & Sons, 1994.
4. G. W. Schofield, *Engineering Surveying*, Butterworth, Heinemann, New Delhi, 2001.
5. G. Joseph, *Fundamentals of Remote Sensing*, Universities Press, 2003

CE 203 FLUID MECHANICS (3 0 0 6)

Fluid properties; Pressure measurement; Hydrostatic forces on plane and curved surfaces; Buoyancy and equilibrium; Stability, metacentric height; Types of flow; Continuity; Energy and momentum equations; Velocity distribution and velocity coefficients, practical applications; Navier Stoke equation; Shear stress and pressure gradient; Flow through pipes, Hagen-Poiseuille equation; Turbulence, Prandtl's mixing length, eddy viscosity; Darcy-Weisbach equation for flow through pipes, friction factor, Moody diagram, minor losses, pipes in series and parallel, equivalent length, pipe network analysis; Water hammer; Boundary layer concept, drag coefficients, control of boundary layer; Dimensional analysis and similitude.

Texts:

1. V.L. Streeter and E.B. Wylie, *Fluid Mechanics*, McGraw Hill, 1997.
2. P.N. Modi and S.M. Seth, *Hydraulics and Fluid Mechanics*, Standard Book House, 1998.

References:

1. B.F. White, *Fluid Mechanics*, McGraw Hill, 1994.
2. K S. Massey,*Mechanics of Fluids*, Van Nostrand Reinhold Co., 1979.
3. J. Frabzini,*Fluid Mechanics with Engineering Applications*, McGraw Hill, 1997.
4. J.H. Spurk, *Fluid Mechanics – Problems and Solutions*, Springer, 2003.

CE 205 STRUCTURAL ANALYSIS - I (3 0 0 6)

Different types of structures, Loads on the structural system, static and kinematic indeterminacy, Methods of Analysis: Equilibrium equations, compatibility requirements, Introduction to force and displacement methods, Analysis of trusses: plane truss, compound truss, complex truss and space truss, Arches and suspension cables, three hinged arches and suspension cables, Deflection of Beams, various methods for calculation of deflection,
Analysis of indeterminate structures by force methods, flexibility coefficients, Energy methods: Principle of minimum potential energy, principle of virtual work, Castigliano's theorems, Reciprocal theorem, unit load method, Influence line and Rolling loads, beam, frames and arches, Muller-Breslau Principles and its applications to determinate and indeterminate structures.

Texts:

1. C.S. Reddy, *Basic Structural Analysis*, Second Edition, Tata McGraw Hill, 2005.
2. R.C. Hibbeler, *Structural Analysis*, Pearson Education, 6th edition, 2009.

References:

1. D.S. Prakash Rao, *Structural analysis: Unified approach*, Universities Press, 1996.
2. C.H. Norris, J.B. Wilbur, S.Utku, *Elementary Structural Analysis*, Tata McGraw Hill, 4th edition, 2003.
3. L. S. Negi and R. S. Jangjid, *Structural Analysis*, Tata Mc. Graw, New Delhi, 1997.

CE 206 GEOTECHNICAL ENGINEERING - I (3 0 0 6)

Origin of soil, Phase relationships, Identification and classification of soils, Effective stress principle, Permeability of soils, Compressibility of soils, Seepage and flownets, Terzaghi's one-dimensional consolidation theory, Shear strength of soils, Effective stress and total stress strength parameters, Total and effective stress paths, Compaction of soils.

Texts:

1. Gopal Ranjan & A.S.R. Rao, *Basic and Applied Soil Mechanics*, New Age International, 2000.
2. K. Terzaghi, R. B. Peck and G. Mesri, *Soil Mechanics in Engineering Practice*, John Wiley & Sons, 1996.

References:

1. S.R. Kaniraj, Design Aids in Soil Mechanics & Foundation Engineering, Tata McGraw Hill, 1988.
2. T.W. Lambe and R.V. Whitman, *Soil Mechanics*, John Wiley & Sons, 1969.

CE 214 FLUID MECHANICS LAB (0 0 2 2)

Measurement of fluid pressure using various manometers and gauges., Experimental study on capillarity, Determination of coefficient of viscosity of a fluid using viscometer, Experimental study on stability of floating bodies, Study on fluid pressure distribution on immersed bodies, Study of different types of flow using Reynold's apparatus, Determination of friction factor in pipes using pipe friction apparatus., Experimental study on flow nets using
Hele-Shaw apparatus, Experimental study on cavitations., Study of flow behavior in open channels using tilting flume.

Texts/References:

1. P.N. Modi and S.M. Seth, *Hydraulics and Fluid Mechanics*, Standard Book House, 1998.
2. K. L Kumar, *Engineering Fluid Mechanics*, Eurasia Publishing Company (P) Ltd., New Delhi, 1999.

CE 215 GEOTECHNICAL ENGINEERING - I LAB (0 0 2 2)

Specific gravity test, Sieve analysis, Hydrometer analysis, Atterberg limits, Classification of soil, Compaction test, Permeability test, Relative density, Field density test.

Texts:

1. D. Fratta, J. Aguettant, and L. R. Smith, *Soil mechanics laboratory testing*, Boca Raton, CRC Press, USA, 2007.
2. J. Bardet*, Experimental soil mechanics*, Upper Saddle River, Prentice Hall, USA, 1992.

References:

1. C. Liu and J. B. Evett, *Soil properties: testing, measurement and evaluation*, Upper Saddle River, Prentice Hall, USA, 1997.
2. J. Biarez, and P. Y, Hicher, *Elementary mechanics of soil behaviour: saturated remoulded soils,* Rotterdam A.A., Balkema, USA, 1994.
3. R. Jack, *Understanding soil mechanics*, Albany Delmar Pub., 1995.

CE 301 HYDRAULICS AND HYDRAULIC STRUCTURES (3 1 0 8)

Open channel hydraulics, uniform flow, critical flow, Gradually varied flow, hydraulic jump,unsteady flow; Introduction to pumps and turbines; Channel design, erodable and non erodable channels, silt theories, sediment transport; Introduction to river engineering, meandering, river training works; Introduction to Dam engineering, classification of Dams, design of spillway; Basic principle of design of hydraulic structures; Cross drainage works.

Texts:
1. V.T. Chow, *Open Channel Flow*, McGraw Hill, 1975.
2. S.K. Garg, *Irrigation Engineering and Hydraulic Structures*, Khanna Publishers, 1992.

References:
1. H.M. Chaudhry, *Open Channel Flow*, Prentice Hall of India, 1998.
2. K. Subramanya, *Flow in Open Channels*, Tata McGraw Hill, 1998.
3. V.L. Streeter and E.B. Wylie, *Fluid Mechanics*, McGraw Hill, 1997.
4. B.F. White, *Fluid Mechanics*, McGraw Hill, 1994.
5. B.C. Punmia, *Irrigation and Water Power Engineering*, Standard Publishers, 1992
6. J. Frabzini, *Fluid Mechanics with Engineering Applications*, McGraw Hill, 1997.

CE 302 STRUCTURAL ANALYSIS - II (3 1 0 8)

Classical method of analysis of framed Structures: Slope deflection method, Moments distribution methods, effect of symmetry and antisymmetry, sway correction, Approximate methods: Substitute frame methods for gravity load, Lateral load analysis: Portal and Cantilever methods, Matrix method of structural analysis: Stiffness method: Local and global stiffness matrices, assembly, band storage, solution of resulting simultaneous algebraic
equation, boundary conditions, application to plane and space truss, analysis of plane frame, grid and three dimensional frame.

Texts:

1. W. Weaver and J. M. Gere, *Matrix analysis of framed structures*, CBS Publishers, 2nd edition, 2004.
2. C.K. Wang, *Intermediate Structural Analysis*, Tata McGraw Hill, 1984.

References:

1. C.S. Reddy, *Basic Structural Analysis*, Second Edition, Tata McGraw Hill, 2005.
2. G.S. Pandit and S.P. Gupta, *Structural Analysis - A matrix approach*, Tata McGraw Hill, 2nd edition, 2008.
3. C.H. Norris, J.B. Wilbur, S.Utku, *Elementary Structural Analysis*, Tata McGraw Hill, 4th edition, 2003.
4. M.B. Kanchi, *Matrix Methods of Structural analysis*, Enlarged edition, Wiley Eastern Limited, 1993.

CE 303 GEOTECHNICAL ENGINEERING - II (3 0 0 6)

Types of retaining walls, Earth pressure theories, Sheetpiles and bulkheads; Shallow foundations: Terzaghi's bearing capacity theory, Stress distribution, Immediate and consolidation settlement; Deep foundations: Load carrying capacity of piles, Settlement of pile groups; Foundation types, selection and design; Stability of slopes, Site investigation and subsoil exploration.

Texts:

1. G. Ranjan and A.S.R. Rao, *Basic and Applied Soil Mechanics*, New Age International, 2000.
2. J.E. Bowles, *Foundation Analysis and Design*, McGraw Hill, 1996.

References:

1. S.R. Kaniraj, *Design Aids in Soil Mechanics & Foundation Engineering*, Tata McGraw Hill,1988.
2. P.N. Kurian, *Design of Foundation Systems: Principles & Practices*, Narosa, 1994.

CE 305 REINFORCED CONCRETE DESIGN (3 1 0 8)

Working stress and limit state method of design of R.C. Structures, Design of Beam: Singly reinforced, Doubly reinforced beam, Flanged beam, Shear and bond, development length, detailing of reinforcement, Torsion, Serviceability criteria: Deflection, Design of Slab: One way and two way slab, detailing, redistribution of moments, Design of Column: Axial loading, Uniaxial bending, Biaxial bending, Slender column, Foundation: Isolated and Combined
footing.

Texts:

1. S. U. Pillai and D. Menon, *Reinforced Concrete Design*, Tata McGraw-Hill 3rd edition, 2009.
2. P.C. Varghese, *Limit State Design of Reinforced Concrete*, Prentice Hall India, 2008.

References:

1. S.N. Sinha, *Reinforced Concrete Design*, Tata McGraw-Hill, 2nd Edition, 2002.

2. M.L. Gambhir, *Fundamentals of Reinforced Concrete Design*, Prentice Hall India, 2006.
3. A. K. Jain, *Reinforced concrete: Limit state design*, Nem Chand and Bros. 1999.
4. J. Macgregor and J. K. Wight, *Reinforced Concrete: Mechanics and Design*, Prentice Hall, 5th edition, 2008.
5. R. Park and T. Paulay, *Reinforced Concrete Structures*, John Wiley and Sons, 1975.

CE 312 HYDRAULICS AND HYDRAULIC STRUCTURES LAB (0 0 2 2)

Determination of resistance coefficient in open channels, Experimental study on variation of specific energy with depth of flow in open channels, Measurement of flow using weirs and notches, Measurement of flow using a Parshall flume, Experiments on gradually varied flow (GVF) in open channels, Experimental study on hydraulic jumps, Experimental studies on centrifugal and reciprocating pumps, Experimental studies on impulse and reaction turbines.

Texts/References:

1. P.N. Modi and S.M. Seth, *Hydraulics and Fluid Mechanics*, Standard Book House, 1998.
2. K. L Kumar, *Engineering Fluid Mechanics*, Eurasia Publishing Company (P) Ltd., New Delhi, 1999.

CE 313 GEOTECHNICAL ENGINEERING - II LAB (0 0 2 2)

Direct shear test, Vane shear test, Unconfined compression test; Triaxial compression tests: Unconsolidated undrained, Consolidated undrained, Consolidated drained; Consolidation test, Standard penetration test.

Texts:

1. Fratta, D. Aguettant, J. and Roussel- Smith, L., *Soil mechanics laboratory testing*, Boca Raton, CRC Press, USA, 2007.
2. J. Bardet, *Experimental soil mechanics*, Upper Saddle River, Prentice Hall, USA,1992.

References:

1. Liu, C. and Evett, J. B. , Soil properties: testing, measurement and evaluation, Upper Saddle River, Prentice Hall, USA, 1997.
2. Biarez, J. and Hicher, P-Y., *Elementary mechanics of soil behaviour: saturated remoulded soils*, Rotterdam A.A., Balkema, USA, 1994.
3. Jack, R., *Understanding soil mechanics*, Albany Delmar Pub., 1995

CE 304 TRANSPORTATION ENGINEERING - I (3 0 0 6)

Introduction to Transportation Engineering; Vehicle and driver characteristics; Pavement materials and characterization; Pavement analysis and design: Flexible pavements, Rigid pavements; Geometric design of Highways: Cross sectional elements, Horizontal alignment, Vertical alignment; Evaluation of Transportation Improvement; Terminology used in railways; Track design; Points and crossings; Capacity of Railway transit systems.

Texts:

1. P. Chakroborty and A. Das, *Principles of Transportation Engineering*, Prentice Hall India, 2003.
2. S.C. Saxena and S.P. Arora, *A text book of Railway engineering*, Dhanpat Rai, 2001.

References:

1. C.J. Khisty and B.K. Lall, *Transportation Engineering: an introduction*, Prentice Hall India, 2003.
2.F.L. Mannering, W.P. Kilareski, and S.S. Washburn, *Principles of Highway engineering and traffic analysis,* John Wiley and Sons, 2005.
3. C.S. Papacostas and P.D. Prevedouros, *Transportation Engineering and Planning*, Prentice Hall India, 2001.
4. J.H. Banks, *Introduction to Transportation Engineering*, McGraw-Hill, 2002.
5. N.A. Harold, *Highway materials, Soil and Concrete*, Prentice Hall, 2004.
6. S.K. Khanna and C.E.G. Justo, *Highway Engineering*, Nem Chand Bros., 2002.
7. Y. H. Huang, *Pavement Analysis and Design*, Pearson Education, India 2008.

CE 307 ENVIRONMENTAL ENGINEERING - I (3 0 0 6)

Introduction, Population Forecasting and Water Demand, Physical, Chemical and Biological Characteristics of Water and Wastewater, Wastewater Flow, Sewerage system and sewer design, Basic Microbiology: cells, classification and characteristics of living organisms. Metabolic Processes, Microorganisms in Natural Water Systems, Biological Oxidation of Organic Matter. Introduction to Environmental Chemistry, Stoichiometry and Kinetics of Chemical Reactions, Equilibrium Constant and Solubility Products, pH and Alkalinity. Development of Oxygen Sag Model. Flow sheets for Water and Wastewater Treatment, Introduction to Solid Waste, Air Pollution and Noise Pollution.

Texts:

1. H. S Peavy, D. R. Rowe and George Tchobanoglous, *Environmental Engineering*, McGraw-Hill International Ed., 1985.
2. T. J McGhee, *Water Supply and Sewerage*, McGraw-Hill Inc., 1991.

References:

1. M. L Davis and D. A Cornwell, *Introduction to Environmental Engineering*, McGraw-Hill, Inc.,1991.
2. Metcalf & Eddy*, Wastewater Engineering- Treatment and Reuse* (Revised by G. Tchobanoglous, F. L. Burton and H. D. Stensel), Tata McGraw Hill, 4th Edn., 2004.
3. C. N Sawyer, P. L McCarty and G. F. Parkin, *Chemistry for Environmental Engineers*, McGraw- Hill, 1994.
4. APHA, *Standard Methods Examination of Water and Wastewater*, American Public Health Association, Washington DC, 1995.
5. *Manual for Sewer and Sewerage*, Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Development, Govt. of India, 1993.
6. *Manual for water supply and treatment*, Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Development, Govt. of India, 1999.

CE 308 CONSTRUCTION TECHNOLOGY AND MANAGEMENT (3 0 0 6)

Construction as industry and its challenges, Role of construction management, Methods of construction managements, Basic requirements of construction management: Learning structures, Life cycle of construction projects: Examples of real projects and its learning requirements, Stages of awarding contract, types of contract, contract documents, arbitration and settlement of disputes, contract laws and handling of contracts, commissioning of project,
Principles of estimation, Principles of general and detailed specifications, Introduction to network based project management techniques: Defining activities and their interdependence, drawing of network, time and resource estimations, use of network as scheduling techniques, use of network as control techniques i.e. project monitoring, Construction Technology: construction of superstructure and substructures, Various construction methods: Excavation, Earth-moving, Drilling, Blasting, Dewatering, foundation, Finishing items, painting, flooring, brick works. Examples of construction of structures such as buildings, bridges, roads, tunnels, industrial structures, Quality Management and Construction safety, Use of information technology in
construction industries, Automation in construction industry: a general discussion.

Texts:

1. F. Harris, R. McCaffer and F. Edum-Fotwe, *Modern Construction Management*, Blackwell Publishing, 2006.
2. C. J. Schexnayder and R. E. Mayo, *Construction Management Fundamentals*, McGraw Hill, New Delhi, 2003.

References:

1. J. Singh, *Heavy Constructon-Planning, equipment and methods*, Oxford & IBH Publishing Co. Pvt 1993.
2. R.L. Peurifoy and C.J. Schexnayder, *Construction planning and equipment, and methods*, Sixth edition, Tata McGraw-Hill, 2006.
3. D.S. Berrie and B.c. Paulson, *Professional construction management including C.M., Design construct and general contracting*, Third edition, McGraw Hill International edition, 1992.
4. L.S. Srinath, *PERT and CPM principles and Applications*, Third edition, Affiliated east-west press Pvt Ltd, 2001.
5. D.G. Carmichael, *Construction engineering Networks: Techniques, planning and management*, Ellis Horwood Publishers Chichester 1989.
6. K.K. Chitkara, *Construction project management: planning, scheduling and controlling*, Tata McGraw-Hill, 2008.

CE 309 DESIGN OF STEEL STRUCTURES (3 1 0 8)

Steel structures - advantages, design loads, structural steel sections, material properties, Codes and Specifications: IS 800, 2007, Design Concepts: Working stress design, limit state design, plastic design, LRFD. Classification of sections, Forms of constructions, Design of connections, types of connections, Bolt connections: ordinary black bolts, HSFG bolts and their design in shear, bearing, bending, tension; prying force, slip resistance, block shear failure. Welded connections: different types of weld connections and design, detailing of connections. Design of eccentric connections, Design of tension members: design criteria, net and gross area, examples, Design of compression members: concept of stability and buckling, failure modes, effective lengths, local and global buckling, design of compression members of various types. Design of flexural members: moment curvature relations, stability and lateral-torsional buckling, design against shear, serviceability requirements, beamcolumn design. Design of base plates, load transfer mechanism, design of slab base, gusseted base and anchorage. Steel structural systems.

Texts:

1. N. Subramanian, *Design of Steel Structures*, Oxford University Press, 2008.
2. L. S. Negi, *Design of Steel Structures*, Tata McGraw Hill, 1997.

References:

1. S. A. Raz, *Structural Design in Steel*, New Age International Publisher, 2002.
2. M. Edwin, J. Gaylord and J. E. Stallmeyer, *Design of Steel Structures*, McGraw-Hill, 1991.
3. P. Dayaratnam, *Design of Steel Structures*, S. Chand & Co., 2003.
4. S. M. A. Kazimi and R. S. Jindal, *Design of Steel Structures*, Prentice Hall of India Pvt Ltd, 1988.

CE 311 HYDROLOGY AND WATER RESOURCES ENGINEERING (3 0 0 6)

Surface water hydrology - hydrologic cycle, rainfall and its measurement, mean rainfall, runoff; Flow measurements; Infiltration losses; Storm hydrology; Unit Hydrograph; Storm hydrograph; Reservoir planning - Investigations, life of reservoir; Flood estimation and routing, flood forecasting; Surface and sub-surface drainage, water logging, remedial measures, drainage of land; Ground water hydrology - Introduction, types of aquifers, wells, well yield; Soil-Water-Plant relationships, crop water requirement; Layout of canal system; Types and methods of irrigation.

Texts:

1. V.T. Chow, D.R. Maidment, and L.W. Mays, *Applied Hydrology*, McGraw Hill, 1998.
2. V.P. Singh, *Elementary Hydrology*, Prentice Hall, 1993.

References:

1. H.M. Raghunath, *Hydrology – Principles, Analysis and Design*, Wiley Eastern Ltd., 1986.
2. A.M. Michael, *Irrigation – Theory and Practice*, Vikas Publishing House, 1987.
3. D.K. Todd, *Groundwater Hydrology*, John Wiley & Sons, 1993.
4. K. Linsley, *Water Resources Engineering*, McGraw Hill, 1995.
5. S.K. Garg, *Irrigation Engineering and Hydraulic Structures*, Khanna Publishers, 1992.
6. H.P. Ritzema (Editor-in-Chief), *Drainage Principles and Applications*, ILRI Publication 16, 1994.

CE 314 TRANSPORTATION ENGINEERING - I LAB (0 0 2 2)

Laboratory: Evaluation of road aggregates for various properties: Sieve Analysis, Los Angeles Test, Flakiness and Elongation Test, Impact Test, Angularity Number Test, Evaluation of Bitumen for various properties: Softening Point Test, Penetration Test, Viscosity Test, Ductility Test, Stripping Test, Bituminous mix design – Marshal Mix Design Method.

Texts:

1. S.K. Khanna and C.E.G. Justo, *Highway Engineering*, Nem Chand Bros., 2002.
2. N.A. Harold, *Highway materials, Soil and Concrete*, Prentice Hall, 2004.

References:

1. IS Codes and IRC Codes.

CE 315 ENVIRONMENTAL ENGINEERING - I LAB (0 0 3 3)

Solid analysis; pH, Alkalinity, Turbidity and Conductivity measurements; Estimation of Hardness, Dissolved Oxygen, BOD and COD; Plate Counts and MPN test; Estimation of Fluoride and metals using colorimetric methods, Introduction to advance instruments i.e. Atomic Adsorption Spectroscopy (AAS).

Texts/References:

1. C. N Sawyer, P. L McCarty and G. F. Parkin, *Chemistry for Environmental Engineers*, McGraw-Hill,1994.
2. APHA, *Standard Methods Examination of Water and Wastewater*, American Public Health Association, Washington DC, 1995.
3. *Manual for Sewer and Sewerage*, Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Development, Govt. of India, 1993.
4. *Manual for water supply and treatment* , Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Development, Govt. of India, 1999.

CE 400 INTRODUCTION TO PROJECT (0 0 3 3)

This course is designed to teach the students about different aspects of carrying out the research project in different areas of Civil Engineering.

CE 401 ENVIRONMENTAL ENGINEERING - II (3 0 0 6)

Particle Fluid Mechanics as applied to the settling of Type I and II suspensions. Design and operation of Sedimentation Tanks. Coagulation and Flocculation. Hydraulics of Filtration, Design and Operation of Filter Units. Disinfection Methods. Ion exchange and Adsorption. Water Softening, Manganese and Iron Removal. Wastewater Treatment – Preliminary, Primary and Secondary Treatment Units. Aerobic and Anaerobic Processes. Purpose,
theory and design of aeration units. Sludge treatment and disposal, Wastewater stabilization ponds, Aerated ponds and Oxidation ditches. Site-visits to Water and Wastewater Treatment Works.

Texts:

1. H. S Peavy, D. R Rowe and G. Tchobanoglous, *Environmental Engineering*, McGraw-Hill International Ed.,1985.
2. Metcalf & Eddy*, Wastewater Engineering- Treatment and Reuse* (Revised by G. Tchobanoglous, F. L. Burton and H. D. Stensel), Tata McGraw Hill, 4th
Edn., 2004.

References:

1. T. J McGhee, *Water Supply and Sewerage*, McGraw-Hill, Inc,1991.

2. J. M. Montgomery, *Water Treatment Principles and Design*, John Wiley & Sons,1985
3. M. L Davis and D. A Cornwell, *Introduction to Environmental Engineering*, McGraw-Hill, Inc.,1991.
4. S. J Arceivala and S. R. Asolekar, *Wastewater Treatment for Pollution Control and Reuse*, Tata McGraw Hill, 2006.
5. *Manual for Sewer and Sewerage*, Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Development, Govt. of India, 1993.
6. *Manual for water supply and treatment*, Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Development, Govt. of India, 1999.

CE 403 TRANSPORTATION ENGINEERING - II (3 0 0 6)

Traffic flow fundamentals; Uninterrupted Traffic flow: Traffic stream characteristics, Traffic flow models, capacity and LOS analysis; Interrupted Traffic flow: Traffic flow at signalized and un signalized intersections; Design of Traffic facilities: Highways, intersection, interchanges; Transportation planning; Introduction to planning; Travel demand forecasting: Four step planning, Advance methods for travel demand forecasting; Airport related Terminology; Airport configuration; Geometric design of runway; Air travel demand forecasting; Harbor related Terminology; Traffic forecasting and hinterland; Harbor layout.

Texts:

1. C.S. Papacostas and P.D. Prevedouros, *Transportation Engineering and Planning*, Prentice Hall India, 2001.
2. R. Horonjeff and F.X. McKelvey, *Planning and design of airports,* McGraw-Hill, 1994.

References:

1. P. Chakroborty and A. Das, *Principles of Transportation Engineering*, Prentice Hall India, 2003
2. R.P. Roess, W.R. McShane, and E.S. Prassas, *Traffic Engineering*, Prentice Hall, 1990.
3. H.P. Oza and G.H. Oza, *Dock and Harbor Engineering*, Chorotar, 4th edition, 1999.

CE 410 TRANSPORTATION ENGINEERING - II LAB (0 0 2)

Headway studies: Free flow, Intermediate flow, High Flow; Speed-Volume studies; observed method; Signal design; Parking studies; O-D survey; Acceleration Noise; Vision testing.

Texts:

1. C.S. Papacostas and P.D. Prevedouros, *Transportation Engineering and Planning*, Hall India, 2001.
2. R. Horonjeff and F.X. McKelvey, *Planning and design of airports*, McGraw-Hill, 1994.

References:

1. P. Chakroborty and A. Das, *Principles of Transportation Engineering*, Prentice Hall India,
2. R.P. Roess, W.R. McShane, and E.S. Prassas, *Traffic EngineEring*, Prentice Hall, 1990.

3. H.P. Oza and G.H. Oza, *Dock and Harbor Engineering*, Chorotar, 4th edition, 1999.

CE 402 DESIGN PROJECT (1 0 3 5)

Load calculations, complete design and drafting of one concrete and one steel structure, such as buildings, water tank, bridges, concrete dam, industrial structures.

Text:

1. V. K. Raina, *Concrete bridge Practice: Analysis, Design and Economics*, Tata McGraw-Hill, 2002.
2. P. Agarwal and M. Shrikhande, *Earthquake Resistant Design of Structures*, Prentice Hall of India, 2006.

References:

1. S. U. Pillai and D. Menon, *Reinforced Concrete Design*, Tata McGraw-Hill 3rd Edition, 2009.
2. Bureau of Indian Standards, *IS 456: 2000 – Plain and Reinforced Concrete – Code of Practice*, 2000.
3. Bureau of Indian Standards, *SP 34: 1987 – Handbook of Concrete reinforcement and Detailing*, 1987.
4. Bureau of Indian Standards, *SP 16: 1980 – Design Aids for Reinforced Concrete*, 1980.
5. Bureau of Indian Standards, *IS 800: 2007 – General Construction in Steel - Code of Practice*, 2007.
6. Bureau of Indian Standards, *IS 1893: 2002 – Criteria of Earthquake Resistant Design of Structures Part I General Provisions and Buildings*, 5th revision, 2002.
7. Bureau of Indian Standards, *IS 13920: 1993 – Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces – Code of Practice*, 2003.
8. R. L. Brockenbrough and F. S. Merrit, *Structural Steel Designs Handbook*, Mc Graw Hill, 1999.
9. C. E. Reynolds and J.C. Steedman, *Reinforced Concrete Designers Handbook*, E & FN Spon, 10th edition, 2000.
10. M. Fintel, *Handbook of Concrete Engineering*, Springer, 1985.

DEPARTMENTAL ELECTIVE COURSES

CE 411 DYNAMICS OF STRUCTURES (3 0 0 6)

SDOF systems: Equations of Motion, Free vibration, damping, Forced vibrations under harmonic, impulse and general loadings, Response spectrum Generalized SDOF systems: Rigid body distributed mass and stiffness systems; MDOF Systems: Dynamic properties, modal damping, classical damping, modal super position methods; Numerical methods in dynamics: Eigen value analysis, direct integration scheme, Continuous systems: Equations of motion, Hamilton's principle, Lagrangian formulation, Free and force vibration scheme, Wave propagation; Introduction to Random vibration: Random variables, Random process, moment and characteristic function, spectral analysis, response to random excitation; Application of structural dynamics in the design of block and frame foundation.

Texts / References:

1. R.W. Clough and J. Penzien, *Dynamics of Structures*, Second edition, McGraw Hill International edition, 1993.
2. M. Paz, *Structural Dynamics*, CBS Publishers, 1987.

3. A. K. Chopra, *Dynamics of Structures: Theory and applications to earthquake engineering*, Prentice Hall of India Ltd., 1997.
4. K. Rao, *Vibration analysis and foundation dynamics*, Wheeler, 1998.
5. E. Siniu and R.H. Scanlan, *Wind effects on structures: fundamentals and applications to design*, John wiley and sons, 1997.

CE 412 MECHANICS OF COMPOSITE MATERIALS (3 0 0 6)

Introduction – classifications, terminologies. Macromechanical analysis of lamina – Hooke's law for anisotropic, monoclinic, orthotropic, transversely isotropic and isotropic materials–2D Unidirectional and angle ply lamina – Strength theories of lamina. Micromechanical analysis of lamina –Volume and mass fraction, density and void content – Evaluation of Elastic modulii, Ultimate strength of unidirectional lamina. Macromechanical analysis of laminates – Laminate code, Stress strain relations – In-plane and Flexural modulus,Hygrothermal effects. Failure Analysis and Design – Special cases of laminates, symmetric, cross ply, angle ply, angle ply and antisymmetric laminates, failure criteria and failure modes.

Texts/ References:

1. R. M. Jones, *Mechanics of Composite Materials*, Taylor & Francis, 1998.
2. B D. Agarwal and J. D Broutman, *Analysis and Performance of Fiber Composites*, John Willey and Sons, 1990.
3. P. K. Mallik, *Fiber reinforced composites : Materials, Manufacturing and Design*, Marcel and Dekker, 1993.
4. Kaw, K. Arthur, *Mechanics of Composite Materials*, CRC Press, 1997.
5. P. K, Mallik, *Composite Engineering Hand Book*, Marcel and Dekker, 1997.

CE 413 FINITE ELEMENT METHODS IN ENGINEERING (3 0 0 6)

Basic concepts of engineering analysis, Methods of weighted residuals and variational formulations, Finite element discretization, Shape function, Lagrange and serendipity families, Element properties, Iso-parametric elements, Criteria for convergence, Numerical evaluation of finite element matrices (Gauss quadrature integration), Assemblage of elements, Analysis of plane stress/strain, axi-symmetric solids, Three dimensional stress analysis, Poisson's and Laplace equations, Flow though porous media, Solution technique; Finite element programming, Use of package programs.

Texts / References:

1. T. R. Chandrapatula and A. D. Belegundu, *Introduction to finite elements in engineering*, Third Edition, Prentice Hall of India, 2001.
2. P. Seshu, *Text book of finite element analysis*, Prentice Hall of India, 2003.
3. J. N. Reddy, *An introduction to the finite element method*, McGraw Hill Inc. 1993.
4. R. D. Cook. D. S. Malkus. M. E. Plesha, and R. J. Witt, *Concepts and application of finite element analysis*, fourth Edition, John Wiley & Sons, 2002.
5. O.C. Zienkiewicz and R.L.Taylor, *The Finite element method*, Butterworth Heinemann (Vol I and Vol. II), 2000.
6. C.S. Krishnamoorthy, *Finite Element Analysis, Theory and programming*, Tata McGraw Hill, 1994.
7. K.J. Bathe, *Finite Element Procedures in Engg. Analysis*, Prentice Hall of India, 1996.

CE 414 ADVANCED STRUCTURAL MECHANICS (3 0 0 6)

Bending of curved beam. Beams on elastic foundation – infinite, semi- inifinite and beams of finite length. Analysis of thin plates – Navier's and Levy's solution for rectangular plate, Circular plates. Buckling of column and frames, energy method for computing critical load. Cylindrical shell membrane theory. Dynamic system: discrete and continuous, Lagrange & Hamiltons formulation, Free and forced vibration analysis- convolution integral, mode
superposition technique. Approximate methods.

Texts / References:

1. S. Tomoshenko, *Strength of materials – Advanced theory and problems, Vol-II*, Von Nostrand,2003.
2. S.P. Timoshenko and S.W.Krieger , *Theory of plates and shells*, McGraw Hill, 1976.
3. D.G. Fertis, *Advanced Mechanics of Structures*, Marcel Dekker, 1996.
4. A. Chajes, *Principle of structural stability*, Waveland Press, 1993.
5. R. W. Clough, J. Penzien and R. W. Clough, *Dynamics of structures*, McGraw Hill, 1975.
6. L. Meirovitch, *Methods of Analytical Dynamics*, McGraw Hill, 1970.

CE 415 PRESTRESSED CONCRETE AND INDUSTRIAL STRUCTURES (3 0 0 6)

Design of prestressed concrete sections for flexure, shear, bond and anchorage forcesminimum weight design; Analysis and design of indeterminate prestressed structures, Choice of cable profiles, Concordancy and linear transformation of cable profile, effect of creep and shrinkage on prestressed concrete structures; Design of end block, Partial prestressing, Definition- principles and design approach, Composite structures; Wind load analysis on Industrial building, Braced and Unbraced Industrial building.

Texts /References:

1. E. G. Nawy, *Prestressed Concrete: A fundamental approach*, Prentice Hall, 1995.
2. T.Y. Lin, *Design of Prestressed Concrete Structures*, John Wiley, & Sons, 1963.
3. S.K. Mallick and A.P. Gupta, *Prestressed Concret*, Oxford & IBH, 1992.
4. G.S. Charles and J.E. Johnson, *Steel Structures-Design and Behaviour*, Addison –Wesley, Pub Co., 1997.
5. W.F.Chen and S.Toma, *Advanced analysis of steel frames*, CRC press,1994.

CE 416 BRIDGE ENGINEERING (3 0 0 6)

Investigation and site selection, hydraulic factors, alignment, traffic aspects, types of bridges; Loading standard, IRC specification, Impact factor, General design consideration, Structural design of highway and railway bridges in masonry, reinforced, pre-stressed concrete and steel; Superstructures: Slab bridge, beam and slab bridge, plate girder and composite bridges, Bearings and expansion joints, Bridge foundation: types of foundation, design of well and pile foundation, Bridge vibration: traffic loading, seismic and wind effect, construction techniques and maintenance.

Texts / References:

1. D. J. Victor, *Essentials of Bridge Engineering*, Oxford and IBH, 1980.

2. N. K. Raju, *Design of Bridges*, Oxford and IBH, 1988.
3. V. K. Raina, *Concrete bridge Practice: Analysis, Design and Economics*, Tata McGraw Hill, 2002.
4. L. Fryba, *Dynamics of Railway Bridges*, Thomas Telford, 1996.

CE 417 EXPERIMENTAL STRESS ANALYSIS (3 0 0 6)

Introduction to strain measurement, electrical resistance strain gauges, strain gauge circuits; Photoelasticity, Optics of photoelasticity, Photoelastic effect, Isoclinics and Isochromatics, Determination of fringe constant, Methods of stress separation, Frozen stress method; Moire technique; Holography; Photoelastic coating and brittle coating.

Texts / References:

1. J.W. Dally and W.F. Riley, *Experimental stress Analysis*, McGraw Hill, 1991.
2. H. Wieringa, *Experimental Stress Analysis*, Kluwer Academic Pub. 2002..
3. R. Budynas, *Advanced Strength and Applied Stress Analysis*, Mc. Graw Hill, 1998.

CE 418 PAVEMENT MANAGEMENT SYSTEMS (3 0 0 6)

Introduction to Pavement Management Systems, Functional and structural condition of pavements, Pavement network, Pavement Distress survey, Rating procedures, Present Serviceability concept, Roughness Measurement and analysis, IRI Index, Skid Resistance Measurement, Structural Evaluation of Pavements by Nondestructive testing, Back calculation Analysis, Pavement strengthening based on Deflection data, Pavement Distress Identification and equipment, Pavement Condition Prediction Models, Maintenance and rehabilitation techniques, Network and project level Management, PMS based on analyticalempirical method, Future Directions and Research needs in PMS, Highway Development and Management (HDM) for road project investments.

Texts/References:

1. M.Y.Shahin, *Pavement Management for Airports, Roads and Parking lots*, Chapman & Hall, 1994.
2. R. Haas, W. R. Hudson, and J.P.Zaniewski, *Modern Pavement Management*, Krieger Publishing Company, 1984.
3. W.R. Hudson, R. Haas and W. Uddin, *Infrastructure Management: Integrating Design, Construction, Maintenance, Rehabilitation, and Renovation*, McGraw Hill, 1997.
4. H. Yang, *Pavement Analysis and Design*, Huang, Prentice-Hall, Inc. Englewood Cliffs, 1993.

CE 419 PRINCIPLES OF REMOTE SENSING (3 0 0 6)

Introduction to Satellite Remote Sensing; energy source and radiation principles; remote sensing systems, multi-spectral scanners; thermal infrared line scanners, sideway looking airborne radar; Microwave Sensors: Passive and active, data acquisition from LANDSA, ERS, SPOT and IRS satellites, digital enhancement techniques; digital image analysis: visual, digital and classification accuracy, Introduction to GIS, applications of remote sensing for Earth resources management.

Texts/References:

1. T.M. Lillesand and R.W. Kiefer, *Remote Sensing and Image Interpretation*, John Wiley & Sons, New York, 1994.
2. J.B. Campbell, *Introduction to Remote Sensing*, Taylor & Francis, London, 1996.
3. F.F. Sabins, *Remote Sensing: Principles and Interpretation*, W.H. Freeman and Company, New York, 1997.
4. R.N. Colwell (Editor-in-Chief), *Manual of Remote Sensing, Vol. I & II*, American Society of Photogrammetry, Falls Church, Virginia, 1983.
5. G. Joseph, *Fundamentals of Remote Sensing*, Universities Press, New Delhi, 2003.
6. J. R. Jensen, *Remote Sensing of the Environment an Earth Resource Perspective*, Pearson Education. Delhi, 2003.

CE 420 INFORMATION TECHNOLOGY IN CONSTRUCTION ENGINEERING (3 0 0 6)

Data and knowledge flow in construction engineering, Introduction to decision support systems (DSS) and management information systems (MIS), Various elements of DSS and MIS. Data representation; Database management; Data warehousing, access, analysis and visualization; Knowledge discovery in databases: data Mining; Application of Geographic Information system (GIS) and virtual reality. Data flow in estimation, planning, scheduling
and construction; Material procurement and inventory management. Knowledge acquisition and validation, Knowledge representation; Knowledge based decision support systems; Artificial Intelligence and expert systems; Construction problems and their solution. Elements of Computer networks: Use of computer networks, Concepts of network layer, Application layer: network security, Domain name system (DNS), Electronic mail, the world wide web,
multimedia; Controlling and reporting of remotely located construction projects.

Texts/References:

1. E. Turban and J.E. Aronson, *Decision support system and Intelligent systems*, Prentice Hall of India, 2003.
2. P. Ponniah, *Data warehousing fundamentals: A comprehensive guide for IT professionals*, John Wiley & Sons Inc. 2001.
3. S. Sadagopan , *Management information system*, Prentice Hall of India ,1997.
4. A. S. Tanenbaum, *Computer Network* , Prentice Hall of India, 2003.

CE 421 DESIGN OF FOUNDATIONS AND RETAINING STRUCTURES (3 0 0 6)

Advanced bearing capacity theories; Design of shallow foundations: strip footings, isolated footings, combined footings, rafts; Design of deep foundations: single piles, pile groups, pile caps, caissons, vertical uplift and lateral capacity; Design of retaining structures: rigid and flexible walls, coffer dams, diaphragm walls, braced cuts.

Texts/References:

1. J.E. Bowles, *Foundation Analysis and Design*, McGraw Hill, 1996.
2. P.N. Kurian, *Design of Foundation Systems : Principles & Practices*, Narosa , 1994.
3. M.J. Tomlinson, *Foundation Design and Construction*, Addison Wesley, 2001.
4. M.J. Tomlinson, *Pile Design and Construction Practice*, E & FN Spon, 1987.
5. R. B. Peck, W. E. Hanson and T. H. Thornburn, *Foundation Engineering*, John Wiley & Sons,1974.

CE 422 GROUND IMPROVEMENT AND GROUND ENGINEERING (3 0 0 6)

Soil compaction: laboratory methods, field methods, compaction control; Soil stabilisation: using additives, sand drains, stone columns, lime columns; Grouting: types of grouts, methods of grouting; Soil reinforcement: using strips, geogrids, geotextiles, geomembranes; Dewatering methods; Soil nailing; Underpinning; Tunneling.

Texts/References:

1. T.W. Lambe and R.V. Whitman, Soil Mechanics, John Wiley & Sons, 1969.
2. K. Terzaghi, R. B. Peck and G. Mesri, *Soil Mechanics in Engineering Practice*, John Wiley & Sons, 1996.
3. M. R. Hausmann, *Engineering Principles of Ground Modification*, McGraw Hill, 1990.

CE 423 QUANTITATIVE METHODS IN CONSTRUCTION MANAGEMENT (3 0 0 6)

Introduction to System analysis, system approach in contracting, System analysis of total construction management; Models and simulations. Construction scheduling: Inventory and crew scheduling, Linear programming, Integer programming, Transportation techniques, dynamic programming. Decision making in uncertain environments, probability theory, Game theory and bidding strategies. Material management, inventory theory, supply chain
management, Economic aspect of project and Cash flow in construction management. Value engineering in construction management.

Texts/References:

1. H. N. Ahuja, *Construction performance control by Networks*, John Wiley & Sons, 1976.
2. H.A. Taha, *Operational research An Introduction*, Seventh Edition, Prentice Hall of India, 2003.
3. J.R. Evans and E.Minieka, *Optimization algorithms for Networks and graphs*, Second editions, Marcel Dekker Inc. 1992.

CE 432 HYDRAULIC MACHINES (3 0 0 6)

Introduction – pumps, centrifugal pump, reciprocating pump, slip, indicator diagram, air vessels, hydraulic transient, specific speed, characteristic curves, cavitation, multi-stage pumps, screw pump, jet pump; Turbines, classification, Pelton Wheel, Francis Turbine, Kaplan Turbine, specific speed, selection of turbines; Mini power plant – planning; Miscellaneous hydraulic pumps and machines – submersible pump, gear pump, screw pump, sewage pump, hydraulic press, hydraulic accumulator, hydraulic ram.

Texts / References:

1. P.N. Modi and S.M. Seth, *Hydraulics and Fluid Mechanics*, Standard Book House, 1998.
2. J. Lal, *Hydraulics Machines*, Metropolitan Book Co., 1969.
3. I. J. Karassik. J. P. Messina, P. Cooper, and C. C. Heald, *Pump Handbook*, McGraw-Hill, Third ed., 2001
4. T. Jiandong, Z. Naibo, W. Xianhuan, H. Jing, and D. Huishen, *Mini- Hydropower*, John Wiley & Sons, 1997.

CE 434 GROUNDWATER HYDROLOGY AND MANAGEMENT (3 0 0 6)

Introduction to groundwater hydrology; Well and aquifer characteristics; Groundwater flow in aquifers, groundwater recharge, fluctuation of water table beneath a recharge site; Hydraulics of fully and partially penetrating wells in confined, leaky and unconfined aquifers under steady and transient conditions; Analysis of pumping test data; Groundwater investigations; Basin management of groundwater and groundwater quality; Model studies; Sea water intrusion.

Texts/ References:

1. D.K. Todd, *Groundwater Hydrology*, John Wiley & Sons, 1993.
2. C. Walton, *Groundwater Resources Evaluation*, McGraw Hill, 1970.
3. H.M. Raghunath, *Groundwater Hydrology*, New Age International, 1993.
4. O.D.L. Strack, *Groundwater Mechanics*, Prentice Hall, 1989.
5. S.P. Garg, *Groundwater and Tube Wells*, Oxford & IBH Publishing Co., 1993.

CE 441 AIR POLLUTION AND INDUSTRIAL WASTE MANAGEMENT (3 0 0 6)

Air Pollutants, their sources and harmful effects on the environment; Meteorology as applied to air pollution and dispersion of air pollutants, Air quality and emission standards, Removal of gaseous and particulate matter. Sources and types of wastes; solid, liquid and gaseous wastes; Water use in industry, industrial water quality requirements; Control and removal of specific pollutants in industrial wastewaters from dairy, fertilizer, distillery, tannery, sugar,
pulp and paper, iron and steel, metal plating etc.

Texts / References:

1. K. Wark and C. F. Warner, *Air Pollution-Its Origin and Control*, Harper & Row, New York, 1981.
2. N. D. Nevers, *Air Pollution Control Engineering*, Mc. Graw Hill International Ed., 1985.
3. N. L. Nemerow, *Zero Pollution for Industry: Waste Minimization through Industrial Complexes*, John Wiley & Sons, 1995.
4. N L Nemerow, *Liquid Waste of Industry: Theoy, Practices and Treatment*, Addison-Wesley,1971.
5. S. J. Arceivala, *Wastewater Treatment for Pollution Control*, Tata Mc. Graw Hill, 1999.
6. W. W. Eckenfelder, *Industrial Water Pollution Control*, Mc. Graw Hill, 2000.

CE 442 PAVEMENT DESIGN (3 0 0 6)

Pavement Materials, Pavement as multilayered structure, subgrade, base and subbase, bituminous materials, individual properties, non-linear models of granular materials and bituminous mixes elastic modules and Poisson's ratio, concrete pavement, Pavement Design, AASHTO, Shell, Asphalt Institute, Japan, Austoroads methods, analytical pavement design, Indian context, overlay design, Pavement Management, Pavement evaluation, Benkelman beam and Falling Weight Deflectometer, pavement maintenance management, financial viability.

Texts / References:

1. D. Croney and P. Croney, *The Design and Performance of Road Pavements*, 2nd Edition, McGraw-Hill, International Series in Civil Engineering, 1992.
2. Ministry of Surface Transport, Government of India, *Specification for Road and Bridge Wok*, 3rd revision, Published by IRC, 1995.

3. E. J. Yoder and M. W. Witczak, *Principles of Pavement Design*, 2nd Edition, John Wiley & Sons.

CE 443 COMPUTER AIDED DESIGN (3 0 0 6)

Principles of Computer aided design. Computer graphics fundamentals. Points and lines; 3D transformation and projections; Plane curve and space curve; Surface description and generation; Hidden line algorithm for wireframe modelling; Surface modelling; Solid modelling; Representation of 3-D objects; Data Structure–Concept of link list, stack, Queue,Tree.

Texts / References:

1. S. Harrington, *Computer graphics: A Programming approach*, McGraw Hill, 1987.
2. D. F. Rogers and J.A Adams, *Mathematical elements of Computer Graphics*, McGraw Hill, 1990.
3. J.D. Foley, A.V. Dam, S. K. Feiner, and J. F. Huges, *Computer Graphics: Principle and Practice in C*, Addison Wesley Publishing Company, 1995.

CE 444 ENVIRONMENTAL MANAGEMENT (3 0 0 6)

The need for environmental awareness and protection in both natural and man-made systems – effects on atmosphere, water, ecological systems and quality of life. Environmental Impact Assessment and Integrated Environmental Management, Practical applications – cradle to grave concept, life cycle analysis, clean technologies. Environmental Audit, Compliance Audit; Concept of ISO and ISO 14000. Needs of developing countries. Governmental standards for Environmental Protection. Emerging Global Environmental Issues. Environmental Legislation.

Texts/ References:

1. R. G. John and W. C. David, *Environmental Impact Analysis Handbook*, McGraw-Hill, 1980.
2. R F Fuggle and M A Rabie, *Environmental Management in South Africa*, Juta & Co. Ltd., Johannesburg, 1991.
3. R M Harrison (Ed.), *Pollution – Causes, Effects and Control*, Whitstable Lithop Ltd, 1990.
4. L. W Canter, *Environmental Impact Assessment*, McGraw-Hill.

CE 445 SOLID WASTE ENGINEERING (3 0 0 6)

Solid waste- history, materials flow, the need for integrated solid waste management; Municipal solid waste-characteristics and quantities; Collection Systems-municipal wastes; commercial wastes, recyclable materials; Material separation and processing of municipal solid waste; Combustion and energy recovery-heat value, materials and thermal balances, combustion hardwares, undesirable effectes; Biochemical process-anaerobic digestion,composting and other processes; Landfills-planning, sitting, landfill processes, landfill design, landfill operations, post-closure care and use of old landfills; Current issues in solid waste management.

Texts/ References:

1. P. A. Vesilind, W. A. Worrel and D. R. Reinhart, *Solid Waste Engineering*, Thomson Brooks/Cole, First Edition, 2002.
2. H. S. Peavy, D. R Rowe and G. Techobanoglous, *Environmental Engineering*, McGraw-Hill International Ed, 1985.

3. M. L. Davis and D. A Cornwell, *Introduction to Environmental Engineering*, Mcgraw-Hill, Inc, International Edition, 1991.
4. A. P. Sincero and G. A. Sincero, *Environmental Engineering – A Design Approach*, Prentice- Hall India, 1996.