CE 3001 STRENGTH OF MATERIALS 3-0-0: 3 Credits

I. Generalized Hooke's Law for Isotropic materials-plane stress & plane strain problems; Uniaxial Stress; Biaxial (Two-dimensional) analysis of stresses and strains with graphical representations; Graphical representations for plane stress problems

II. Bending stress analysis for symmetrical and unsymmetrical cross-sections

III. Shear stress distribution in massive and thin-walled cross-sections; shear center for thin-walled cross sections with at least one axis of symmetry

IV. Differential equation for deflection of beams - Principle of superposition –Successive integration of differential equation - Macaulay's method - Area Moment Theorems-Conjugate Beam Method

V. Shear force and bending moment diagrams for Propped cantilever, Fixed and Continuous beams (except Three Moments' Theorem and Castigliano's Theorem)

VI. Torsion of bars with circular cross-sections, Torsion in thin walled tubes

VII. Strain energy for axial load, bending, torsion and shear. Buckling of columns-Euler's theory, Rankine's formula, Secant formula

References:

i. TIMOSHENKO S. P. & YOUNG : Elements of Strength of Materials
ii. TIMOSHENKO S. P. : Strength of Materials
iii. RAMARUTHAM S.: Strength of Materials
iv. SUBRAMANIAN : Strength of Materials

CE 3003 SURVEYING-I **3-0-0: 3 Credits**

I. Introduction:
Types of Surveying, Scale, Principles of Surveying, Shrinkage of Maps

II. Chain Surveying:
Types of Chain, Chain handling; Principles of Chain Surveying and Equipments; Methods of Chain Survey; Errors in Chain Surveying; Obstacles in Surveying; Field Book and Recording

III. Compass Surveying:
Prismatic Compass; Bearings: Whole Circle and Reduced Bearings; Computation of Bearings; Traversing; Local Attraction; Adjustment of Errors; True Bearing; Magnetic Declination

IV. Plane Table Survey:
Principles of Plane Table Survey, Equipments and Uses; Methods of Locating Features; Two-Point and Three-Point Problems; Telescopic Alidade

V. Leveling:
Principles, Scope, Terms, Equipments; Types of Levels, Dumpy Level; Temporary and Permanent Adjustments; Methods of Levelling; Level Book and Computation; Missing Data; Curvature and Refraction Correction; Reciprocal Levelling

Contouring: Definition; Methods of Contour Survey; Plotting of Contours.

Area and Volume determination.

VI. Theodolite Survey:
Scope; Types of Theodolites; Description of a Transit Theodolite, Temporary and Permanent Adjustments; Measurement of Horizontal Angles; Errors and Elimination; Methods of Traversing; Computation of Bearings; Coordinate System; Gale's Traverse Table; Missing Data, Plotting

VII. Tacheometry:
Instrument; Tacheometric constant; Anallactic Lens, Principle, Computation; Methods of tacheometry; Subtense Bar

References :

i. KANETKAR T. P. : Surveying and Levelling (Vols. I & II)
ii. PUNMIA B. C. : Surveying (Vols. II & III)
iii. DUGGAL S K : Surveying Vol I & II

CE 3005 GEOTECHNICAL ENGINEERING-I 3-0-0: 3 Credits

I. Introduction – Nature of Soil, Phase Representation and Relationships

Introduction to particulate behaviour : Three-phase system : – soil solids, water and air; Basic definitions and functional relationships : - Specific gravity; Void ratio; Porosity; water content; Unit Weights & Density : - bulk, dry, saturated, submerged and natural; Degree of saturation & Density index ; Structure of soil; soil texture; Size, range and shapes of individual soil particles; field identification of soils;

II. Index Properties and Soil Classification

Particles size distribution: Sieve analysis; distribution curve characteristics; grain size analysis for fine-grained and mixed soils; use of hydrometer; Consistency limits and indices; Activity and Sensitivity of clays

Classification of Soils: Descriptive, based on soil type; by origin; by structure; Textural, Unified and Indian Standard Classifications

III. Soil Moisture Relationship – Capillarity, Permeability and Seepage

Capillarity in soils; Free and adsorbed water; Permeability of soils: Darcy's Law; Determination of coefficient of permeability by constant head & falling head tests, Permeability of stratified soil deposits. Factors affecting permeability;

Seepage Analysis: Head, Gradient & Potential, Seepage pressure. Two dimensional flow - Laplace equation; Phreatic line in Earth dams; Graphical method of flow net construction: for flow below sheet piles, earth dams with or without core / filter; Seepage discharge across hydraulic structures; Piping; Flow net – electrical analogy;

Pore water pressure and the concept of effective stress; Quick sand condition

IV. Compressibility, Compaction and Consolidation

Difference between Compaction and Consolidation; Compaction tests : Standard and Modified Proctor ; Factors affecting compaction; Field compaction methods and control; One-dimensional consolidation – spring analogy; Terzaghi's theory of one-dimensional consolidation; Consolidation of undisturbed & remoulded soils; Laboratory consolidation test – analysis and results; Coefficient of volume change, Coefficient of consolidation, Compression index, Degree of consolidation; Secondary consolidation

V. Earth Pressure Theory

Plastic equilibrium in soil – active & passive cases. Active earth pressure – Rankine's Theory; Active & passive earth pressure of cohesive soil; Rankine's active thrust by trial wedge; Coulomb's wedge theory – Rebhann's construction & Culmann's construction

VI. Shear Strength

Measurement of shear strength – Unconfined strength test; Direct shear tests;Vane shear test and Triaxial tests – strain-controlled tests; Concepts of both Unconsolidated and Consolidated Specimens subjected to shear without drainage (with or without pore water pressure measurement); drained shear; Mohr strength envelopes for Total and Effective stresses; Mohr-Coulomb failure theory;

VII. Stability of Slopes

Stability analysis of finite & infinite slopes; Types of slope failures; Methods of analysis for slope stability – method of slices; Bishop's simplified method; Friction circle method; Stability Number; Stability of slopes of Earth dams

References :

i. VENKATARAMAIAH C : Geotechnical Engineering
ii. RANJAN GOPAL and RAO A. S. R. : Basic & Applied Soil Mechanics
iii. LAMBE T. W. and WHITMAN R. V. : Soil Mechanics

CE 3007 BUILDING MATERIALS & CONSTRUCTION 3-0-0: 3 Credits

I. **Building Stones:** Varieties of Indian Stones, Quarrying blasting, Dressings of stones, Characteristics of good building stones, Slate, Marble, Artificial stones, Stone Preservation

II. **Bricks and Tiles:** Constituents of brick earth and their properties, Manufacture of bricks, Clamps & Kilns, Types of brick, Defects in bricks, Tests on bricks; Mosaic and Ceramic tiles – manufacture and advantages

III. **Limes, Cements & Mortar:**
Lime – Types, properties and uses.
Cement – Composition, Varieties, Properties, Methods of manufacture; Tests on cement.
Mortar- Lime mortar, Cement mortar, Surkhi mortar, Mud mortar, Stabilized mud mortar, Gypsum and plaster of paris, Hydraulic mortar, Puzzolona mortar

IV. **Timber, Metals and Alloys:** Varieties of Indian timber, Characteristics and suitability for different uses, Defects in timber, Diseases and decay in timber, Preservation and Seasoning, Veneers, Fiber boards, Block boards

V. **Planning for Construction:** Site Preparation, Layout for building, Earthwork; antitermite and other pests treatments; site office and material storage; Construction of various building components – Foundation, Superstructure, Roofs and Floors of different types and their construction procedures; Services in buildings : plumbing, water supply and electrical fixtures; House Drainage : Floor slopes for efficient drainage; Drainage from roof tops and around buildings; Drainage Plans and water harvesting measures

VI. **Load-Bearing Walls:** Types of walls, Design considerations; Cavity walls: Introduction, General features and construction; Partition walls: Brick, Concrete and Glass partitions; Damp Proofing: Cause and effects of damping; materials and methods for Damp Proofing –
D P C treatment

VII. **Brick and Stone Construction:** Stone and Brick masonry: different types with sketches; Necessity of Bonds; Different types of Bonds; Definitions – Quoin, header, stretcher, closer, frog, etc., Mixing of mortar, Preparing Bricks and tiles for laying, curing of masonry work

Concrete Construction: Batching of mixes; casting process, compaction and curing; requirement of mix design and casting of test cubes – removing cubes from moulds and curing for strength tests; bar-bending equipments and preparation of reinforcement for R C C works

References:

i. JHA JANARDAN : Building Materials
ii. RANGWALA S. C. : Engineering Materials
iii. PUNMIA B. C. : Building Construction
iv. BINDRA and BINDRA : Building Construction

CE 4001 STRUCTURAL ANALYSIS-I 3-0-0: 3 Credits

I Analysis of Statically Determinate Pin-Jointed Trusses
Stability and Determinateness, Force analysis of Compound and complex trusses, Tension co-efficient method – application to simple space trusses

II. Deflection of Pin-Jointed Trusses:
Application of Castigliano's theorem and principle of virtual work, Unit load method, Graphical method – Williot - Mohr diagram

III. Influence Lines for statically determinate beams and trusses:
ILD for reaction, SF and BM of simple and compound beams, ILD for member forces of simply supported truss girders with parallel and non-parallel chords; effect of moving live loads; Focal length and counter bracing

IV. Three-Hinged Arches:
Eddy's theorem, BMD, Normal thrust and Radial shear at any c/s, Influence Lines

V. Suspension Bridges:
Analysis of cables, effect of temperature, anchor cables, three-hinged stiffening girder, ILD for BM and SF

VI. Masonry Structures:
Conditions for stability; stability and stress analysis of dams Retaining walls: supporting backfills - without and with surcharge

VII. Energy Concepts:
Principle of virtual work; Maxwell-Betti reciprocal theorem; Castigliano's theorem;
Application to determinate structures

References:

i. TIMOSHENKO S. P. & YOUNG : Theory of Structures
ii. JUNNARKAR S. : Mechanics of Structures

CE 4003 STRUCTURAL DESIGN – I **3-1-0: 4 Credits**

I. Introduction to Plastic Analysis & Limit State Design:
Stress-strain curve for mild steel; bending of beams; plastic analysis approach; limit states for steel design

II. Simple Bolted Connections & Welded Connections :
Types of bolts & bolted joints; bearing type connections; slip-critical connections
Weld types; design of groove welds and fillet welds
Eccentric Connections

III. Tension Members & Compression Members
Design procedure of tension members, Design of axially-loaded compression members, column splice

IV. Beams
Design procedure for rolled beams, (a) Laterally supported beams
(b) Laterally unsupported beams

V. Plate Girder
Design of Panel Sections, Stiffeners and Curtailment of Flange plates

VI. Gantry Girder
Design procedure of gantry girder

VII. Roof Trusses
Load combinations, Analysis of truss, Deflection of truss, Design procedure

References:

i. IS : 800 – 2007 Code of Practice for General Construction in Steel
ii. SP : 6(1) – 1964 Handbook for Structural Engineers : I. Structural Steel Sections
iii. DUGGAL S. K.: Design of Steel Structures; Tata McGraw Hill
iv SUBRAMANIAN N.: Design of Steel Structures; Oxford University Press

CE 4005 TRANSPORTATION ENGINEERING-I 3-0-0: 3 Credits

I. Introduction and Highway Development in India:
Different modes of Transportation, Characteristics of Road Transport, Brief history and development of Road Construction, Jayakar Committee Recommendations, Road Classification, Long term Road Plans, Vision – 2021, NHDP, Rural Roads Development Plan

II. Highway Alignment, Survey and Detailed Project Report:
Fundamental Principles of Highway Alignment, Factors controlling the selection of alignment, Engineering Surveys for a Highway Project, Drawings, Preparation of Detailed Project Reports (DPR)

III. Geometric Design of Highways:
Road Cross-sectional Elements: Width of Carriageway, Formation Width, Right of Way, Camber, Shoulder, Kerb, Road Margins, Design Speed, Sight Distances, Design of Horizontal curves, Super elevation, Extra widening on Horizontal curves, Transition curves, Set back distance at curves, Gradient, Design of Vertical curves –Summit and Valley curves

IV. Traffic Engineering:
Traffic Characteristics, Traffic Studies, Traffic Volume, Traffic Forecast, Traffic Capacity, Traffic Control Devices, Parking Studies, Accident Studies, Highway Safety, Intersections-At grade and Grade Separated Intersections, Traffic Control Devices, Traffic Signs, Traffic Signal Systems, Traffic Islands, Road Markings, Highway Lighting, Intelligent Transportation Systems

V. Pavement Design:
Types of Pavements, Flexible and Rigid, Pavement composition, Unconventional Pavements, Flexible Pavement Design as per IRC, Stresses in Concrete Pavements, Modulus of subgrade reaction, Design of rigid pavements as per IRC, Highway Drainage

VI. Highway Materials and Construction
Subgrade Soil, Aggregates, Bitumen, Tar, Emulsion, Modified Bitumen, Cement Concrete, Tests on Aggregates, Tests on Bitumen, Bituminous Mix Design, Construction of WBM roads, Soil Stabilised Roads, Different types of Bituminous Constructions, Construction of cement Concrete Pavements, Equipments used in Highway Construction

VII. Pavement Evaluation and Maintenance:
Pavement Evaluation-Structural and Functional, Benkelman Beam, Falling Weight Deflectometer (FWD), Dynamic Cone Penetrometer (DCP), Roughness measurement, Distresses in flexible and concrete pavements, Maintenance and Rehabilitation of Pavements, Overlay Design as per IRC

References :

i. KHANNA S. K. and JUSTO C. E. G.: Highway Engineering
ii. KADYALI L. R. and LAL N. B. : Principle and practices of Highway Engineering
iii. CHAKRABORTY P. and DAS A.: Principles of Transportation Engineering

CE 4007 FLUID MECHANICS-I **3-0-0: 3 Credits**

I. Introduction:

Fluid and continuum, Physical properties of fluids, Rheology of fluids.

II. Fluid Statics:

Pressure-density-height relationship, Manometers, Pressure on plane and curved surfaces, Center of Pressure, Buoyancy, Stability of immersed and floating bodies

III. Kinematics of Fluid Flow:

Types of fluid flows: Continuum, & free molecular flows. Steady and unsteady, uniform and non-uniform, Laminar and turbulent flows, Rotational and irrotational flows, Compressible and incompressible flows, One, two and three dimensional flows, streamlines, Continuity equation, Stream function and velocity potential.

IV. Dynamics of Fluid Flow:

Euler equation of motion along a streamline and its integration, Bernoullie's equation and its applications- Pitot tube, Orifice, Venturi meter, Orifice meter, Notches and weirs, Momentum equation

V. Laminar and Turbulent Flows:

Equation of motion for laminar flow through pipes and parallel plates, turbulent flow , eddy viscosity , mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces , resistance to flow, minor losses , power transmission through a pipe.

VI. Boundary Layer concept:

Boundary layer concept, boundary layer over a flat plate , laminar boundary layer , application of momentum equation, turbulent boundary layer , laminar sub- layer , separation and its control, drag and lift, drag on a sphere , a two dimensional cylinder, and an aerofoil, Magnus effect.

VII. Dimensional Analysis and Hydraulic Similitude:

Dimensional analysis, Buckinghams Pi theorem, important dimensionless numbers and their significance, geometric, kinematics and dynamic similarity, model studies.

References:

i. S.K.Agarwal: Fluid Mechanics & Machinery,TMH.
ii. Hunter Rouse, Elementary Mechanics of fluids, John Wiley & Sons.
iii. I.H.Shames, Mechanics of Fluids McGraw Hill,
iv. Dr.D.S. Kumar, Fluid Mechanics and Fluid Power Engineering, S.K. Kataria and Sons
v. Modi, P.N.and Seth, S.H., Hydraulics and Fluid Machines, Standard Book House,

CE 5001 STRUCTURAL ANALYSIS-II **3-0-0: 3 Credits**

I. Three-Moments Theorem:
Analysis of continuous beams, without or with support settlement

II. Influence lines for Continuous Beams:
Muller-Breslau principle, ILD for reaction, SF and BM of statically indeterminate beams using conjugate beam method

III. Principle of Least Work:
Analysis of statically indeterminate trusses and frames

IV. General Method:
Consistent deformation method, Flexibility method, Analysis of statically indeterminate beams, trusses and frames

V. Analysis of Arches:
Two-hinged arches: circular and parabolic

VI. Slope Deflection Method:
Analysis of continuous beams and portal frames without or with side sway, use of symmetric and anti-symmetric conditions

VII. Moment Distribution Method:
Analysis of continuous beams and portal frames without or with side sway, use of symmetric and anti-symmetric conditions

References:

1. TIMOSHENKO & YOUNG: Theory of Structures
2. KINNEY: Statically Indeterminate Structures

CE 5003 FLUID MECHANICS-II **3-0-0: 3 Credits**

I. Introduction:

Difference between open channel flow and pipe flow, geometrical parameters of a channel; continuity equation

II. Uniform Flow:

Chezy's and Manning's equation for uniform flow in open channel, velocity distribution, most efficient channel section

III. Energy and Momentum principles:

Critical depth, concept of specific energy and specific force, application of specific energy principles for interpretation of open channel phenomena.

IV. Non-uniform flow in open channel:

Equation of gradually varied flow and its limitations, flow classification and surface profile, integration of varied flow by analytical, graphical and numerical methods

V. Hydraulics Jump, Surges, Water Waves:

Classical hydraulic jump, evaluation of the jump elements in rectangular and non-rectangular channels on horizontal and sloping beds, open channel surge, celerity of gravity wave, deep and shallow water waves.

VI. Hydraulic pumps:

Introduction, Rotodynamic pumps classification on different basis, basic equations, velocity triangles, manometric head, efficiencies, cavitation in pumps, characteristic curves.

VII. Hydraulic Turbines:

Introduction, Rotodynamic machines, Pelton turbine, reaction turbine, Francis and Kaplan turbine, unit quantities, similarity laws and specific speed, cavitations, characteristic curves.

References:

i. Lal, Dr. Jagdish, Hydraulic Machines
ii. Garde, R.J. Fluid machines through problems, New Age International Pvt Ltd, 2nd Edition
iii. Streeter, V.L. and White, E.B., Fluid Mechanics, McGraw Hill, New York, 8th Edition
iv. Asawa, G.L. Experimental Fluid Mechanics, Vol 1., Nemchand and Bros, Roorkee
v. Ranga Raju, K.G., Flow through open channels, TMH, 2nd edition

CE 5005 STRUCTURAL DESIGN-II **3-1-0: 4 Credits**

I: Properties of Concrete and its Ingredients:

Types of cement and their characteristics; ingredients of concrete; Aggregates quality and grading – coarse and fine aggregates; Concrete types and their composition : use in different structural units; law of water-cement ratio; compaction requirement; additives and admixtures; Tests on cement and concrete; design of mix proportions by fineness modulus and trial mix methods Reinforcements – types of reinforcement and their properties;

II: Limit State Method of Design:

Design concepts, limit state of serviceability; characteristic strength of materials; characteristic loads; factored moment; partial safety factors; stress-strain relationship for concrete and steel; stress block parameters; limit state of collapse for flexure; singly and doubly reinforced rectangular and Tee beams

III: Limit state design for Shear, Bond and Torsion:

Shear reinforcement in form of vertical stirrups and bent-up bars; shear strength of concrete; minimum shear reinforcement; development length; design for torsion reinforcement

IV: Design of Slabs:

One way and two way slabs; circular slabs

V: Design of Columns:

Short axially loaded columns; helical reinforcement; columns with axial load and uniaxial/biaxial bending; interaction charts as per SP – 16

VI: Design of Foundations:

Isolated column footings of square, rectangular and circular shapes; combined footing; strip footing

VII: Design of Staircases:

Types of staircases; design of doglegged and open-well types

References:

i. Reinforced Concrete by Dr. B.C. Punmia

ii. Reinforced Concrete by Mallik and Gupta

iii. Reinforced Concrete by Vazirani and Ratwani

iv. Reinforced Concrete by S. Unikrishna Pillai and Devdas Menon

CE 5007 CONSTRUCTION PLANNING AND MANAGEMENT
3-0-0: 3 Credits

I. Introduction:
Indian construction Industry, Construction project management and its relevance. Stakeholders of a construction project. Project organization.

II. Construction Economics:
Introduction. Economic decision making. Cash-flow diagrams. Present worth comparison, Future worth comparison, Annual cost and worth comparison, Rate of return method. Project cost estimation- preliminary and revised estimates.

III. Construction Equipments:
Brief study of equipments required for earth work, dredging, conveyance, concreting, hoisting, pile driving, compaction and grouting. Investment and operating costs, output of various equipments.

IV. Networks:
Elements of Networks and their definitions, events and Activities Rules of Network, partial situation and Fulkerson's rule. Development of Network. Forward planning, Backward planning event oriented, Activity oriented networks; Plan Breakdown; Sequencing example: House construction

V. Management techniques:
CTPM, PERT and BAR CHARTING with particular reference to Building Construction PERT - Time computations, Earliest expected time and its formulations, Latest allowable time and its computation; CPM - Network Analysis, Planning, scheduling and control; Start and finish times of activity EST, EFT, LST and LFT; Float and Total Floats, Free floats, Independent floats, Interfering floats; Per-critical, Sub-critical, Critical Activities, PERT network Analysis,
Slack positive, Negative, Zero slacks and Critical Paths in Network

VI. Management techniques (contd.):
CPM Cost Model, Resource allocation and Histograms; Project Management Software

VII. Public Works Accounts:
Various forms used in construction works, Measurement book, Cash book, Material at site account, Imprest account, Stock tools and plants, Various types of running bills, Secured advance, Final bills. Construction quality management.

Reference Books:
1. SHARMA S. C. : Construction Equipment and Management
2. PEURIFOY R. L. : Construction Planning, Equipments and Materials
3. PUNMIA B. C. : CPM and PERT Analysis

CE 6001 ENVIRONMENTAL ENGINEERING 3-0-0: 3 Credits

I. Water Resources:
Quality & demand of water, factors effecting demand, Population forecast

II. Surface Sources & Intake works – Classification & conduits

III. Water Treatment
Characterisation and drinking water standards; Treatment of water – Screening, Plain sedimentation and with coagulation. Filtration- Slow sand, Rapid sand and Pressure Filters;

IV. Water Treatment (Contd)
Disinfection, Softening & other miscellaneous treatments of water; Water borne diseases,

V. Distribution system:
Different types of pipe line networks; Layout of Pipe Lines, Pipe joints & fittings, valves; Design, Methods of distribution, distribution reservoirs

VI. Sewage and Drainage:
Quantity of Sewage and Storm water, Design of sewers and Water drains; Plumbing and house drainage

VII. Sewer Appurtenances and Sewage Treatment:
Layout, Septic tank, Imhoff tank, Pumping of sewage

Books References:

i. GARG S. K. : Water Supply
ii. GARG S. K. : Sanitary Engineering
iii. CPHEEO Manual on Water Supply and Treatment
iv. CPHEEO Manual on Sewerage and Sewage Treatment
v. BIRDIE : Water Supply & Sanitary Engg
vi. CHATTERJEE A. K. : Water Supply, Waste Disposal and Environmental Engineering

CE 6003 TRANSPORTATION ENGINEERING-II 3-0-0: 3 Credits

I. Introduction:
History and development of Indian Railways, Water transportation and Air transport, Advantages and disadvantages of each.

II. Railway Engineering:
Location surveys and alignment, Permanent way, Gauge, Coning of Wheels, Function of Rails, Type of Rail sections, wear on Rails, Rail Failures, Rail flaw detection, Creep of Rails, Rail Joints, Function of sleepers, Types of sleepers, sleeper density, Ballast, Rail Fixtures and Fastenings, Formation and Subgrade, Failures in rail embankment and measures.

III. Geometric Design of Rail Tracks:
Cross-sectional Elements of a railway tract, Horizontal curves, Super-elevation or Cant, Equilibrium Cant, Cant deficiency, Cant Excess, Negative superelevation, Gradients, Vertical Curves. .

IV. Points and Crossings, Junctions, Stations and Railway Yards:
Turnouts, Points and switches, Crossings, Type of Crossings, track junctions, Design of a turnout, Design of diamond crossing and cross-over, Functions and Requirements of a Railway Station, Types of Stations, Function of Station Yards, Sidings

V. Signaling, Interlocking and Track Resistances:
Object and Principles of signaling, classification of signals, Necessity and functions of interlocking, Traction and Tracting Resistances, Hauling Capacity of a Train

VI. Airport Engineering:
Aircraft characteristics, Runway, Taxiway, Aprons, Terminal Area

VII. Docks & Harbour:
Types, breakwaters, docks, wharves, quays, transit sheds, navigational aids.

References:

i. Chandra and Agrawal : Railway Engineering
ii. Saxena and Arora : A Text Book of Railway Engineering
iii. M.M. Agarwal, Railway Engineering, Prabha & Co. 2007
iv. Khanna S.K. and Aurora, M.G. Airport Planning and Design
v. Oza and Oza, Elements of Dock and Harbour Engineering

CE 6005 SURVEYING-II **3-0-0: 3 Credits**

I. Curves and Curve Setting:
Introduction: Necessity, types of curves, applications
Simple curves – Degree of curve, methods of curve setting, Obstacles in curve setting
Compound curve, Reverse curve, Transition curve, Vertical curve

II. Triangulation:
Scope, classification, inter-visibility, satellite station, eccentricity of signals, base line and its extension

III. Theory of Errors:
Terms, Laws of weights, M.P.V. & M.P.E., adjustment of geodetic triangle with central station, adjustment of level line

IV. Geodetic Levelling:
Scope, curvature & refraction corrections, axis-signal correction, Single angle observation, reciprocal levelling

V. Electronic Distance Meter:
Scope, electromagnetic waves, phases of waves, types of waves, distance by transit time and phase difference, carrier waves, different EDM instruments, Total station

VI. Astronomy:
Terms- Celestial sphere, Zenith, Nadir, Horizon, Vertical circle, Latitude, Longitude, Altitude, Azimuth, Right Ascension, Declination, Hour angle, Ecliptic. Different co-ordinate systems, Spherical triangle, Time – sidereal time, apparent time, mean solar time, equation of time, determination of azimuth, latitude longitude

VII. Hydrographic Surveying
Scope, applications, methods of sounding, three point problem

References :
KANETKAR T. P. : Surveying and Leveling (Vol. II)
ARORA K. P. : Surveying Vol. II

CE 6007 GEOTECHNICAL ENGINEERING-II 3-0-0: 3 Credits

I. Site Investigation and subsoil exploration:
Methods of soil exploration; Planning a subsoil exploration: Number of boreholes and depths of exploration for various types of works; Field Tests: Standard penetration test; Dynamic and Static cone penetration tests; Vane shear test; Soil samplers & collection of soil samples

II. Stress Distribution in Soil Media and Settlement :
Stress Distribution: Boussinesq's and Westergaard's equations, Pressure distribution diagram, Newmark's influence chart; Contact pressure below foundations –Steinbrenner's coefficients Settlement of foundations : Elastic, Consolidation and Creep settlements; Total and Differential settlements; Rate of settlement, I. S. Code limitations for different structures Settlement calculation from consolidation characteristics and using N-values

III. Bearing capacity:
Terminology: Ultimate and Safe Bearing Capacities; Allowable Bearing Pressure Gross and Net Bearing Capacities; Net Soil pressure for a specified settlement; Bearing capacity from equations of Terzaghi, Skempton, Brinch Hansen and Meyerhoff; I. S. Code of Practice; Bearing capacity from N-values; Effect of ground water table Plate Load test: Procedure, Limitations and determination of permissible bearing capacity for footings in sand and clay soils
Eccentrically loaded footings – useful width concept

IV. Shallow Foundations:
Type of foundations: Isolated and combined footings; Rafts foundations Proportioning of footings for even settlement

V. Pile Foundation:
Types of piles; Pile construction; Load carrying capacity of piles : Dynamic and static Formulae; Elastic analysis of single axially loaded pile; Group action and efficiency; Underreamed pile foundation; Introduction to Laterally loaded piles and Batter piles Negative skin friction – cause and prevention of n s f effect on piles; factor of safety of pile subjected to negative skin friction Pile load tests : ultimate, routine, vertical and horizontal; permissible settlement

VI. Machine Foundations:
Soil dynamics, Mass-spring system; Mass-system with damping; Natural frequency of foundation soil systems; Machine Foundations: Types of Machines and Machine Foundations Vibration isolation: Types and Methods of Isolation

VII. Caissons:
Shapes and Types of wells or caissons, their advantages and disadvantages; components of a well foundation; Depth of well foundation and bearing capacity; Forces acting on a well foundation. Well sinking: operation and problems; Drilled caissons; Pier foundations

References :

i. VENKATRAMIAH C. : Geotechnical Engineering
ii. GARG S. K. : Soil Mechanics and Foundation Engineering
iii. BRAHMA S. P. : Foundation Engineering
iv. BOWLES J. F. : Foundation Analysis and Design

CE 7001 EARTHQUAKE RESISTANT DESIGN 3-0-0: 3 Credits

I Ground Motion during Earthquakes:
Seismology, Seismic Zoning Map, Characteristics and Study of Strong Motion; Types of Waves: P-, R- and S-waves; Epicenter, Hypocenter, Locating Epicenter; Terminologies - magnitude, intensity and measurement, Record of notable earthquakes

II Dynamics of Structures:
Undamped system; Springs in parallel or in series; Newton's laws of motion; D' Alembert's principle; Dynamic equation of motion; Solution of dynamic equation of motion for critically, overdamped and underdamped system; Logarithmic decrement; Free and forced vibration; Response of single D.O.F system to harmonic loading.

III Time domain solution of dynamic equation of motion and response spectra:
Central difference method; Newmark's average acceleration method. Construction of response spectrum; Tripartite response spectrum; Response spectrum for elastic design

IV Free and forced vibration of shear buildings:
Natural frequency and normal modes; Orthogonality properties of normal modes; Modal superposition method; Response of a shear building to base motion.

V Philosophy of Earthquake Resistant Design of R C Buildings:
Concepts; Effect of Vibration on Structures; Basics of Earthquake Resistant Design;
Architectural consideration in Design of Buildings to resist earthquakes; strong column-weak beam principle; Ductility consideration in Earthquake Resistant Design;

VI Earthquake Resistance consideration for R C Buildings as per IS 1893-2002:
IS 1893-2002 – BIS code provisions; Design Lateral Load – determination on Code Procedure; Infill wall consideration in Seismic Analysis; Mathematical modeling and Stepwise Procedure for Analysis

VII Seismic Evaluation and Retrofitting of Buildings:
Provisions for Improving Performance of non-engineered Masonry Construction; Retrofitting Strategies of R C and Masonry Buildings; Practical Approach towards Seismic Evaluation of R C Buildings; Description of Form 6

References:

i. AGARWAL PANKAJ and SHRIKHANDE MANISH : Earthquake Resistant Design of Structures, Prentice-Hall (2006)
ii. COBURN ANDREW and SPENCER ROBIN : Earthquake Protection, John Wiley
iii. CHOPRA A. K. : Dynamics of Structures – Theory and Applications to Earthquake Engineering, Prentice Hall
iv. IS : 1893 - 2002, Indian Standard Criteria for Earthquake Resistant Design of Structures :
v. Part I – General Provisions and Buildings
vi. IS : 13920-1993, Indian Standards Guide to Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces

CE 7003 IRRIGATION ENGG AND HYDROLOGY 3-0-0: 3 Credits

I. Irrigation Principles and Practices:

Introduction, Necessity, Advantages and disadvantages of irrigation, Classification, Methods of irrigation, Soil – water - crop and their relationship, Frequency of irrigation.

II. Water Requirement of Crop:

Optimum use of water, Factors affecting water requirement of a crop, Duty, Delta and base period and their relationship, Consumptive use, irrigation efficiency.

III. Flow Irrigation:

Classification of canals, Canal alignment, Flow in alluvial channels, Design of channels for maximum permissible velocity, Kennedy's silt theory and design of channels on its basis, Lacey's silt theory and regime equations, Design of channels based on Lacey's equation.

IV. Flow irrigation (Contd..):

Canal capacity, Canal losses, Lined channels & their design, Construction and maintenance of irrigation channels, Lift irrigation: Classification, Location, Water lifting arrangement, Yield of wells, Well Troubles.

V. Diversion Head Works:

Selection of sites, Constituent parts of weir, Causes of failure of weir on permeable foundation, Bligh's creep theory, Khosla's theory, Cross drainage works: Necessity, Types and their selection, River training works.

VI. Hydrology:

Hydrological cycle, precipitation, Measurement analysis, Average depth of rainfall, Factors affecting runoff, Runoff measurements, Mass curves, Flood frequency studies.

VII. Hydrology (Contd..)

Hydrograph, Unit hydrograph, Infiltration, Estimation of runoff by infiltration method, Flood routing.

References:

i. Bharat Singh: Irrigation Engineering.
ii. S. K.Garg: Irrigation Engineering & Hydraulic Structures.
iii. B.C.Punmia ,Pandey B.B.Lal: Irrigation and water power engineering

CE 7005 FINITE ELEMENT APPLICATIONS IN CIVIL ENGINEERING
3-0-0: 3 Credits

I. Introduction:
General description and analysis procedure; Basic equations in elasticity, Linear constitutive Laws; Concept of element and node, Element aspect ratio, Nodal degree of freedom, Co-ordinate systems, Generalized co-ordinate form of displacement, Convergence requirements, Pascal triangle.

II. Matrix Displacement Formulation:
Matrix displacement equation, Stiffness matrix and its properties, Stiffness matrices for bar element, truss element, beam element; Use of symmetry and partitioning of matrix, Skyline storage.

III. Shape Functions:
Defination, Polynomial shape functions, Shape functions in Cartesian co-ordinates and Natural co-ordinates, Shape functions using Lagrange polynomials, Shape functions for serendipity family elements.

IV. Strain Displacement Matrix and Stiffness Equation Assembly:
Strain displacement matrices for bar element, CST element, beam element; Stiffness matrix for CST element for direct approach, Isoparametric formulations, Jacobian matrix.

V. Variational Formulation:
General variational method in elasticity, Potential energy in elastic bodies, Principle of minimum potential energy, Rayleigh-Ritz method.

VI. Analysis of Bars and Trusses:
Analysis of tension bars/columns. Two dimensional trusses, Calculation of reactions.

VII. Analysis of Beams and Rigid Frames:
Beam analysis, Moment curvature relation, Strain energy, Analysis of two dimensional rigid frames.

References:

1. DESAI C. S. and ABEL J. F.: Introduction to the Finite Element Method
2. CHANDRUPATLA, T.R. & BELEGUNDU, A.D.: Introduction to Finite Elements in Engineering
3. BHAVIKATTI, S.S.: Finite Element Analysis

CE 7007 COMPUTER AIDED STRUCTURAL DESIGN 3-0-0: 3 Credits

I: Matrix analysis techniques, System of linear algebraic equations, Gauss elimination method, Cholesky decomposition method, Ill-conditioned and well conditioned systems.

II: Flexibility method, System approach of flexibility method, Member approach of flexibility method, Equivalent joint loads, Solution of a truss, beam and frame problems.

III: Stiffness method, properties of stiffness matrix, system approach, member approach, derivation of element stiffness matrices for truss, beam and frame member, assemblage of element stiffness matrices, solution of a truss, beam and frame problem.

IV: Introduction to FEM, Introduction to basic equations of theory of elasticity, Constitutive relations, potential energy approach, principle of minimum potential energy, Rayleigh-Ritz principle, Weighted residual methods, Galerkin's method, use of Rayleigh-Ritz principle and Galerkin's method to solve a differential equation.

V: Initial value problem, boundary value problem etc., Gradient theorem, Gauss divergence theorem, weak formulation of a strong form of an equation, Euler-Bernoulli equation, Essential and natural boundary condition, functional, building the expression of potential energy from the original strong form of the equation.

VI: Description of different types of elements, Isoparametric, sub-parametric and super-parametric formulation, procedure to build shape functions of one dimensional, two dimensional element (3 noded triangular element, four noded isoparametric element), Use of Lagrange interpolation function to find the expression for shape functions.

VII: Derivation of stiffness matrix for one dimensional truss and beam element following direct potential energy method, derivation of stiffness matrix for four nodded isoparametric quadrilateral element following direct potential energy method, derivation of matrix characteristic equations for a one/two dimensional problem following Galerkin's method, Numerical integration methods (Gauss quadrature technique), Inputs for a general FE program, bandwidth minimization.

References:

i. Introduction to Finite elements in engineering method by T. Chandrupatla and R. Belegundu, .
ii. Finite element analysis: Theory and programming by C. S. Krishnamurthy
iii. Introduction to Finite Element Method by J. N. Reddy
iv. Concepts and applications of finite element analysis, 4th edition by R. D. Cook, D. S. Plesha, M. E. Plesha and R. J. Witt.
v. Textbook on Finite Element Method by P. Seshu

CE 7009 BRIDGE ENGINEERING & TUNNELLING 3-0-0: 3 Credits

I. Introduction

Definition, Importance of bridge, Components of Bridge, Classification of Bridges 2 Site section, Preliminary data to be collected, Preliminary drawings- Determination of Design discharge – Lineal waterway, Economical span, Location of piers and Abutment, Vertical clearance above HFL, Sub-soil exploration- Scour depth, traffic projection, Investigation report, preparation of Detailed Project Report (DPR) of bridges choice of bridge type, Quality assurance for bridge projects 3

II. Loading Standards for Road Bridges :

Evolution of Bridge loading standard as per relevant IRC specification i.e. Dead load IRC standard live load, Impact effect, Application of live loads on deck slabs, Wind load, Longitudinal forces, Centrifugal forces, Horizontal forces due to water currents, Buoyancy effect, Earth pressure, Temperature effect, Seismic force, etc. Slab culvert, Box culvert, pipe culvert, T-beam bridge superstructure, Design of Deck Slab, Abutment, Piers, Wing wall, etc. Brief Introduction to rigid frame, Arch and Bowstring girder bridges
Pretension and post tensioned concrete bridges, prestressed concrete T-beam bridge superstructure.

III. Bridge Bearings

Introduction function of bearings, Bearings for steel bridges and concrete bridges, Bearing for continuous span bridge, IRC provisions for bearing, Material specifications, Types of bridge foundations, general design criteria and methods of construction : Open foundation, Caisson foundations – Open, Monolith, Pneumatic and Box or Floating types, Drilled caissons, Pier foundations, Pier Nosing

IV. I.G. Construction, Repair, Rehabilitation of Bridges :

Introduction to construction of of bridges and maintenance, Inspection of bridges, Types of failure in bridges, Maintenance and Rehabilitation of bridges, Protective and Training Works at Bridge sites

V.TUNNEL ENGINEERING. Introduction:

General Aspects, Classification, Definitions and Purpose of Tunnels, Advantages and Disadvantages, Conditions favorable for Tunnel construction, Economics

VI. Tunnel Alignment

Location of centre line on ground, Surveying, Preliminary exploration, Approaches to Tunnels, Tunnel alignment and grade, Size and Cross-section of Tunnels, Design and Construction of Portals, Verification of Tunnel Cross-sections, Types of Drills, Selection of Drilling Equipment and Drilling Pattern, Types of Explosives and Requirement, Detonators and Triggering operation, Blasting techniques

VII. Geotechnical Aspects and Tunneling Operations:

Geotechnical Exploration for Profile and Nature of Rock; Planning operation – Number of Entrances and sequence of operations in driving of tunnels Tunneling Methods : Hard rock, Soft soils, Choice of Method of Construction, Ground Support, Compressed Air tunneling; Advantages, Classification of Shafts, Location and Size of Shafts in Rocks, Shaft Sinking in Soft Soils, Protection around Shaft Openings and Shaft Support; Objects of Tunnel Ventilation, Methods of Ventilation, Air Requirement and Air Conditioning, Lighting and Drainage of Tunnels; Precautions in Handling and Storing Explosives, Safety Requirements during Blasting Operation and during Tunneling

References:

i. VICTOR D. J : Essentials of Bridge Engineering
ii. KRISHNA RAJU N : Design of Bridges
iii. ALGIA J. S : Bridge Engneering
iv. SRINIVASAN R : Harbour, Dock and Tunnel Engineering

CE 7011 SOIL ENGINEERING **3-0-0: 3 Credits**

I. Clay Mineralogy:

Clay minerals: molecular structure of clay minerals, atomic & molecular bond, adsorbed and double layer water; Structure of clay in deposits: honey-combed, flocculated & dispersed structures;

II. Drainage & Dewatering:

Ditches & sumps, Well point system, Shallow well system, Deep well drainage, Electro-osmosis method, Protective filters.

III. Shear Strength:

Use of stress path in triaxial test – Undrained & drained tests for N.C. & O.C. clay samples. Elastic & Plastic deformation, yielding, hardening and plastic flow, Elastic & Elasto-Plastic behaviour,

IV. Critical State Soil Mechanics :

Introduction, Critical State line, Roscoe and Hvorslev surfaces, Critical state boundary – Interpretation and significance

V. Bulk head & Cofferdams:

Classification – cantilever sheet pile wall in cohesionless and in cohesive soils.
Anchored bulkheads – Free-earth and fixed earth concepts; Design aspects

VI. Shaft, Tunnels & Conduits :

Stress distribution in the vicinity of shaft, Stress distribution around tunnels, arching in soils; Classes of underground conduits, loads on conduits.

VII. Geoenvironmental Engineering :

Sources of underground contamination and transportation, site characterisation, remediation methods, Environmental Geotechnology: Management of solid waste, landfills, flyash management

References:

i. LEONARDS G. A. : Foundation Engineering, McGraw Hill
ii. SCOTT R. F. : Soil Mechanics
iii. GARG S.K. – Soil Mechanics & Foundation Engineering

CE 7013 DISASTER MANAGEMENT **3-0-0: 3 Credits**

I Introduction

Types of disasters, Natural hazards and disasters

II Disaster Risk Reduction and Phases of Disaster Management

Mitigation, preparedness, response, recovery, rehabilitation, community capacity building, disaster risk reduction by education, information and public awareness, role of government in disaster management

III Earthquake

Structure of earth, plate tectonics, causes of earthquake, epicenter, hypocenter, magnitude and intensity, isoseismals, different types of earthquake waves, seismic zoning of India, structural form and earthquake resistance, plan and shape of buildings, soft stories, slenderness limitations, strong column-weak beam theory, base isolation – different techniques, soil response to earthquake, site selection, liquefaction – its causes and remedial measures, retrofitting of structures, use of IS codes

IV Tsunami and Cyclone

Tsunami, The process of triggering waves, dynamics of tsunami waves, management of tsunami disaster

Cyclone, major location of occurrence, intensity of classification, cyclone resistant design, management and mitigation

V Flood and Drought

Flood, types of flood, effects of flood, flood defenses and management

Drought, concept of drought, consequences of drought, drought profile, management and risk reduction, lessons on mitigation

VI Landslide

Causes of landslide, signs and early warning systems of landslides, means of mitigation

VII Fire

Terminologies, fire resistance, fire endurance, fire detection and alarms, properties of different materials at elevated temperatures, mitigation measures

References

i. Chakraborty, Satesh C. : Natural hazard and disaster management

ii. Sharma Neelam: Earthquake resistant building construction

iii. Sahni, P. and Airyabandu, M.: Disaster risk reduction in South Asia

iv. Jain, V. K. : Fire safety in Building

CE 7015 WATERSHED ENGINEERING AND MANAGEMENT
3-0-0: 3 Credits

I.INTRODUCTION: Concept of watershed development, objectives of watershed development, need for watershed development in India, integrated and multidisciplinary approach for watershed management.

II.CHARACTERISTICS OF WATERSHED: Size, shape, physiography, slope, climate, drainage, landuse, vegetation, geology of soils, hydrology and hydrogeology, socio-economic characteristics, basic data on watersheds.

III.PRINCIPLES OF EROSION: Types of erosion, factors affecting erosion, effects of erosion on land fertility and land capability, estimation of soil loss due to erosion, universal soil loss equation.

MEASURES TO CONTROL EROSION: Contour techniques, ploughing, furrowing, trenching, bunding, terracing, gully control, rock-fill dams, brushwood dam, gabion.

IV.WATER HARVESTING: Rainwater harvesting, catchment harvesting, harvesting structures, soil moisture conservation, check dams, artificial recharge, farm ponds, percolation tanks.

V.LAND MANAGEMENT: Land use and land capability classification, management of forest, agricultural, grassland and wild land, reclamation of saline and alkaline soils.

VI.ECOSYSTEM MANAGEMENT: Role of ecosystem, crop husbandry, soil enrichment, inter, mixed and strip cropping, cropping pattern, sustainable agriculture, bio-mass management, dry land agriculture, Silvi pasture, horticulture, soil forestry and afforestation.

VII.Planning of watershed management activities, peoples participation, preparation of action plan, administrative requirements.

TEXT BOOKS:

i. Watershed Management by JVS Murthy – New Age International Publishers.

ii. Water Resource Engineering by R.Awurbs and WP James – Prentice Hall Publishers.

REFERENCES:

i. Watershed Management by VVN Murthy – Kalyani Publications.

ii. Irrigation and Water Management by D.K. Majumdar – Prentice Hall of India.

CE 7017 CONCTRETE STRUCTURES: 3-0-0: 3 Credits

I. **Retaining Walls**: Types of retaining walls, Lateral earth pressure on retaining walls, Rankine's theory, Design of Cantilever and Counterfort retaining walls.

II. **Containers**: Design of Bunkers and silos, Jansen's and Airy's theories.

III. **Domes**: Membrane stresses, Design of segmental domes with and without lantern.

IV. **Liquid Storage Tanks:** Design of liquid retaining structure-strength and cracking considerations, Combined tension and moment, Ground tanks, Overhead tank, Circular, rectangular tanks and Intze tank with staging.

V. **Building Frames**: Analysis and design of building frames for wind and earthquake forces.

VI. **Concrete Bridges:** I.R.C. loadings, Dispersion principles, Design of slab, box culverts and Tee-beam bridges.

VII. **Prestressed Concrete:** Basics concepts, Materials used in prestressed concrete, Methods of prestressing, Basic inequalities, Design of rectangular sections, Losses in prestressing.

References:

1. Mallick S. K. & Gupta A. P.- Reinforced Concrete.
2. Punmia B. C., Jain Ashok Kumar & Jain Arun Kumar- Reinforced Concrete Structures.
3. Vazirani & Ratwani- Concrete Structures

CE 7019 CONCRETE TECHNOLOGY AND MATERIALS: 3-0-0: 3 Credits

I. Cement Hydration:
Cement Types, CSH gel formation, hydration equation

II. Paste Micro-structure;
Porosity, gel pore and capillary porosity

III. Fresh concrete mixing:
Mixers, mixing time, pumped concrete, vibration of concrete

IV. Strength of concrete:
Factors affecting strength of concrete, Behaviour under compressive stress, fracture mechanics approach

V. Permeability and Durability;
Sulphate attack, Acid attack, Alkali – aggregate reaction, freezing and thawing

VI. Concrete mix design;
Types of concrete; IS Method, British DOE, ACI method

VII. Admixtures:
Chemical and mineral admixtures, accelerator, retarders, water reducers

Reference Books:

1. Concrete technology, A.M. Neville and J. J. Brooks
2. Corrosion of steel in concrete, P. Sechiessl
3. Concrete technology, Santha Kumar
4. Property of concrete, A. M. Neville

CE 8001 ENVIRONMENTAL POLLUTION & CONTROL 3-0-0: 3 Credits

I. Solid Wastes:

Definitions, sources, characteristics and perspectives; Types of Solid Wastes: Municipal wastes, Industrial wastes, Hazardous wastes; Solid Waste generation, Typical generation rates and factors that affect them; Physical and Chemical characteristics of Solid Wastes

II. Solid Waste Management:

Materials flow in society, collection services, types of collection systems, Collection routes, Proper Solid Waste Management (Reduction in raw materials usage, Reduction in solid waste quantities, Materials recovery, Energy recovery); Transfer Stations: Location of transfer stations, transfer means and methods

Incineration; Composting, Vermicomposting; Pyrolysis, Sanitary Land fill, Leachate and Gas Control

III. Air Pollution:

Air Pollution : Past, present and future, Historical review, Global implications, Scales of Concentration; Classification and Properties of Air pollutants; Sources, Behaviour and Effects of Pollutants; Photochemical smog; Indoor Air Pollution

IV. Meteorology and Natural Purification Processes:

Elemental properties of the atmosphere: Heat, Pressure, Winds, Moisture, Relative Humidity; Lapse rate; Inversions and Stability

Dispersion of Air Pollutants: Atmospheric dispersion equations; Modelling & estimation of plume rise; Effects of Air Pollution on Meteorological Conditions

V. Environmental Pollution Control:

Air Pollution Sampling and Measurement (stack and ambient time- avg methods);

Design and Development of Process equipments for Air Pollution Control; Settling Chambers; Cyclone Separators; Filters, Electrostatic Precipitators, Scrubbers; Absorption by Liquids and Solids; Combustion

Stream Sanitation: oxygen sag curves; Stream Reaeration equations (Streeter-Phelps Equation)

VI. Noise Pollution:

Introduction; Nature and propagation of sound; Acoustic Impedance; Sound Intensity; Sound Levels, relationship between different sound levels, loudness of sound, measurement of noise, decibel addition, noise control measures, noise standards (CPCB)

VII. Pollution Control Acts and Treaties:

Major international treaties like Montreal Protocol, Kyoto Protocol; concept of Carbon Trading; major environmental legislations in India (in brief)

References :

i. PEAVY R., ROWE and TECHOBANOLOUS : Environmental Engineering
ii. CHATTERJEE A. K. : Water Supply, Waste Disposal and Environmental Engineering
iii. SINCERO, ARCADIO P. & SINCERO GREGORI. A: Environmental Engineering: A Design Approach
iv. MASTERS M GILBERT: Introduction to Environmental Engineering & Science
v. BIRDIE G.S. & BIRDIE J.S. : Water Supply and Sanitary Engg
vi. GARG S.K.: Sewage Disposal and Air Pollution Engineering
vii. CPHEEO Manual on Solid Waste Management

CE 8003 HARBOUR, DOCK AND AIRPORT ENGG 3-0-0: 3 Credits

I. Introduction

History and development of water transportation; Types of water transportation; Advantages and disadvantages

II. Ports & Harbours

Classification; Differences between port and harbour and their requirements; Site selecton; Essential features of a good harbour-size, depth, turning basin, harbour entrances.

Natural phenomena – Tides, Wind and Waves, Littoral drift.

Harbour works – Breakwaters, Wharves, Piers, Jetties, Quays

Berthing structures – Dolphins, Trestles, Moles, Mooring accessories.

Apron; Transit sheds; Warehouses

Dredging – Different types and their operation

Navigational aides – Necessity, different types and requirements

III. Docks

Types – Wet docks, Tidal basins, Repair docks, Dry docks, Floating docks, Marine railway; Locks and lock gates.

IV. Airways

Introduction – History & development of air transport, Advantages and disadvantages

Airport Planning – Regional planning, Factors affecting site selection, Surveys;

Airport classification.

Airport obstructions – Zoning laws, Classification of obstructions, Imaginary surfaces , Approach zone, Turning zone.

V. Runway

Orientation – Wind rose diagram, Basic runway length, Corrections for elevation, temperature and gradient, Geometric design, Cruising speed, Air speed, Beaufort scale, Different types of runway; Airport capacity.

VI. Terminals

Terminal area – Functions, Apron, Hangar, Aircraft parking system, Airport layouts

VII. Air Traffic Control & Visual Aids

Airport markings and landings; Landing aids

Landing systems – Instrumental landing system

References

i. SRINIVASAN R: Harbour, Dock & Tunnel Engineering
ii. BINDRA S.P.: A Course in Docks & Harbour Engineering
iii. OZA H.P.: Dock & Harbour Engineering
iv. VASWANI N. K.: Airport Engineering
v. KHANNA S.K. & ARORA M.G.: Airport Planning & Design

CE 8005 ROCK MECHANICS AND APPLICATION OF CIVIL ENGG TO SURFACE MINING **3-0-0: 3 Credits**

I. Introduction and Basic Concepts:

Rock as material-geological considerations; Rock forming minerals; Fabric of rocks; Mechanical nature of rock; Joints and Faults.

II. Rock Exploration and Rock Testing:

Objective; Methods of rock exploration; Direct penetration; Core boring; Core recovery; Rock Quality Designation; Laboratory testing of rock specimens: Uniaxial compression, Tri-axial shear tests at high confining pressures.

III. Rock Engineering Behaviour:

Mechanical behaviour: Strength of rocks; Influence of discontinuities upon engineering behaviour of rock masses; Rock quality indices; Joints; Folds and Faults; Methods of improving properties of rock masses: Pressure grouting; Consolidation grouting, Rock reinforcement.

IV. Introduction to Surface Mining:

Advantages and disadvantages of surface mining vis-à-vis underground mining; Open-pit layout and design; Selection of surface boundary of quarry; Difference between peat coal, lignite, bituminous and anthracite; Heavy earth moving machinery; Bench and dump formation; Dragline, shovel, bucket-wheel excavator; Surface miner; Dumper; Bench configuration of highwall; Formation of external and internal dump.

V. Rock Slope Stability in Surface Mining:

Slope failure in rock quarry batter, Failure in weathered rock: Toppling failure, plane failure and wedge failure in rock slope; Slope failure in soil slope or soft rock.

VI. Waste Dump Slope stability in Surface Mining:

Different failure modes in waste dump; Geo-engineering parameters in waste dump stability; Stability of shovel-dumper dump; Stability of dragline dump; Stability of external dump; Different methods of stability analysis.

VII. Mining Environment:

Air, water and noise pollution due to surface-mining; Rehabilitation and resettlement policy of surface-mining; slope-stabilisation by geo-textiles; Reclamation of surface mining; Surface mine closure.

References:

i. Jaeger and Cook: Fundamental of Rock Mechanics.
ii. Stagg K.G. and Zienkiewicz O.C: Rock Mechanics in Engineering Practice.
iii. Surface Mining Technology by S.K.Das; Lovely Prakashan, Dhanbad, 1994.
iv. Coal Mining by S.P.Mathur
v. Rock Slope Engineering; Hoek and Bray; The Institution of Mining and Metallurgy; 1981.
vi. Pit Slope Manual by CAN MET Canada.

CE 8007 GROUNDWATER ENGINEERING 3-0-0: 3 Credits

I. Introduction and Occurrence of Groundwater:

Introduction: Ground water development in India, Conjunctive use of ground water, Groundwater in the Hydrologic Cycle, Vertical distribution of Groundwater, Geologic formations as Aquifers, Types of Aquifers, Storage Coefficient.

II. Groundwater Movement:

Darcy's law, permeability. Determination of Hydraulic Conductivity, Anisotropic Aquifers, Groundwater Flow rates, Groundwater Flow directions, General Flow Equations

III. Groundwater and Well Hydraulics:

Steady Unidirectional Flow, Steady Radial Flow to a Well, Well in a Uniform Flow, Unsteady Radial Flow in a Confined and Unconfined Aquifers, Well flow near Aquifer Boundaries, Characteristic Well Losses, Specific Capacity

IV. Artificial Recharge of Groundwater:

Concept of Artificial Recharge, Recharge Methods, Research on Water Spreading, Waste Water Recharge, Recharge Mounds, artificial Recharge for Energy Purposes

V. Ground Water Modeling Techniques:

Porous Media models, Analog Models, Electrical Analog Models, Digital Computer Models

VI. Ground Water Geophysical Investigations:

Surface geophysical techniques, Electrical resistivity, Seismic refraction and reflection, Remote Sensing application.

VII. Ground Water Quality:

Water sampling, Potable water standards of WHO, Geotechnical survey of ground water for various requirements.

References:

1. TODD D. K.: Ground Water Engineering, John Wiley.
2. RAGHUNATH H. M.: Ground Water, New Age Int.
3. BOWNER H.: Ground Water Hydrology, McGraw Hill.

CE 8009 SEWERAGE AND SEWAGE TREATMENT 3-0-0: 3 Credits

I. **Design of Sewers:**
Estimation of storm runoff, hydraulics of sewer, velocity, design of sewer system

II. **Structural Design of Buried Sewers:**
Types of loads; loads on conduits due to backfill, loads on conduits due to super imposed loads; trench condition, embankment condition, tunnel condition; supporting strength of rigid conduit

III. **Constituents in wastewater:**
Physical characteristics, inorganic and organic characteristics, biological characteristics

IV. **Mass Balances, Flow Models and Reactor types:**
Mass Balances, Flow models, batch reactor, plug flow, complete mix reactor, reaction rates

V. **Design of Screen, Grit Chamber:**
Design parameters as per manual and design of screen and grit chamber with flow control devices

VI. **Sedimentation:**
Design parameters and design of a primary sedimentation tank.

VII. **Fundamentals of biological treatment:**
Bacterial Growth and Energetics, bacterial growth and biomass yield, microbial growth kinetics, Monod's Equation, Modeling Suspended Growth Treatment Process, Substrate removal in attached growth treatment process

References:

i. QASIM: Wastewater treatment plant design.
ii. Manual on Sewerage and Sewage Treatment
iii. REYNOLDS, RICHARDS: Unit Operations and Processes in Environmental Engineering
iv. METCALFE, EDDY: Wastewater Engineering

CE 8011 DAM AND WATER POWER ENGINEERING 3-0-0: 3 Credits

I. Reservoir Regulation:

Fundamentals of dam and reservoir. Reservoir yield, Rule curve, Determination of reservoir capacity by analytical and mass curve methods. Reservoir sedimentation.

II. Earth Dams:

Selection of sites, Types of earth dams, Factor of safety, Slope stability with & without seepage forces, Construction details for homogeneous and non-homogeneous sections.

III. Gravity Dams:

Forces on gravity dams including earthquake Stress analysis, Overflow & Non-overflow sections, Uplift forces consideration, Drainage of dam etc., Stability checks, Joints.

IV. Arch Dams, Buttress and Other Dams:

Constant radius & constant angle section factor of safety, Advantages, etc.

V. Water Power Development:

Definition of base load, peak load, load curve base load plant, peak load plant, load factor, capacity factor, utilization factor, gross head, net head, firm power, secondary power, storage, pondage, pondage factor, estimation of power demand-long and short term type, estimation of power, based on discharge and head, run off-river plants-high and low head plants, dam power plants, diversion canal plants, inter-basin diversion plants, tidal plants and pumped storage plants.

VI. Surge Tank:

Simple surge tank, restricted orifice tank and differential rank. Surges in rectangular ad non-rectangular sections, Surges for partial and complete closure of turbine.
Rigid water column theory for concrete pipes, Elastic water column theory, Graphical and numerical methods to solve water hammer problems.

VII. Economical Design of Penstocks:

Economical velocity and economical diameter, Material cost and power cost analysis to determine the diameter.
Design of hydraulics passages like Scroll cases, Draft tubes, Installation of turbines, Materials of constructions etc.

Book References:

1. JUSTIN, CREAGER and HINDS: Hydro-Electric Engineering Handbook.
2. DANDEKAR M. M. and SHARMA K. N.: Water Power Engineering.
3. PUNMIA B. C., PANDEY and LAL B. B. : Irrigation ad Water Power Engineering

CE 8013 PRE-STRESSED CONCRETE 3-0-0: 3 Credits

I. Introduction to the Prestressing Systems :
Review of basic concepts and properties of materials; tensioning devices; pre-tensioning and post-tensioning techniques; Fressynet, Magnel Blaton, CCL and other systems

II. Flexural Strength of Prestressed Concrete :
Rectangular and flanged beams at limit state; simplified code procedure; flexural design of slabs rectangular and flanged beams in service for type I behaviour; design of two-span continuous beam – parasite reactions; concordant cable; profiles; linear transformations

III. Losses in Prestressed Concrete :
Estimation of losses due to elastic deformation; shrinkage, creep relaxation in steel; friction and anchorage slip

IV. Deflection of Prestressed Concrete Members :
Factors influencing deflection; short and long term deflection of uncracked members; deflection of cracked beams; code requirements

V. Shear and Torsion in Prestressed Concrete Beams:
Principal and shear stresses; ultimate shear resistance; design of reinforcements for shear and torsion

VI. Transfer of Prestress in Prestressed Members :
Transmission length; bond stresses; transverse stresses; end-zone reinforcement; code provisions

VII. Anchor Zone Stresses in Post-Tensioned Members :
Stress distribution in the end blocks; anchor zone reinforcement

References :

i. MALLICK and GUPTA : Prestressed Concrete
ii. GUYON : Prestressed Concrete
iii. RAJU N. K. : Prestressed Concrete

CE 8015 CONSTRUCTION ENGINEERING PRACTICES: 3-0-0: 3 Credits

I. Concrete production:
Ready mix concrete, batching Mixing, transporting, compaction and curing

II. Development of strength:
Normal Curing, Steam curing, Maturity rule, influence of temperature

III. Temperature problem in concreting
Hot and cold weather concreting

IV. Special concrete: Fibre reinforced concrete, High strength concrete, high volume concrete, self compacting concrete, polymer composite concrete.

V. Quality control:
Validity of strength, acceptance and compliance, quality control chart

VI. Corrosion of reinforcement:
An electrochemical process, Polarization, Carbonation and chloride induced

VII. Tests of concrete in structures:
Corrosion monitoring techniques, HCP, LPR, AC impedance, Destructive and Non destructive testing

Reference Books:

1. Concrete technology, A.M. Neville and J. J. Brooks

2. Corrosion of steel in concrete, P. Sechiessl

3. Concrete technology, Santha Kumar

4. Property of concrete, A. M. Neville

CE 7021 ENVIRONMENTAL ENGINEERING 3-0-0: 3 Credits

I. Water Treatment and Pollution:

Characterization of water and waste water- basic terminologies. Major processes of water and waste water treatment (no numericals)

II. Solid Wastes:

Definitions, sources, characteristics and perspectives; Types of Solid Wastes: Solid Waste generation; Physical and Chemical characteristics of Solid Wastes, types of collection and transportation systems, Reduction in solid waste quantities, Materials recovery, Energy recovery; transfer means and methods

Incineration; Composting, sanitary landfill

III. Air Pollution:

Air Pollution : Past, present and future, Historical review, Global implications, Scales of Concentration; Classification and Properties of Air pollutants; Sources, Behaviour and Effects of Pollutants; Photochemical smog; Ozone Depletion, Green House Effect

IV. Meteorology and Natural Purification Processes:

Elemental properties of the atmosphere: Heat, Pressure, Winds, Moisture, Relative Humidity; Lapse rate; Inversions and Stability

V. Environmental Pollution Control:

Design and Development of Process equipments for Air Pollution Control; Settling Chambers; Cyclone Separators; Filters, Electrostatic Precipitators, Scrubbers; Absorption by Liquids and Solids; Combustion

VI. Noise Pollution:

Introduction; Nature and propagation of sound; Acoustic Impedance; Sound Intensity; Sound Levels, relationship between different sound levels, loudness of sound, measurement of noise, noise control measures, noise standards (CPCB)

VII. Pollution Control Acts and Treaties:

Major international treaties and major environmental legislations in India (in brief)

References:

i. PEAVY R., ROWE and TECHOBANOLOUS : Environmental Engineering
ii. CHATTERJEE A. K. : Water Supply, Waste Disposal and Environmental Engineering
iii. SINCERO, ARCADIO P. & SINCERO GREGORI. A: Environmental Engineering: A Design Approach
iv. MASTERS M GILBERT: Introduction to Environmental Engineering & Science
v. BIRDIE G.S. & BIRDIE J.S. : Water Supply and Sanitary Engg
vi. GARG S.K.: Sewage Disposal and Air Pollution Engineering
vii. CPHEEO Manual on Solid Waste Management

CE 7023 GEOTECHNICAL ENGINEERING 3-0-0: 3 Credits

I. Soil Formation & Composition:

Origin of soil, process of weathering & formation of different soil types; inter particle forces ; soil minerals ; soil – water system, structure of soils, soil texture; size and range of soil particles; shapes of individual sand and clay particles

II. Ground Investigation:

Planning the ground investigation programme ; Types of soils & rock samples ; methods of soil exploration; Groundwater observations ; Location, spacing and depth of borings, Overview of field tests : Soil samplers & collection of soil samples

III. Soil Improvement:

Improvement techniques; Surface compaction; Drainage methods, Vibration Methods; Precompression & Consolidation; Grouting; Chemical stabilization; Soil Reinforcement

IV. Difficult Soils:

Weak & compressible soils; Expansive soils; Collapsible soils; Frozen soils; Corrosive soils

V. Geotechnical Earthquake Engineering:

Earthquakes, ground shaking, liquefaction, surface rupture, permanent ground deformations & other related natural disasters; Earthquake force effect on soil structures

VI. Environmental Geotechnology:

Environmental cycles ; Natural cycles ; Environmental imbalance ; Birth of environmental geotechnology ; Contaminated soils ; Applications ; Load – environment design criterion

VII. Introductory Rock Mechanics:

Index properties of rocks; Classification of rocks; In – situ state of stress; Mechanical properties of rocks

References:

i. MURTHY V.N.S. – Soil Mechanics & Foundation Engineering
ii. GULHATI S.K. & DATTA M. - Geotechnical Engineering
iii. TERZAGHI & PECK – Soil Mechanics in Engineering Practice

CE 7025 COMPUTER ORIENTED NUMERICAL METHODS
3-0-0: 3 Credits

I: Errors in Numerical Calculations:
Introduction, Computer Data Storage Capacities; Mathematical Preliminaries, Errors and Their Computations, A General Error Formula.

II: Solution of Algebraic and Transcendental Equations:
The Bisection Method, Method of Regula-Falsi, Secant Method, System of Nonlinear Equations, Newton-Raphson Method,

III: Interpolation and Curve Fitting:
Polynomial Interpolation, Errors In Polynomial Interpolation, Finite Differences, Forward Difference, Backward Difference, Central Difference, Newton's Formulae For Interpolation, Lagrange's Interpolation Formulae For Unevenly Spaced Points, Hermite's Interpolation Formulae, Least Square Curve Fitting Procedures, Least Square Curve Fitting For Continuous Functions, Orthogonal Polynomials, Gram-Schmidt Orthogonalization Process.

IV: Numerical Differentiation and Integration:
Numerical Differentiation, Cubic Spline Method, Numerical Integration, Trapezoidal Rule, Simpson's 1/3 Rule, Newton-Cotes Integration Formulae, Gauss Quadrature Rule.

V: Matrices and Linear Algebraic Equations:
Vector and Matrix Norms, Solution of Linear Equations – Direct Method, Gauss Elimination Method with Partial Pivoting, Gauss – Jordan Method to Calculate Inverse, LU Decomposition, Ill Conditioned Linear Systems, Eigenvalue Problem, Householder's Method.

VI: Numerical Solution of Ordinary Differential Equations:
Euler's Method, Runge -Kutta Method, Predictor - Corrector Method, Adam - Moulton Method.

VII: Numerical Solution of Partial Differential Equations
Finite Difference Approximation of Derivatives, Laplace's Equation, Gauss – Seidel Method, Parabolic Equations, Hyperbolic Equations.

References:

i. Introductory Methods of Numerical Analysis by S. S. Sastry. Prentice Hall of India, New Delhi.

ii. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyenger and R. K. Jain. New Age International.

CE 7027 STRUCTURAL ENGINEERING 3-0-0: 3 Credits

I. Analysis of Statically Determinate Pin-Jointed Trusses

Stability and Determinateness, Force analysis of Compound and complex trusses, Tension co-efficient method – application to simple space trusses

II. Deflection of Pin-Jointed Trusses:

Application of Castigliano's theorem and principle of virtual work, Unit load method, Graphical method – Williot - Mohr diagram

III. Influence Lines for statically determinate beams and trusses:

ILD for reaction, SF and BM of simple and compound beams, ILD for member forces of simply supported truss girders with parallel and non-parallel chords; effect of moving live loads; Focal length and counter bracing

IV. Three-Hinged Arches:

Eddy's theorem, BMD, Normal thrust and Radial shear at any c/s, Influence Lines

V. Retaining walls:

Design of cantilever and counterfort retaining walls

VI. Domes

Member stresses, Design of segmental domes with lantern

VII. Water tanks

Design of circular and rectangular water tanks, Intze tanks with staging

References:

i. TIMOSHENKO S. P. & YOUNG : Theory of Structures
ii. JUNNARKAR S. : Mechanics of Structures
iii. Dr. B. C. Punmia: Reinforced Concrete Design