BACHELOR OF TECHNOLOGY (CIVIL ENGINEERING)

Curriculum Book (3rd to 8th Semester)

DEPARTMENT OF CIVIL ENGINEERING

DR B R AMBEDKAR NATIONAL INSTITUTE OF TECHNOLOGY

BACHELOR OF TECHNOLOGY (CIVIL ENGINEERING)

VISION

To emerge as a nationally recognized centre of excellence in the science and application of civil engineering, fuelled by a rigorous and dynamic academic programme nurturing research and development in cutting edge areas, with strong emphasis on Industry linkages by way of rendering state of the are consultancy services.

MISSION

To impart quality civil engineering education attuned to the needs of the Industry with emphasis on practical exposure aided by well equipped laboratories, which in turn feed a vigorous research and development programme in addition to creating capabilities for industrial consultancy.

INTRODUCTION

The four years Bachelor of Technology (B. Tech.) programme in Civil engineering with a batch strength of 30 students was initiated under the auspices of Guru Nanak Dev University (GNDU) Amritsar in the year 1990. During the formative years of the Development, this programme was known as B. Tech. in Structural Engineering and Construction Management. The current nomenclature was adopted when the degree programme was affiliated to the newly established Punjab Technical University for the period July 1997 through October 2002. The Department has been enjoying complete academic autonomy in running is degree programme after the conferment of Deemed University status on the erstwhile Regional Engineering College with effect from October 2002.

Being the oldest engineering discipline in vogue, Civil Engineering is the father of all engineering disciplines. With such a distinguished history behind it and centuries of accumulated knowledge and skills it becomes a delicate and often onerous task while framing the course curriculum to do justice to the reservoir of knowledge inherited from the past while at the same time reconciling it to the dramatic changes brought about by the digital revolution.

While framing a dynamic and all-inclusive course curriculum emphasis has been laid on including the basic aspects of all facets of the discipline, namely, construction materials, structural analysis, structural design in steel and concrete, water resources engineering, transportation engineering, environmental engineering, surveying and geotechnical engineering. At the same time, in recognition of the importance of computer applications, course like structural analysis in particular, have been framed in such a manner as to encourage the student to exploit the potential of computers for solving engineering problems.

A strong curriculum is only one important component of the tripod of the Departments' competitiveness. The second component is a competent, well qualified and dedicated faculty and supporting staff. The Department boasts of maximum number of faculty members with PhDs' from premier institutes. The faculty reputation is enhanced by its commendable publication record and its effectiveness is complimented by trained and skilled supporting staff.

The third component of relevance is a vigorous and dynamic research programme aided by well equipped laboratories which also serve to add value to the undergraduate programme. The following broad areas of research have been identified in the Department:

- Fibre Reinforced Cementitious Composites
- Geosynthetics, Reinforced Soil Systems
- Fatigue Behaviour of Reinforced Concrete and other Composites
- Numerical Modelling and Analysis
- Earthquake Resistant Analysis and Design and Detailing of Structures

The Department has powerful softwares for linear as well as non-linear finite element based analysis of structures, e. g. STAAD III, STAAD PRO, and ATENA. All the faculty members of the Department are actively involved in teaching, research and providing consultancy services to the construction industry. The department has the privilege of generating the maximum consultancy revenue in the Institute. Four external research scholars are registered for their Ph.D. programmes with the Department faculty, as are two external M. Tech. students. The department has also started M.Tech. Program in Structural and Construction Engineering from the academic session 2004 – 2005.

THIRD SEMESTER

S. NO.	COURSE NO.	COURSE TITLE	PERIODS			CREDITS	Pre-requisite
			L	T	P/D		
1.	CE -201	Surveying	3	0	0	3	
2.	CE -203	Hydraulic Engineering	3	1	0	4	
3.	CE -205	Water Supply Engineering	3	0	0	3	
4.	CE -207	Civil Engineering Material	3	0	0	3	
5.	CE -209	Concrete Technology	3	0	0	3	
6.	CE -211	Strength of Materials	3	1	0	4	
7.	CE -221	Surveying Laboratory	0	0	2	1	
8.	CE -223	Hydraulic Engineering Laboratory	0	0	2	1	
9.	CE -227	Concrete Technology Lab.	0	0	2	1	
		TOTAL				**23**	

FOURTH SEMESTER

S. NO.	COURSE NO.	COURSE TITLE	PERIODS			CREDITS	Pre-requisite
			L	T	P/D		
1.	CE -202	Structural Analysis I	3	1	0	4	CE-211 Strength of Materials
2.	CE -204	Waste Water Engineering	3	0	0	3	
3.	CE -206	Irrigation Engineering	3	0	0	3	CE-223 Hydraulic Engineering
4.	CE- 208	Building Construction	3	0	0	3	
5.	MA	Numerical Methods	3	1	0	4	
6.	ID	Open Elective	3	0	0	3	
7.	CE -222	Environmental Engg. Lab.	0	0	2	1	
8.	CE- 224	Structural Analysis Laboratory	0	0	2	1	
		Total				22	

FIFTH SEMESTER

S. NO.	COURSE NO.	COURSE TITLE	PERIODS			CREDITS	Pre-requisite
			L	T	P/D		
1.	CE -301	Design of Concrete Structures-I	3	1	0	4	CE- 209 Concrete Technology
2.	CE -303	Design of Steel Structures-I	3	1	0	4	
3.	CE -305	Soil Mechanics	3	1	0	4	
4.	CE	Departmental Elective	3	1	0	4	
5.	CE -307	Structural Analysis II	3	1	0	4	CE-202 Structural Analysis I
6.	ID	Open Elective	3	0	0	3	
7.	CE -321	Soil Mechanics Laboratory	0	0	2	1	
8.	CE-322	* Survey Camp				2	
		TOTAL				**26**	

* 3-4 weeks Survey Camp will be held preferably in some hilly area during summer vacation after 4th semester.

SIXTH SEMESTER*

S. NO.	COURSE NO.	COURSE TITLE	PERIODS			CREDITS	Pre-requisite
			L	T	P/D		
1.	CE -302	Foundation Engineering	3	1	0	4	CE-305 Soil Mechanics
2.	CE -304	Design of Concrete Structures-II	3	0	0	3	CE-303 Design of Concrete Structures-I
3.	CE -306	Highway and Traffic Engg.	3	1	0	4	
4.	CE	Departmental Elective	3	1	0	4	
5.	CE- 308	Elements of Earthquake Engineering	3	1	0	4	
6.	ID	Open Elective	3	0	0	3	
7.	CE-322	Concrete Structures Drawing-II	0	0	2	1	
8.	CE-324	Highway and Traffic Engg. Lab.	0	0	2	1	
		TOTAL				**24**	

SEVENTH SEMESTER

S. NO.	COURSE NO.	COURSE TITLE	PERIODS			CREDITS	Pre-requisite
			L	T	P/D		
1.	CE -401	Design of Steel Structures-II	3	0	0	3	CE-301 Design of Steel Structures-I
2.	CE -403	Construction Management	3	0	0	3	
3.	CE	Departmental Elective	3	0	0	3	
4.	CE	Departmental Elective	3	0	0	3	
5.	CE	Departmental Elective	3	0	0	3	
6.	ID	Open Elective	3	0	0	3	
7.	CE-421	Steel Drawing	0	0	2	1	
8.	CE	Industrial Practical Training				4	
9.	CE-400	Project(Phase-I)	0	0	0	2	
		TOTAL				**25**	

Training will be held in summer vacations after 6th Semester.

EIGHTH SEMESTER

S. NO.	COURSE NO.	COURSE TITLE	PERIODS			CREDITS	Pre-requisite
			L	T	P/D		
1.	CE -402	Estimating and Costing	3	1	0	4	
2.	CE	Departmental Elective	3	0	0	3	
3.	CE	Departmental Elective	3	0	0	3	
4.	ID	Open Elective	3	0	0	3	
5.	ID	Open Elective	3	0	0	3	
6.	CE-400	Project (Phase-II)	0	0	0	4	
		TOTAL				**20**	

LIST OF DEPARTMENTAL ELECTIVES:

ELECTIVE I (FIFTH SEMESTER)

S. NO.	COURSE NO.	COURSE TITLE	PERIODS			CREDITS	Pre-requisite
			L	T	P/D		
1.	CE -331	Design of Hydraulic Structures	3	0	0	3	CE-206 Irrigation Engineering
2.	CE -333	Rock Mechanics and Engineering Geology	3	0	0	3	
3.	CE -335	Elements of Remote Sensing and GIS	3	0	0	3	CE-201 Surveying

ELECTIVE II (SIXTH SEMESTER)

S. NO.	COURSE NO.	COURSE TITLE	PERIODS			CREDITS	Pre-requisite
			L	T	P/D		
1.	CE-332	Plastic Analysis of Structures	3	0	0	3	CE-303 Design of Steel Structures-I
2.	CE -334	Advanced Environmental Engineering.	3	0	0	3	
3.	CE -336	Hydrology and Dams	3	0	0	3	CE-206 Irrigation Engineering
4.	CE -338	Advanced Civil Engineering Materials					CE-207 Civil Engg. Material

ELECTIVE III & IV (SEVENTH SEMESTER)

S. NO.	COURSE NO.	COURSE TITLE	PERIODS			CREDITS	Pre-requisite
			L	T	P/D		
1.	CE -431	Advanced Foundation Engineering	3	0	0	3	CE-302 Foundation Engineering
2.	CE -433	Ecology and Environment.	3	0	0	3	
3.	CE -435	Industrial Structures	3	0	0	3	CE-303 Design of Steel Structures-I
4.	CE -437	Prestressed Concrete Design	3	0	0	3	CE-301 Design of Concrete Structures-I
5.	CE -439	Finite Element Methods in Engineering	3	0	0	3	CE-202 Structural Analysis I CE-307 Structural Analysis II
6.	CE -441	Architecture & Town Planning	3	0	0	3	

ELECTIVE V, VI & VII (EIGHTH SEMESTER)

S. NO.	COURSE NO.	COURSE TITLE	PERIODS			CREDITS	Pre-requisite
			L	T	P/D		
1.	CE- 432	Bridge Engineering	3	0	0	3	CE-301 Design of Concrete Structures-I
2.	CE -434	Soil Dynamics.	3	0	0	3	CE-305 Soil Mechanics
3.	CE -436	Hydro Power Engineering	3	0	0	3	CE-206 Irrigation Engineering
4.	CE -438	Software Applications in Structural Engineering	3	0	0	3	CE-202 Structural Analysis I, CE-307 Structural Analysis II
5.	CE -440	Ground Improvement and Ground Engineering	3	0	0	3	CE-305 Soil Mechanics
6.	CE- 442	Railway Airport & Harbor Engg.	3	0	0	3	
7.	CE -444	Quantitative Methods in Civil Engineering	3	0	0	3	
8.	CE -446	Structural Analysis-III	3	0	0	3	CE-202 Structural Analysis I, CE-307 Structural Analysis II
9.	CE -448	Advanced Construction Practices	3	0	0	3	CE-207 Civil Engineering Material

CE 201   Surveying   [3 0 0 3]

Introduction: Definition, classification of surveys, principle, distorted or shrunk scales, precision in surveying.

Chain Surveying: Instruments for measuring distances, chains, tapes, ranging – direct indirect, methods of chaining, folding and opening of chain, chaining on sloping ground, errors in chaining, corrections for linear measurements, Obstacle in chaining, reconnaissance, station selection, Triangulation, Base line measurement, limiting length of offsets, field notes.

Compass Surveying: Instruments used in traversing, bearings, meridians, declination, dip of magnetic needle, bearing of lines from included angles, local attraction, closing error and its removal.

Plane Table Surveying: Introduction to plane table surveying, principle, instruments, working operations, setting up the plane table, centering, leveling, orientation, methods of plane table survey, two and three point problems, Lehmann's Rules, errors.

Levelling: Definitions of terms used in levelling, different types of levels, parallax, adjustments, bench marks, classification of levelling, booking and reducing the levels, rise and fall method, line of collimation method, errors in leveling, permanent adjustments, corrections to curvature and refraction, setting out grades, longitudinal leveling, profile leveling. Automatic Levels.

Contouring: Definition, representation of reliefs, horizontal equivalent, contour interval, characteristics of contours, methods of contouring, contour gradient, Interpolation of contours, uses of contour maps.

Theodolite: Types of theodolites, measurement of angles, temporary and permanent adjustments, closed & open traverse,   consecutive and independent co-ordinates, advantages and disadvantages of traversing, Latitudes and Departures, closing error, Bowditch & Transit Rules, Gales traverse table, Different cases of omitted measurements.

Books Recommended:

1. Punmia B C "Surveying" Vol.1 & 2 Laxmi Publications Pvt. Ltd., New Delhi, 2002.
2. Kanetkar T P and Kulkarni S V "Surveying and leveling" Vol. I & II PVG Prakashan, Pune, 1994.
3. Basak N N "Surveying and leveling" Tata McGraw Hill, New Delhi, 2000.
4. Agor R "Surveying" Khanna Publishers, New Delhi, 1998.
5. Venkataramiah C "A Text Book of Surveying" University Press, Hyderabad, 1998.

CE 203   **Hydraulic Engineering**   **[3 1 0 4]**

Laminar Flow: Navier-stokes equations in cartesian coordinates (no derivation), meaning of terms, flow between parallel plates, stokes law. Flow through porous media, Transition from laminar to turbulent flow.

Boundary Layer Analysis: Assumptions and concept of boundary layer theory. Boundary layer thickness; displacement momentum & Energy thickness laminar and Turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and control.

Turbulent Flow: Definition of turbulence, scale and intensity, Effects of turbulent flow in pipes. Equation for velocity distribution in smooth and rough pipes (no derivation). Resistance diagram.

Flow past immersed bodies: Drag and lift, deformation Drag and pressure drag. Drag on a sphere, cylinder and Airfoil; lift-Magnus Effect and circulation, lift on a circular cylinder.

Uniform flow in open Channels: Flow classifications, basic resistance Equation for open channel flow. Chezy, Manning, Bazin and kutter formulae. Variation of roughness coefficient, conveyance and normal depth. Velocity distribution. Most efficient flow sections; Rectangular, trapezoidal and circular.

Energy and Momentum Principles and Critical Flow: Energy and specific Energy in an open channel; critical depth for rectangular and trapezoidal channels. Alternate depths, applications of specific Energy to transitions and broad crested weirs. Momentum and specific force in open channel flow.

Gradually Varied Flow: Differential Equation of water surface profile; limitation, properties and classification of water and surface profiles with examples. Computation of water surface profile by graphical, numerical and analytical approaches.

Hydraulic Jump and Surges: Theory of Jump, Elements of jump in a rectangular channel, length and height of jump, location of jump, Energy dissipation and other uses. Surge as a moving hydraulic jump. Positive and negative surges

Books Recommended:

1. Massey B S "Mechanics of Fluids" ELBS, Van Nostrand Reinhold Co. Ltd., U. K, 1998.
2. Streeter V L, Wylie E B and Bedford K W "Fluid Mechanics" McGraw Hill, New York, 2001
3. Kumar D S "Fluid Mechanics", S. K. Kataria & Sons Publishers, New Delhi, 1998.
4. Subramanya K "Theory and Application of Fluid Mechanics" Tata McGraw Hill, New Delhi 2001.
5. White F M "Fluid Mechanics" McGraw Hill, New York, 1997.

CE 205   **Water Supply Engineering**   **[3 0 0 3]**

Public Water Supply: Beneficial uses of water, water demand, per capita demand, variation in demand, causes detection and prevention of wastage of water, population forecasting.

Sources of Water Supply: Surface and underground sources, relation and development of source in r/o quality and quantity of water, development of wells. Storage reservoir balancing and service storage, capacity determination by mass curves method. Intake and transmission system: distribution systems: network design. Hydrology principles, zones of under-ground water.

Quality and Examination of Water: Necessity for examination of water impurities in water. Sampling of water, physical, chemical & bacteriological quality for domestic water supply. Drinking water quality standards and criteria.

Water Supply and Drainage of Buildings: System of water supply house connections, metering, internal distribution, sanitary fittings, pipe joints, different types of pipes and pipes materials.

Water Treatment: Unit operations in water treatment, screening, plain sedimentation tank and its theory, sedimentation, aided with coagulation, design of sedimentation tank, flocculation sand filtration, rapid gravity filter, pressure filters, disinfections; Necessary; requirements of a disinfectant, methods, of disinfecting, different practices of chlorination.

Miscellaneous Methods of Water Treatment: Aerial colour, odors & Taster from water, control, removal of iron & manganese from water softening processes, base exchange process, swimming pool water treatment.

Books Recommended

1.   Garg S K "Water Supply Engineering" Vol. I Khanna Publishers, New Delhi, 2003
2.   Raju B S N "Waste and Wastewater" Tata McGraw Hill, New Delhi, I997
3.   Peavy H S and Rove D R "Environmental Engineering" McGraw Hill, New Delhi, 2003
4.   Punmia B C "Water Supply Engineering" Laxmi Publication, New Delhi, 2002
5.   Birdie G S "Water Supply & Sanitary Engineering". Dhanpat Rai Publications, New Delhi, 2003.

CE- 207   **Civil Engineering Materials**   **[3 0 0 3]**

Building Stones: General, Uses of stones, natural bed of stones, qualities of a good building stone, deterioration of stones, preservation of stones, artificial stones, common building stones of India and their uses.

Bricks: General, Composition of good brick earth, Harmful ingredients in brick earth, qualities of good bricks, tests for bricks, classification of bricks.

Lime: General, some definitions calcination, Hydraulicity, setting, slacking, sources of lime, classification of limes, uses of lime, tests for limestones.

Cement: Constituents of Cement**,** Manufacture of Portland cement

Timber: Definition, classification of trees, structure of a tree, felling of trees, seasoning of timber, storage of timber, market forms of timber.

-Mortars and plasters

-Glass for building

-Paints and varnishers, white washing, colour washing and distempering

-Industrial timber products

-Concrete blocks

-Construction chemicals

Books Recommended:

1. Rangwala S C "Engineering materials" Charotar Publishing House, Anand, 2000.
2. Ghose D N "Materials of Construction" Tata McGraw Hill, New Delhi, 2003.
3. Varghese "Building Materials" Prentice Hall of India, New Delhi. 2005.

CE 209 **Concrete Technology** **[3 0 0 3]**

Introduction: Concrete as a Structural material, constituent materials of concrete.

Cement: Types of cements, basic chemistry, heat of hydration, Testing of cement: Fineness, consistency, setting times, strength, types of Portland cements, expansive cements, pozzolanas.

Aggregates: Classification of aggregates, Mechanical properties: Bond, strength, toughness, hardness, physical Properties, Specific Gravity, Bulk density, porosity and absorption, Moisture content, bulking of sand, sieve analysis, fineness modulus, grading of aggregate, maximum aggregate size.

Mix Design: Factors to be considered: water/cement ratio, durability, workability, cement and aggregate content, Design of mix by IS & ACI methods.

Physical Properties of Fresh Concrete: Workability: factors affecting, methods of determination of workability, Density of fresh concrete.

Strength of concrete: Porosity, Gel/space ratio, Total voids in concrete, factors affecting strength: Water/cement ratio, relation between tensile & compressive strengths; bond to reinforcement.

Mixing, Handling, Placing & compaction of concrete: Mixers, mixing time, ready mixed concrete, pumped concrete, vibration of concrete, internal & external vibrators, re-vibration, shotcrete.

Permeability and Durability: Permeability, sulphate attack, action of frost, frost resistance concrete. **Special concretes: Polymer –** Concrete composites, fibre reinforced concrete Ferrocement, Roller compacted concrete, very high strength concrete.

Books Recommended:

1. Neville A M and Brookes J J "Concrete Technology" Pearson Publishers, New Delhi,1994.
2. Neville A M "Properties of Concrete" Pearson Publishers, New Delhi, 2004.
3. Gambhir M L "Concrete Technology" Tata McGraw Hill, New Delhi, 1995.
4. Shetty M S "Concrete Technology" S. Chand & Company, New Delhi, 2002.
5. Mehta P K "Microstructure of Concrete" Indian Concrete Institute and ACC, Bombay, 1997.

CE 211   **Strength of Materials**   **[3 1 0 4]**

Simple stresses and strains: Concept of stress and strain: St. Venants principle of stress and strain diagram, Hooke's law, Young's modulus, Poisson ratio, stress at a point, stresses and strains in bars subjected to axial loading, Modulus of elasticity, stress produced in compound bars subject to axial loading, Temperature stress and strain calculations due to applications of axial loads and variation of temperature in single and compound walls.

Compound stresses and strains: Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stress, ellipse of stress and their applications, Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain, Relationship between elastic constants.

Bending moment and shear force diagrams: Bending moment and shear force diagrams, S F and B M definitions. BM and SF diagrams for cantilevers, Simply supported and fixed beams with or without overhangs and calculation of maximum BM and SF and the point of contraflexure under: Concentrated loads, Uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

Theory of bending stresses: Assumptions in the simple bending theory, derivation of formula: its application to beams of rectangular, circular and channel sections, composite/fletched beams, bending and shear stresses in composite beams.

Torsion: Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts torsional rigidity, combined torsion and bending of circular shafts principal stress and maximum shear stresses under combined loading of bending and torsion, analysis of close-coiled-helical springs.

Thin cylinders and spheres: Derivation of formulae and calculations of hoop stress longitudinal stress in a cylinder, and sphere subjected to internal pressures increase in Diameter and volume.

Columns and struts: Columns under uni-axial load, Buckling of Columns, Slenderness ratio and conditions. Derivations of Euler's formula for elastic buckling load, equivalent length, Rankine Gordon's empirical formula.

Strain energy: Energy of dilation and distortion, resilience stress due to suddenly applied loads, Castigliano's theorem, Maxwell's theorem of reciprocal deflection.

Theories of Failure: Maximum principal stress theory, maximum shear stress, theory, maximum strain energy theory, maximum shear strain energy theory, graphical representation and derivation of equation for each and their application to problems relating to two dimensional stress systems only.

Books Recommended:

1. Pytel A H and Singer F L, "Strength of Materials", 4th Edition, Harper Collins, New Delhi, 1987.
2. Beer P F and Johnston (Jr) E R, "Mechanics of Materials" SI Version, Tata McGraw Hill, India, 2001.
3. Timoshenko S P and Young D H, "Elements of Strength of Materials", 5th Edition, East West Press, New Dlehi, 1984.

4. Bedi D S, "Strength of Materials", 3rd Edition, Khanna Publishing Company 3rd Edition, New Delhi, 2000.
5. Jindal U C, "Introduction to Strength of Materials", Galgotia Publsihing Private Limited 3rd Edition, New Delhi, 2001.

CE 221   **Surveying Laboratory**   **[0 0 2 1]**

1.   To range a line between two stations.

2.   Plotting of details in chain survey.

3.   Plotting of traverse with a compass.

4.   To determine the reduced levels of stations by height of instrument and rise and fall method.

5.   Plotting of details using plane table by method of intersection and method of radiation.

6.   Temporary and permanent adjustments of a theodilite.

7.   Measurement of horizontal angles using a theodilite by method of repetition and method of reiteration.

8.   Traverse adjustment using Gales' traverse table.

CE 223   **Hydraulic Engineering Laboratory**   **[0 0 2 1]**

1. To draw flow net from Hele-Shaw Experiment (flow past a Circular cylinder)

2. To study the transition from laminar to turbulent flow in a pipe.

3. Verification of Stokes law

4. To draw flow net by electrical analogy method

5. Determination of Elements of Hydraulic Jump.

6. Discharge & flow profile of a broad crested weir.

7. To determine the viscosity of a given liquid by capillary-tube-viscometer.

8. To determine Manning's co-efficient of roughness for the bed of a given flume.

9. To measure the velocity distribution in a rectangular flume and to determine the energy and momentum correction factors.

10. To calibrate a current meter.

11. To study the flow over a hump placed in an open channel.

12. Demonstration of surges in an open channel.

13. Demonstration of forced vortex.

CE 225   **Concrete Technology Laboratory**   **[0 0 2 1]**

1.   Standard Consistency of cement.

2.   Initial and final setting time of cement.

3. Soundness of cement.

4. Specific Gravity of Cement.

5. Compressive Strength of Cement.

6. Water absorption and Specific Gravity of Fine aggregates.

7. Water absorption and Specific Gravity of Coarse aggregates.

8. Workability of Concrete by Slump cone method.

9. Workability of Concrete by Compaction Factor method.

10. Workability of Concrete by Vee-Bee consistometer

11. Compressive and Flexural Strength of concrete.

CE 202   Structural Analysis – I   [3 1 0 4]

Introduction: Need of analysis, techniques of structural idealization, basic tools of analysis, reactions in structure, notations and sign conventions, free – body diagrams, static determinacy, stability of structures, principle of superposition, loads on structures.

Plane Trusses: Introduction, member arrangement in a truss, stability and determinacy, roof and bridge trusses, analysis of trusses, notations and sign conventions, equations of condition, zero load test, classification of trusses.

Deflection of Beams: Introduction, direct integration method, moment – area method, conjugate beam method, Principle of virtual work, unit load method, Betti's law, Maxwell's law, Castigliano's theorem.

Combined Bending and Axial Loads: Introduction, limit of eccentricity for no tension in the section, core of the section, middle third rule, wind pressure on chimneys, forces on dams.

Rolling Loads Introduction to rolling loads and influence lines, Determination of shear force, bending moment at a section and absolute shear force and bending moment due to single point load, uniformly distributed load, several point loads etc.

Influence lines: Introduction, moving loads, influence lines, influence lines for reactions, shear force and bending moment, influence lines for beams, girders with floor beams, trusses and arches, absolute maximum B. M. & S. F, Muller Breslau Principle

Arches: Introduction, curved beams, arch versus a beam, three hinged arch, moment, shears and normal thrust in three hinged arches

Cables and Suspension Bridges: Introduction, shape of a loaded cable, cable carrying point loads and UDL, cables with ends at different level, cable subjected to temperature stresses, suspension bridge with two hinged and three hinged stiffening girders, influence lines.

Statically determinate space Trusses:

Concurrent forces in space, moment of force, constraint of point in space, tension coefficient method, simple space trusses, method of sections.

Books Recommended:
1. Utku S, Norris C H and Wilbur J B "Elementary Structural Analysis, McGraw Hill, New York, 1990
2. Jain A K "Elementary Structural Analysis" Nem Chand & Brothers, Roorkee, 1990
3. Reddy C S "Basic Structural Analysis" Tata McGraw Hill, New Delhi, 2003
4. Hibbeler C "Structural Analysis" Pearson Publishers, New Delhi, 2002
5. Punmia B C, Jain A K and Jain A K "Theory of Structures" Luxmi Publications, 2000.

CE 204   Waste Water Engineering   [3 0 0 3]

Introduction: Terms & definitions, systems of sanitation and their merits and demerits, system of sewerage, choice of sewerage system and suitability to Indian conditions. Design & planning of a sewage system.

Design of Sewers: Quantity of sanitary and storm sewage flow, forms of sewers, conditions of flow in sewers, sewers of equivalent section, self cleansing and limiting velocity, hydraulic formulas for flow of sewerage in sewers and their design.

Construction & Maintenance of Sewers: Sewer appurtenances, Materials for sewers, laying of sewers, joints in sewers, testing of sewers pipes, Maintenance operations and precaution before entering a sewer. Excavating Trenches.

House Drainage: Principles of house drainage, traps, Inspection chamber Indian and European type W. C., Flushing Cisterns soil waste and anti-siphonage pipes, plumbing systems.

Characteristics & Testing of Sewage: Composition of sewage, sampling, physical & chemical analysis of sewerage, biological decomposition of sewage, kinetics of organic waste stabilization. Populating equivalent & relative stability.

Treatment of Sewage: Unit processes of waste water treatment, screens, grit chambers, detritus tank, skimming tank, grease traps, sedimentation, chemical treatment, aerobic biological treatment, trickling filter (LRTF & HRTF), activated sludge processes, anaerobic treatment, units-sludge digesters and biogas plants.

Low cost waste water treatment units: Oxidations Ponds, Lagoons, ditches, septic tanks and imhoff tanks, theory, design, advantages & disadvantages.

Sewage Disposal: Dilution, self-purification of streams, oxygen deficiency of polluted streams, oxygen sag serve, deoxygenation and deoxy- genation. Dilution in seawater, disposal by land treatment. Effluent irrigation and sewage farming. Sickness and its preventive measures.

Books Recommended

1. Peavy H S and Rowe D R "Environmental Engineering" McGraw Hill, New Delhi. 2002.
2. Garg S K "Environmental Engineering-Vol. II", Khanna Publishers, New Delhi, 2003
3. Birdie G S "Water supply & sanitation Engineering, Dhanpat Rai Publisher(P) Ltd., New Delhi, 2003
4. Fair G M and Geyer J C "Water Supply & Waster Water Disposal".2002.
5. Nathanson J A "Basic Environmental Technology" Prentice Hall of India, New Delhi. 1999.

CE 206   Irrigation Engineering   [3 0 0 3]

Introduction: Water shed and its management, its relation to hydrologic cycle (in brief), introduction about rain water harvesting and about the present need in Punjab.

Methods of Irrigation: Advantages and disadvantages of irrigation, water requirements of crops, factors affecting water requirement, consumptive use of water, water depth or delta and crop relation, Duty of water, relation between delta, duty and base period, Soil crop relationship and soil fertility, sprinkler Irrigation – advantages & limitations, Planning and design of springler irrigation, Drip irrigation – advantages & limitations, suitability.

Canal Irrigation: Classifications of canals, canal alignment, Inundation canals, Bandhara irrigation, advantages and disadvantages. Silt theories – Kennedy's theory, Lacey's theory, Drawbacks in Kennedy's & Lacey's theories, comparison of Lacey's and Kennedy's theories, Design of unlined canals based on Kennedy & Lacey's theories, suspended and bed loads.

Lined Canals: Types of lining, selection of type of lining, economics of lining, maintenance of lined canals, silt removal, strengthening of channel banks, measurement of discharge in channels, design of lined canals methods of providing drainage behind lining.

Losses in Canals, Water Logging and Drainage: Losses in canals-evaporation and seepage, water logging, causes and ill effects of water logging, anti water-logging measures. Drainage of land, classification of drains surface and sub-surface drains, design considerations for surface drains, advantages and maintenance of tile drains.

Investigation and preparation of irrigation project: Classification of projects, project preparation investigations, design of works and drawings, concepts of multi purpose projects, Major, medium and minor projects, planning of an irrigation project, economics & financing of irrigation works documentation of project report, Present cutes of water changed by Irrigation Department from cultivation.

Tube Well Irrigation: Types of tube wells strainer type, cavity type and slotted type. Type of strainers, aquiclude, aquifer, porosity, uniformity coefficient, specific yield & specific retention, coefficients of permeability, transmissibility and storage.   Yield or discharge of tube well, assumptions, Theim & Dupuit's formulas. Interference of tube wells with canal or adjoining tube wells, optimum capacity. Duty and delta of a tube well. Rehabilitation of tubewells.

River Training Works: Objectives, classification of river training works, design of guide banks, groynes or spurs their design and classification ISI Recommendations of approach embankments and afflux embankments, pitched Islands, artificial cut-offs, objects and design considerations. River control-objectives and methods.

Hydrology: Introduction, precipitation, interception, evapo-transpiration, infiltration, runoff.

Books Recommended

1.   Singh Bharat "Fundamentals of Irrigation Engineering" Nem Chand & Brothers, Roorkee, 1975
2.   Arora K R "Irrigation Water Power & Water Resources Engineering" Standard Publishers Distributors, Delhi, 2002
3.   Garg S K "Irrigation Engineering & Hydraulic Structures" Khanna Publishers, Delhi, 1995
4.   Varshney, Gupta & Gupta "Irrigation Engineering & Hydraulic Structure" Nem Chand & Bros., Roorkee,1982
5.   Asawa G L "Irrigation Engineering" Wiley Eastern Ltd., New Delhi,1993

CE-208   Building Construction   [3 0 0 3]

Brick Masonry: Definitions of various terms used, bond – definition,   need   and scope, type of bonds – Stretcher bond, Header bond, English bond and Flemish bonds, their merits and demerits.
Stone Masonry: Rubble and ashlars work.
Hollow block Masonry: Hollow cement concrete block masonry and hollow clay block masonry.
Walls: Types (i) load bearing and (ii) Non-load bearing walls, Thickness considerations.
Damp Proofing: Causes and ill – effects, preventive measures
Arches and Lintels: Definitions of various terms used in arches, Types – Flat, segmental, semi – circular and Horse – shoe, brick and stone arches, types of lintels, their merits and demerits.
Floors: Constituents, various types of floors commonly used and their suitability for different buildings, constructional details of concrete and terrazzo floors.
Doors and Windows: Location and sizes, types of Doors and windows, Method of fixing door and window frame in walls, ventilators.
Sloping roofs: Definitions of terms used, wooden trusses – king post and queen post truss, steel trusses – fink, fan and north light truss roofs, Jack arch roofs.
Stairs and Staircases: Definition of terms used, Essential requirements, proportioning of steps, types – straight flight, quarter turn, half turn and spiral staircases, mention of ramps, escalators and lifts.
- Footings-types and details
Miscellaneous topics (to be covered briefly): Plastering and Pointing. White washing, colour washing, distempering and painting, Scaffolding, underpinning and shoring, Building Bye-laws.
Books Recommended:

1.   Rangwala S C "Engineering materials" Charotar Publishing House, Anand, 2000.
3.   Bindra & Arora "Building Construction" Dhanpat Rai Publications (P) Ltd, New Delhi, 2003.
4.   Sinha S K and Jha J "Building Construction" Khanna Publishers, New Delhi, 2001.
5.   Rangawala S C "Building Construction" Charotar Publishing House, Anand, 1993.
6.   Ghose D N "Materials of Construction" Tata McGraw Hill, New Delhi, 2003.

MA   Numerical Methods   [3 1 0 4]

Equations: Roots of algebraic transcendental equations, Solution of linear simultaneous equations by different methods using elimination, iteration, inversion,   Gauss-Jordan and Corout's methods.   Homegeneous problems and eigenvalue proble 8, Non-linear equations, intgerpolation, differentiation and evaluation of single and multiple integrals. FORTRAN problems for soil of equations.
Finite Difference Technique: Initial and boundary value problems of ordinary and partial differential equations. Solutions. Solution of various types of plates.

New Marks Methods: Solution of determinate and indeterminate structures by using newmarks procedure. (beams, columns. Beam on Elastic Foundations, Plates).

Statistical Methods: Methods of correlation and regression analysis. Fortran programme for fitting a polynomial equation by least squares.

Initial Value Problems: Galerk is method of least squares. Initial value problem by collocation points, Runngek Iulla method and its Fortran program.

Books Recommended

1. Sastry S S, "*Introductory Methods of Numerical Analysis*", 3rd Ed. Prentice Hall of India Pvt. Limited , New Delhi, 1999.

2. Schilling R J, Harries S L, "*Applied Numerical Methods for Engineers(Using MATLAB and C)*", Thomsan Asia Pvt. Limited, Singapore, 2002

3. Gerald C F, Wheatley P O, " *Applied Numerical Analysis*", 5th Ed (First ISE Reprint) Addison –Wesley Publishing Company, 1998.

4. Chapra S C, Canale R P, " *Numerical Methods for Engineers*", 2nd Ed., McGraw Hill, Singapore , 1990.
5. Gupta S K, " *Numerical Methods for Engineers*", Ist Edition, New Age International Private Limited, New Delhi, 1998.

CE 222   **Environmental Engineering Laboratory**   **[0 0 2 1]**

List of Experiments

1. Determination of Total, suspended, dissolved volatile & fixed residue in a sewage/water sample.

2. Determination of Turbidity.

3. Estimation of the pH-Value.

4. Determination of the carbonate, Bicarbonate and Hydroxide Alkalinity.

5. Determination of the type and Extend of Acidity.

6. Estimation of the Hardness of water (EDTA Method).

7. Estimation of the chloride concentration.

8. Determination of the Dissolved oxygen and percentage saturation.

9. Determination of Biochemical Oxygen Demand BOD of wastewater.

10. Estimation of Chemical Oxygen Demand. (COD)

CE 224   **Structural Analysis Laboratory**   **[0 0 2 1]**

List of Experiments

1. To determine the flexural rigidity of a given beam.
2. To verify the moment area theorems for slope and deflection of a given beam.
3. Deflection of a simply supported beam and verification of Clark-Maxwell theorem.

4.   Experiments on curved beam.

5.   Deflection of statically determinate pin jointed truss.

6.   Study of behaviour of columns and struts with different end conditions.

7.   Experiment on three-hinged arch.

8.   Experiment on two-hinged arch.

9.   Forces in members of redundant frames.

10.   Deflection of a fixed beam and influence line for reactions.

11.   Deflection studies for a continuous beam and influence line for reactions.

12.   Unsymmetrical bending of a cantilever beam.

CE 301   **Design of Concrete Structure – I**   **[3 1 0 4]**

Introduction: Plain and Reinforced Concrete, Objectives of design. Structural systems. Introduction to design philosophies.

Analysis of Beams: Working Stress Method, Assumptions made in theory of reinforced concrete construction, moment of resistance of singly, doubly reinforced and flanged beams.

Limit State Method: Assumptions in analysis, Analysis of singly and doubly reinforced rectangular sections, Analysis of singly reinforced flanged sections.

Design of Beams for flexure: Codal provisions for design as per IS 456:2000 according to working stress and limit state method, Design of singly and doubly reinforced sections, Design of flanged sections.

Design for Shear, Bond & Torsion: Shear Stresses in homogeneous rectangular beams, critical sections, design shear strength of plain concrete, Design of shear reinforcement, Bond stress, Anchorage development length, bond failure & bond strength,

Introduction to torsion in R. C. C. beams, General behaviour in torsion, Design of sections subjected to torsion, shear and flexure.

Design of Slabs: One-Way and two-way slabs. Design of slab sections using IS method. Introduction to flat slabs.

Design of Continuous beams and slabs: Analysis of continuous systems General guidelines & Codal provisions design and detailed drawings of continuous beams and slabs.

Design of columns: Classification and effective length of columns, codal requirements, Analysis and design of sections subjected to axial loading and axial loading combined with bending moment.

Design of Isolated Footings: Types of footings, soil pressure under footings, General design considerations and Codal provisions. Design of isolated, square, rectangular and circular footings. Design of footings subjected to eccentric loads..

Books Recommended

1.   Pillai U. and Menon D., "Reinforced Concrete Design" Tata McGraw Hill, New Delhi (2003).
2.   Jain A.K., "Limit State Design of R. C. C. Structures" Nem Chand & Sons, Roorkee (2002).
3.   Varghese "Limit State Design of Reinforced Concrete" Prentice Hall of India, New Delhi (2003).
4.   Dayaratnam P., "Design of Reinforced Concrete" Oxford & IBH Publishers, New Delhi (2002).
5.   Chandra R., "Limit State Design of Reinforced Concrete" Standard Book House, New Delhi (2002).

CE 303   Design of Steel Structure - I   [3 1 0 4]

Riveted & Welded Joints: Rivets and riveting, stresses in rivets, strength & failure of riveted joints. Riveted joints in framed structures. Types of welds & welded joints, stresses in welds, design of welds, eccentrically loaded welded joints

Tension Members: Types of tension members, net & gross areas, permissible stresses. Design of members subjected to axial loads, combined bending moments & axial loads, lug angles. Tension Splice

Compression Members: Failure modes of columns, end conditions & effective length of columns, various empirical formulae. IS code formula, General codal provisions for design of compression members. Built up compression members, lacing and battening of compression members, splicing of compression members.

Column Bases and Foundations: Types of column bases, design of slab base, Gussetted base & grillage foundations.

Design of Flexural Members: Failure modes permissible stresses, design of laterally supported and unsupported beams web crippling, web budding etc., compound beams.

Design of plate Girders: Components of a plate girder, basic design assumptions, stiffeners in plate girders, design of various components of a welded and riveted plate girder.

Roof Trusses: Types of roof trusses loads on roof trusses, calculation of forces due to combination of different loads. Design of members and joints.

Books Recommended

1. Chandra R "Design of Steel Structures" Standard Publishing House, 1999.
2. Raghupathi M "Design of Steel Structures" Tata McGraw-Hill, New Delhi,1998.
3. Arya A S and Ajmani J L "Design of Steel Structures" Nem Chand Bros. Roorkee,2000.
4. Kazimi S M A and Jindal R S "Design of Steel Structures" Prentice Hall of India, New Delhi,1999.
5. Dayaratnam P "Design of Steel Structures" Wheeler Publishers, New Delhi,1999.

CE 305   Soil Mechanics   [3 1 0 4]

Basic Concepts: Definition of soil and soil mechanics common soil problem in Civil Engineering field. Principal types of soils. Important properties of very fine soil i. e. adsorbed water, base exchange and soil structure. Characteristics of main clay mineral groups. Basic definitions in soil mechanics. Weight volume relationship physical properties of soils.

Index Properties: Determination of Index properties, classification of coarse grained soils and fine grained soils.

Permeability and seepage: Concept of effective stress principle. Seepage pressure, critical hydraulic gradient and quick sand condition. Capillary phenomenon in soil. Darcy's law and its validity seepage velicity. Co-efficient of permeability and its determination average permeability of striated soil mass Factors affecting 'K' and brief discussion.

Compaction: Definition and object of compaction and concept of O.M.C. and zero Air Void Line. Modified proctor test. Factors affecting compaction. Effect of compaction on soil properties and their discussion. Field compaction methods their comparison of performance and relative suitability. Field compactive effort. Field control of compaction by proctor needle.

Consolidation: Definition and object of consolidation difference between compaction and consolidation. Concept of various consolidation characteristics i.e. a_v, m_v and C_v primary and secondary consolidation. Terzaghi's method for one-dimensional consolidation. Consolidation test. Determination of C_v from curve fitting methods. Normally consolidated and over consolidated clays importance of consolidation settlement in the design of structures. **Shear Strength:** Stress analysis of a two - dimensional stress system by Mohr circle. Concept of pole. Coulomb's law of shear strength Coulomb - Mohr strength theory. Relations between principle stresses at failure Shear strength tests. Derivation of skempton's pore pressure parameters. Stress strain and volume change characteristics of sands.

Books Recommended

1. Terzaghi K and Peck R B "Soil mechanics in Engineering Practice" John Wiley and Sons, New York, 1995.
2. Terzaghi K "Theoretical Soil Mechanics", John Wiley and Sons, New York, 1943
3. Ranjan G and Rao ASR "Basic and Applied Soil Mechanics" New Age International Pvt. Ltd., Publishers, New Delhi, 2000
4. Murthy V N S Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil Engineering) ", 2002.
5. Donald P. Coduto "Foundation Design: Principles and Practices", Pearson Education,Eastern   Economy Edition, 2000.

CE 307   Structural Analysis-II   [3 1 0 4]

Statically Indeterminate Beams and Frames: Introduction, types of supports-reaction components, external redundancy, statically indeterminate beams and frames, degree of redundancy

Fixed and Continuous Beams: Bending moment diagrams for fixed beams with different loadings, effect of sinking of supports, degree of fixity at supports, advantages and disadvantages of fixed beams, continuous beams, Clayperons theorem of three moments, various cases of load and geometry of continuous beams.

Slope Deflection Method: Fundamental equations, Applications to continuous beams and portal frames, side sway in portal frames.

Moment Distribution Method: Basic propositions, stiffness of a member, distribution theorem, carry-over theorem, relative stiffness, distribution factors, applications to continuous beams, portal frames with and without side sway, analysis of multi-storeyed frames, method of substitute frame.

Rotation Contribution method: Basic concepts, rotation factor, and application to continuous beams, portal frames and multistoried frames, story shear.

Approximate methods of Structural Analysis: Portal method, Cantilever Method, Substitute Frame Method.

Column Analogy Method: The column analogy, properties of symmetrical analogous column, application to fixed beams and portal frames.

Strain Energy: General principles, strain energy due to axial loading and bending, law of reciprocal deflections, Castigliano's first theorem, beam deflections using Castigliano's first theorem, minimum strain energy, Castigliano's second theorem, analysis of statically indeterminate beams and portal frames.

Redundant Frames: Order of redundancy, frames with one and two redundant members.

Stresses due to lack of fit, the trussed beam, portal frames.

Analysis of two hinged arches:

Influence lines for indeterminate Structures: Muller Breslau Principle, Influence lines for shear force, bending moment and reactions in continuous beams, balanced cantilevers and rigid Frames.

Books Recommended

1. Reddy C S "Basic Structural Analysis" Tata McGraw Hill, New Delhi, 2003.
2. Wang C K "Intermediate Structural Analysis" McGraw Hill, 1998.
3. Punmia B C "Theory of Structures" Luxmi Publications, New Delhi, 1996.
4. Sinha N C "Advanced Theory of Structures" Dhanpat Rai Publications, New Delhi, 2000.
5. Ramamrutham S and Narayan R "Theory of Structures:" Dhanpat Rai & Sons, New Delhi, 1996.

CE 321   Soil Mechanics Laboratory   [0 0 2 1]

List of Experiments

1. Visual Examination of soil samples. Field identification tests. Classification as per IS Code.
2. Determination of water content of soil:
    a. By oven drying method
    b. Pycnometer method
    c. Calcium Carbide method
3. Determination of in- situ density by core cutter method and sand replacement method.
4. Determination of Liquid Limit & Plastic Limit by Casagrande apparatus and penetrometer method.
5. Determination of specific gravity of soil solids by pyconometer method.
6. Grain size analysis of given sample of sand and determination of coefficient of uniformity and coefficient of curvature.
7. Hydrometer analysis.
8. Direct shear test on a given soil sample.
9. Unconfined compression test for fine-grained soil.
10. Triaxial Shear Test.
11. Lab vane shear test
12. Determination of permeability by constant head Methods and variable head method.
13. Compaction test (Proctor) and Modified proctor test. Plot of zero air voids line.
14. Consolidation Test

CE 322   **Survey Camp/Training**   **[0 0 0 2]**

The students will undergo practical training during the summer vacation in a hill station/Institute/Industry.

CE 302   Foundation Engineering   [3 1 0 4]

Earth Pressure: Terms and symbols used for a retaining wall. Movement of wall and the lateral earth pressure. Rankine's and Coulomb's theory for lateral earth pressure. Culmann's graphical construction and Rebhan's graphical construction.

Arching in soil and Braced Cuts: Theory of Arching, Braced excavations, Deep cuts in sand, saturated soft to medium clays.

Soil Investigation: Object of soil investigation for new and existing structures. Depth of exploration for different structures. Spacing of bore holes. Methods of soil exploration and relative merits and demerits.

Stress Distribution: Boussinesq's equation for a point load, uniformly loaded circular and rectangular area, pressure distribution diagrams. New marks chart and its construction. Two- to – one method of load distribution. Comparison of Bossinesq and Westerguard analysis for a point load.   Limitations of elastic formula.

Shallow Foundation: Types of shallow foundations, definitions Terzaghis analysis. Types of failures. Factors affecting bearing capacity. Skemptions equation. B. I. S. recommendations for shape, depth and inclination factors. Plate Load Test and Standard Penetration Test. Contact pressure distribution.   Causes of settlement of structures comparison of immediate and consolidation settlement Calculation of settlement by plate load test and Static Cone Penetration Test data.   Allowable settlement of various structures according to IS Code. Situation most suitable for provision of rafts. Proportioning of rafts in sand and clays. Various methods of designing raft. Floating foundation.

Pile Foundation : Necessity and uses of piles, classification of piles. Merits and demerits of different types based on composition. Types of pile driving hammers & their comparison. Effect of pile driving on adjacent ground. Use of Engineering news formula and Hiley's formula for determination of allowable load. Pile Load Test, separation of skin friction and point resistance using cyclic pile load test data. Related Numerical problems.

Determination of point resistance and frictional resistance of a single pile by static formula. Piles in clay, safe load on a friction and point bearing pile. Pile in sand spacing of piles in a group, factors affecting capacity of a pile group. Efficiency of pile group bearing capacity of a pile group in clay.   Settlement of pile groups in clay and sand Negative skin friction.

Stability of Slopes: Necessity, causes of failure of slopes. Stability analysis of infinite and finite slopes in sand and clay. Taylor's stability number and its utility.

Caissons and wells: Major area of use of caissons Advantages and disadvantages of open box and pneumatic caissons. Essential part of a pneumatic caisson. Components of a well. Calculation of allowable bearing pressure. Conditions for stability of a well. Terzagh's analysis for Lateral stability of a well, embedded in sand.   Forces acting on a well foundation. Computation of scour depth, Tilts & Shifts.

Machine Foundations: Theory of vibrations, foundations subjected to vibrations, determination of dynamic properties of soil, Dynamic analysis of block foundations.

Books Recommended

1. Peck R B, Hanson W B and Thorn burn T H "Foundation Engineering" Jonh Wiley and Sons Inc, New York. 1974
2. Teng W C "Foundation Design" Prentice Hall of India, New Delhi, 1988.
3. Bowles J E "Foundation Analysis and Design" McGraw Hill, New York, 1988.
4. Ranjan G and Rao A S R "Basic and Applied Soil Mechanics" New Age International, New Delhi, 2000
5. Murthy V N S "A Text Book of Soil Mechanics of Foundation Engineering" Sai Kripa Technical Consultants, Bangalore, 1993

CE 304   Design of Concrete Structures – II   [3 0 0 3]

R. C. C. Footings: Design of combined footings (Trapezoidal and rectangular) Design of Strap footing and raft foundations.Design of piles and pile footings.

Beams curved in plan: Design of semicircular beams supported on three supports. Design of circular beam supported on symmetrically placed columns.

Domes: Introduction to different types of domes and shells. Design of spherical and conical domes. Design of cylindrical shells supported on edge beams.

Staircases: Types of staircases, loads on stair, Design of different types of staircases.

Retaining Walls: Design of cantilever and counter fort retaining walls. Design of basement walls.

Water Tanks: Introduction, Design of tanks resting on ground, under ground tanks and elevated tanks.

Books Recommended:

1. Raju N K "Advanced Design of Structures" Tata McGraw Hill, New Delhi, 2000.
2. Varghese P C "Advanced Reinforced Concrete Design" Prentice Hall of India, New Delhi, 2001.
3. Dayaratnam, P" Advanced Design of Concrete Structures" Oxford and IBH Publishing Co, Pvt. Ltd., New Delhi, 2002.
4. Syal I.C "Behaviour, Analysis and Design of Reinforced Concrete structural Elements" S. Chand & company, New Delhi, 2003.
5. James, G. Mac Gregor, "Reinforced Concrete- Mechanics and Design", Prentice Hall, N.J., New York,1997.

CE 306   Highway and Traffic Engineering   [3 0 0 3]

Introduction: Importance and role of transportation systems; different modes of transportation, historical development of road construction, Highway Economics.

Highway Planning & Project Preparation: Planning surveys, Highway alignment, Highway Location surveys, soil and material surveys, Highway Projects: drawing and report.

Highway Geometric Design: cross-sectional elements, camber, sight distance-definition analysis of stopping sight and passing sight distances, passing zones. Design of horizontal alignment-super elevation. Extra widening on curves, transition curves. Design of vertical alignment, gradients, types of vertical curves & their design

Highway materials and construction: Desirable properties of soil, Road aggregates, bitumen, cement & cement concrete as highway materials. Various types of roads & their construction-earth roads, gravel roads, W.B.M., bituminous, surface treatment, penetration macadam, premix carpet, bituminous concrete, sheet asphalt and quality control during construction.

Pavement Design: Design of flexible and rigid Pavements.

Elementary Traffic Engineering-Traffic Engineering studies (speed, volume, O & D, parking and accident studies), traffic signs, traffic signals, road markings, road intersection, highway lighting.

Books Recommended

1. Rao G V "Principles of Transportation and Highway Engineering" Tata McGraw-Hill,New Delhi, 1996
2. Khanna S K and Justo C E G "Highway Engineering", Nem Chand and brothers; Roorkee. 2002
3. Bhanot K L Highway Engineering, S. Chand & Company (P) Ltd. New Delhi, 1990
4. Ahuja T D "Highway Engineering" Standard Book House Delhi, 1995
5. Kamla A "Transportation Engineering" Tata McGraw-Hill, New Delhi, 1993.

CE 308   Elements of Earthquake Engineering   [3 1 0 4]

Undamped free vibrations of single degree of freedom systems: Introduction, definitions, characteristics of a dynamic problem, degrees of freedom, Newton's law of motion, De Alembert's Principal, free body diagram, derivations of differential equation of motion, solution of differential equation of motion, equivalent stiffness of spring combinations, springs in series, springs in parallel.

Damped free vibrations of single degree of freedom systems: Introduction, types of damping, free vibrations with viscous damping, over-damped, critically- damped and under- damped systems, logarithmic decrement, structural damping.

Earthquake Resistant Design Philosophy: Introduction, criteria for earthquake resistant design, principles of reliable seismic behaviour, structural forms for earthquake resistance, earthquake forces versus other forces.

Lateral Load Analysis: Idealization of structures and selection of analysis, equivalent lateral force concepts, response spectrum analysis, seismic forces as per IS : 1893 – 1984 and   IS : 1893 – 2000.

Behaviour and Design of Concrete Structures: Characteristics of concrete and reinforcing steel, influence of bond and anchorage and confinement of concrete, Seismic design and detailing of reinforced concrete and masonry buildings (IS 13920; IS 13 827: IS 13828; IS 4326) and flexural strength and ductility of RC members, shear behaviour of RC members, beam column joints in moment resisting frames.

Books Recommended

1. Paz M "Structural Dynamics – Theory and Computation" CBS Publishers and Distributors, New Delhi, 2003.
2. Chopra A K "Structural Dynamics" John Wiley & Sons, New Delhi, 2002.
3. Dowrick D J "Earthquake Resistant Design for Engineers and Architects" John Wiley & Sons, New York, 2000.
4. Paulay and Priestley "Seismic Design of Reinforced Concrete and Masonry Buildings" John Wiley and sons, New York, 1992.
5. Rao S.S.,"Mechanical Vibrations" Pearson Education Publishers, 2004.

CE 322   **Concrete Structures Drawing-II**   **[0 0 2 1]**

Structural Drawings/Reinforcement detailing of

1. R.C.C. Footings
2. Beams curved in plan
3. Domes
4. Staircases
5. Retaining Walls
6. Water Tanks

CE 324   **Highways and Traffic Engineering Laboratory**   **[0 0 2 1]**

List of experiments

1. Aggregate crushing value test.
2. Aggregate attrition test.
3. Impact value test.
4. Abrasion test (Dorry's & Los Angeles)
5. Soundness test.
6. Flakiness test.
7. Water absorption & specific gravity test.
8. Laboratory C. B. R. test.
9. North Dakota cone test.
10. Penetration test on bitumen.
11. Softening point test for bitumen.
12. Ductility test.
13. Specific gravity Test.
14. Viscosity test.
15. Flash point and fire point test.
16. Marshall Stability test.

7th Semester

CE 401   Design of Steel Structures –II   [3 0 0 3]

Design of Round Tubular Structures: Introduction, round tubular sections, permissible stresses, tube columns and compression members, tube tension members, tubular roof trusses, Design of tubular beams, Design of tubular purlins.

Design of steel foot bridge: Introduction, design of flooring, cross girders, analysis of N- type truss, design of various members of truss, design of joints, design of bearings.

Design of complete industrial building with design of:
   a)   Gantry Girder
   b)   Column bracket.
   c)   Mill bent with constant moment of inertia
   d)   Lateral and longitudinal bracing for column bent etc.

Design of a single track through type Railway Bridge with lattice girders having parallel chords (for B. G):
   a)   Design of stringer and stringer bracing
   b)   Design of cross girders
   c)   Design of connection between stringer and cross girder
   d)   Design of main girders – various members and their joints
   e)   Design of bottom lateral bracing and top lateral bracing
   f)   Design of portal bracing and sway bracing
   g)   Design of bearings – rocker and rollers

Books Recommended

   1.   Arya A S and Ajmani J L "Design of Steel Structures" Nem Chand & Bros, Roorkee,1996.
   2.   Chandra R "Design of Steel Structures" Vol. I & II Standard Book House, Delhi,1991
   3.   Raz S A "Structural Design in Steel" New Age International (P) Ltd., New Delhi, 2002
   4.   Raghupathi M "Design of Steel Structures" Tata McGraw-Hill Publishing Company ltd., New Delhi, 1999.
   5.   Dayaratnam P "Design of Steel Structures" Wheeler Publishers, New Delhi, 2000.

CE 403   Construction Management   [3 0 0 3]

Introduction: Need of project planning & Management, value Engineering, time value of money, construction schedule activity & event, bar chart, milestone chart, uses & draw backs.

PERT: Construction of PERT network, time estimate & network analysis, forward pass & backward pass, event slack, critical path, data reduction.

CPM: Definitions, network construction, fundamental rules determination of project schedule, activity time estimates, float types, their significance in project control, critical path.

Three phase application of CPM: Planning scheduling & controlling, updating an arrow diagram, time grid diagram, resource scheduling.

Cost analysis & contract: Types of project cost, cost time relationships cost slopes, conducting a crash programme, determining the minimum total cost of a project.

Factor affecting Selection of equipment: Type of equipment, depreciation cost, operating cost, Economic life of equipment, maintenance & repair cost.

Earth Moving Machinery: Tractors & related equipment, bulldozers, scrapers, Power shovels, dragline, hoes etc.

Construction Equipment: Grading / proportioning, batching mixing, types of mixers, concrete pumps, placing & compacting concrete.

Hoisting & Transporting Equipment: Hosts, winches, cranes, belt conveyors, truck etc.

Books Recommended

1. Srinath L R "PERT & CPM" Affiliated East-West press (P) Ltd., New Delhi,1999.
2. Modi P N "PERT &CPM" Standard Book House Delhi, 1995.
3. Wiest J D "A Management Guide to PERT & CPM" Prentice Hall of India (P) Ltd, New Delhi, 1997.
4. Peurify R L "Construction, Planning Equipment & Management" McGraw Hill Book company, New Delhi, 1996.
5. Sharma S C "Construction Equipment & its Management" Khanna Publishers, Delhi, 1990.

CE 421 **Steel Drawing** **[0 0 2 1]**

List of Drawings

Detailed working drawings for

Industrial buildings

Steel Foot Bridge & Through Type Railway Bridge

CE Industrial Practical Training **[0 0 0 4]**

The students will undergo practical training in the Industry/Academic/Research Institute.

CE 400 **Project (Phase I)** **[0 0 4 2]**

Independent study by the student in any area of interest related to civil engineering.

CE 400   Project (Phase II)   [0 0 0 4]

The independent study of Project (Phase I) will be continued.

CE 402   Estimating and Costing   [3 0 0 3]

Estimates: Types, complete set of estimate, working drawings, site plan, layout plan, index plan, plinth area administrative approval and Technical Sanction.

   (i)   Estimate of buildings
   (ii)   Estimate of R. C.C. works
   (iii)   Estimate of sloped roof and steel structures
   (iv)   Estimate of water supply and sanitary works
   (v)   Estimates of roads (a) Earthwork   (b) Bridges and culverts c) Pavement
   (vi)   Estimate of Irrigation works.

Analysis of Rates: For earthwork, concrete works, D. P. C., Brickwork, stone masonry, plastering, pointing, road work, carriage of materials.

Specifications: General specification for different classes of building, detailed specifications for various Civil Engineering Works.

Contracts: Types of contracts, tender, tender notice, tender form, submission and opening of tender, earnest money, security money, measurement book,   muster roll, piecework agreement and work order

Accounts: Division of accounts, cash, receipts of money, cashbook, temporary advance, imprest and accounting procedure.

Arbitration: Arbitration, arbitrator, and arbitration act, powers of arbitrator, arbitration awards.

Books Recommended

   1.   Chakraborti M "Estimating and Costing" Published by the author 21 B, Bhabananda Road, Calcutta,2002.
   2.   Dutta B N "Estimating and Costing in Civil Engineering" UBS Publishers' Distributors Ltd., New Delhi, 1999.
   3.   Birdie G S "Estimating and Costing" Dhanpat Rai & Sons, Delhi,1994.
   4.   Kohli D. D.,Kohli R.C.,'Estimating and Costing",S.Chand & Company,New Delhi,2004
   5.   Spence Gedder,"Building and Public Works Administration, Estimating and Costing",Newnes Publishers,London,UK,1950.

__Departmental Electives:__

__Elective-I (Fifth Semester)__

CE 331   Design of Hydraulic Structures   [3 0 2 4]

Dams: Gravity dams, arch and buttress dams and earthen dams, also introduction about rivers and canal projects in Punjab.

Canal Falls: Necessity and location, types of falls and their description, selection of type of falls, principles of design, design of Sarda type, straight glacis and inglis or baffle wall falls.

Canal outlets: Essential requirements, classification, criteria for outlet behaviours, flexibility, proportionality, sensitivity, etc. Details and design of non-modular, semi-modular and modular outlets.

Distributory Regulators: Off take alignment, cross regulators-their functions and design, Distributory head regulators - their functions and design, canal escape.

Cross Drainage Works: Definitions, choice of type, hydraulic design considerations. Aqueducts their types and design, siphon aqueducts their types and design considerations, super passages, canal siphons and level crossings.

Diversion Head Works: Foundation and investigations: component parts of a diversion head work and their design considerations, silt control devices.

Theory of Seepage: Seepage force and exit gradient, salient features of Bligh's Creep theory, Lane's weighted Creep theory and Khosla's theory Determination of uplift. Pressures and floor thickness.

Design of Weirs Weirs versus barrage, design consideration with respect to surface flow, hydraulic jump and seepage flow. Design of a barrage or weir.

Energy Dissipation Devices: Use of hydraulic jump in energy dissipation, Factors affecting design, types of energy dissipation and their hydraulic design.

Books Recommended:

1.   Sharma S K "Design of Irrigation Structures" S. Chand & Company (Pvt.) Ltd., New Delhi.
2.   Murty C S "Design of Minor Irrigation and Canal Structures" Wiley Eastern Ltd. New Delhi.
3.   Garg S K "Irrigation Engineering & Hydraulic Structures" Khanna Publishers, Delhi,1999.
4.   Arora K R "Irrigation Waterpower & Water Resources Engineering" Standard Publishers Distributors, Delhi, 2003.
5.   Asawa G L "Irrigation Engineering" Wiley Eastern Ltd., New Delhi 2001.

CE 333   Rock Mechanics and Engineering Geology   [3 0 0 3]

General Geology: Divisions of geology, Importance of Engineering Geology versus geology applied to Civil Engineering practices. Weathering, definition types and effect. Geological works

of rivers, wind, glaciers as agents of erosion, transportation and deposition, resulting features and engineering importance.

Rocks and Minerals: Minerals, their identification and physical properties of minerals, igneous, sedimentary and metamorphic rocks, their formation and structures. Classification of rocks for engineering purpose. Rock quality designation (RQD).

Structural Geology: Brief idea about stratification, apparent dip, true dip, strike and unconformities.

Folds: Definition, parts of a fold, classification, causes relation to engineering operations.

Faults: Definition, parts of a fault, classification cause relation to engineering purposes.

Joints: Definition, attitude, joint set, joint systems, classification in relation to engineering operations.

Engineering Geology: Geological considerations in the Engineering Projects like tunnels, highways, foundations, dams, and reservoirs. Earthquake. Definition, terminology, earthquake waves, intensity, recording of earthquake, seismic zones in India, factors to be considered and methods in earthquake proof construction.

Earth movements: Landslides and land subsidence, elementary idea about classifications, factors causing landslides and land subsidence, preventive measures like relating walls, slope treatment, chemical stabilization and drainage control.

Engineering Properties of Rocks and Laboratory Measurement: Uniaxial compression tests, tensile tests, permeability test, shear tests, effect of size and shape of specimen and rate of testing. Confining pressure, stress strain curves of typical rocks. Strength of intact and fissured rocks, effect of anisotropy, influence of effect of pore fluid type instauration and temperature.

In-situ determination of Engineering Properties of Rock Masses: Necessity of in-situ test, uniaxial load tests in tunnels and open excavation, cable tests, flat jack test, shear test, pressure tunnel test. Simple methods of determining in-situ stresses, bore hole over coring technique-bore hole deformation gauges.

Improvement in Properties of Rock Masses: Pressure grouting for dams and tunnels, rock reinforcement, rock bolting.

Books Recommended

1. Goodman R E "Introduction to Rock Mechanics", John Wiley & Sons, New York, 1989
2. Jaguer J C and Cook N G W "Foundational of Rock Mechanics" 3rd ed., Chapman & Hall London, 1979
3. Lama R D and Vutukuri V S with Saluja S S "Handbook on Mechanical Properties of Rocks" Vols. I to IV, Trans Tech Publications, Rockport, MA.
4. Arora D S "A Text Book of Geology", Mahindra Capital Publishers, Chandigarh, 1988
5. Singh P "Engineering and General Geology" S. K. Kataria and Sons, New Delhi, 1992

CE 335   Elements of Remote Sensing and GIS   [3 0 0 3]

Introduction to Geographic Information System: Definitions and related terminology, evolution of GIS, components of GIS, approaches to the study of GIS.

Maps and GIS: Introduction, Map scale and classes of maps, the mapping process, plane coordinate systems and transformations, geographic coordinate system of earth, map projection, georeferencing and topographic mapping.

Digital Representation of Geographic Date: Introduction, database and database management systems, raster geographic date representation, vector data representation, data representation and data analysis in GIS.

Raster Basic GIS Data Processing: Introduction, acquiring and handling raster geographic data, raster based GIS data analysis, cartographic modeling.

Vector Based GIS Data Processing: Introduction, Characteristics of vector based GIS data processing, topological and non-topological functions.

Remote Sensing and GIS: Introduction, Principles of electromagnetic remote sensing, remote sensing system classifications, imaging characteristics, extraction of metric information from remotely sensed images, integration of remote sensing and GIS.

Books Recommended:

1. Lo C P and Young K W "Concepts and Techniques of Geographic Information Systems" PHI Pvt. Ltd, New Delhi, 2002.
2. Campbell, "Introduction to Remote sensing", CBS Publishers & Distributors, New Delhi,2003.
3. Burrough P A "Principles of Geographic Information Systems for Land Resources Assessment" Oxford University Press, 2003.
4. Duggal S K "Surveying Volume 2" Tata McGraw Hill, New Delhi, 2004.
5. Donnay J.P. "Remote Sensing and Urban Analysis", CBS Publishers & Distributors, New Delhi,2003.

CE 332   Plastic Analysis of Structures   [3 0 0 3]

Introduction: Ductility of metals: Concept of plastic design, Overloaded factors, Ultimate load as design coition.

Analysis of Indeterminate Structures: Hinge formation in indeterminate structures, Redistribution of moments, Assumption made for structure subjected to bending only.

Minimum Weight Design: Concept, assumption, Design of frame with prismatic members, Elements of linear programming and its application to minimum weight design problems.

Deflection: Assumption, Calculation of deflection at ultimate loads, Permissible rotations.

Secondary Design Considerations: Influence of direct load, shear local bucking, lateral bucking, repeated loading and brittle fracture on moment capacity. Design of eccentrically loaded columns. Problem of incremental Collapse, Shake down analysis. Special considerations for design of structures using light gauge metals.

Books Recommended

1.   Neal B G "Plastic Methods of Structural Analysis" Chapman Hall, London
2.   Manika Selvam V K "Limit Analysis of Structures" Dhanpat Rai Publications, New Delhi, 1997.
3.   Arya A S and Ajmani J L "Design of Steel Structures" Nem Chand & Bros, Roorkee.1992.
4.   Chandra R "Design of Steel Structures" Vol. I & II Standard Book House, Delhi, 1999.
5.   M.P. Nielsen, "Limit Analysis and Concrete Plasticity" CRS Press, London, 1998.

CE 334   Advanced Environmental Engineering   [3 0 0 3]

Water Pollution: Water borne disease, hardness of water, purification water; storage filtration, chlorination, chlorination of water on small scale, examination of water & health criteria for water supplies, fluoridation of water. Swimming pool sanitation health education. Hosrock's apparatus & sampling.

Ecology: Introduction, biosphere, scope, ecosystem, population regulation, national cycles. Energy flow forests & wild life, human activity, green house effect.

Air Pollution: composition, air of occupied rooms, discomfort, indices of thermal comfort, comfort zones, air pollution sources, pollutant, metrological conditions, indications of air pollution, health & other aspects of air pollution, prevention & control disinfections of air.

Ventilation: Concept, standard of ventilation, types of ventilation.

Lighting: Requirements of good lighting, measurement of light, natural lighting, light measurement units, measurement of day light, artificial lighting, method of artificial illumination, lighting standards.

Noise Pollution: Definition, effect of noise, Exposure, noise control.

Radiation: Source of radiation exposure, type of radiation, radiation units, Biological effect of radiation, radiation protection.

Metrological Environment: Atmosphere pressure, measurement effects of atmospheric pressure on health.

Air Temperature: Effects of heat-stress, preventive measures effect of cold stress.

Housing: Criteria for good housing, house standards, rural housing, housing & health over crowding.

Excreta Disposal: Public health, importance, extent of problem how diseases is carried from excreta sanitation barrier, method of excreta disposal, excreta disposal in unsewered area.

Books Recommended

1. Garg S K "Environmental Engineering", Khanna publishers New Delhi.2003
2. Rao C S "Environmental Engineering", McGraw Hill Book Company.2001
3. Metcalf & Eddy, "Waste Water Engineering- Treatment Disposal and Reuse", Tata-McGraw Hill Publishing company limited, New Delhi 2003.
4. Masters G M "Introduction to Environmental Engineering and Science" Prentice Hall of India, New Delhi.
5. Eckenfelder W W "Industrial Water Pollution control" McGraw Hill, New Delhi 1989.

CE 336   **Hydrology and Dams**   **[3 0 0 3]**

Introduction, Precipitation: Importance of hydrological data in water resources planning. The hydrologic cycle. Mechanics of precipitation, types and causes, measurement by rain gauges, Gauge net-works, hyetograph, averaging depth of precipitation over the basin, mass-rainfall curves, intensity duration frequency curves, depth area-duration curves.

Interception, Evapo-transpiration and infiltration: Factors affecting interception.
Evaporation from free water surfaces and from land surfaces, transpiration, Evapo-transpiration.

Infiltration-Factors affecting infiltration, rate, infiltration capacity and its determination.

Runoff: Factors affecting runoff, run-off hydrograph, unit hydrograph theory, S-curve hydrograph, Synder's synthetic unit hydrograph.

Peak Flows: Estimation of Peak flow-rational formula, use of unit hydrograph, frequency analysis, Gumbel's method, design flood and its hydrograph, Principles of flood routing through a reservoir by ISD method (description only).

Gravity Dams-Non Overflow Section: Forces acting, Stability factors, stresses on the faces of dam, Design of profile by the method of zoning, Elementary profile of a dam.

Gravity Dams Spillways: Creagers profiles neglecting velocity of approach, profile taking velocity of approach into account, upstream lip and approach ramp, Advantages of gated spillways, Discharge characteristics of spillways.

Arch and Buttress Dams: Classification of arch dam-constant radius constant angle and variable radius types, cylinder theory, expression relating central angle and cross-sectional area of arch. Types of buttress dams, advantages of buttress dams.

Earth Dams: Components of earth dams and their functions, Phreatic line determination by analytical and graphical methods.

Books Recommended

1. Subramanya K "Engineering Hydrology" Tata McGraw-Hill, New Delhi, 2001.
2. Wilson E M "Engineering Hydrology" ELBS, English Language Book Society/Macmillan Education Ltd. London, 1999.
3. Raghunath H M "Hydrology" Wiley Eastern, New Delhi, 2000.
4. Pence V M "Hydrology – Principles and Practices" Prentice Hall, New Jersy. , 1998.
5. Karanth K R "Hydrology" Tata McGraw Hill, New Delhi 2001.

CE 338   Advanced Civil Engineering Materials   [3 0 0 3]

Plastics: Brief history, composition, polymerisation, classification of plastics, resins, Moulding compounds, Fabrication, properties of plastics, uses of plastics, PVC pipes in building.

Glass: General, properties, types and uses, special varieties of glass.

Timber: Characteristics, identification and uses of common Indian timber –teak, deodar, shisham, chil, sal, veneers, plywood, laminated boards-their uses and properties, uses and strength of bamboo, preservation of timber against fire and weather etc.

Miscellaneous Materials: Fly ash, Rubber –types, uses and properties, Heat insulating materials, Sound absorbent materials.

Steel: Market forms, properties of mild steel and hard steel, preventive measures for corrosion.

Composite Materials: Definition, classification – particulate composites, fibrous composites, properties of fibres and conventional materials.

Unidirectional composites: Introduction, volume fractions, weight fractions longitudinal strength and stiffness, factors influencing longitudinal strength and stiffness, transverse strength and stiffness.

Short fiber composites: Introduction, modulus and strength of short fiber composites, rubber reinforced composites.Laminated composites **-** and its applications.Fiber reinforced plastics (FRP) and its applications

Mortars: Properties and uses of cement, lime and surkhi mortars, proportions, mixing, uses.

Steel fibrous concrete: Introduction, types of fibers, properties of steel fibrous   concrete.

Books Recommended

1. Broutman, A Wiley Interscience Publication, John Wiley & sons New York, 1996.
2. Rangwala S C "Engineering Materials" Charotar Publishing House, Anand, 1985.
3. Weather Head R G "FRP Technology" Applied Science Publishers Ltd., London, 1998.
4. Raina K B "Civil Engineering Materials" Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1999.
5. Budinski K G "Engineering Materials, Prentice Hall of India, New Delhi, 1985.

Elective-III & IV (Seventh Semester)

CE 431   Advanced Foundation Engineering   [3 0 0 3]

Soil exploration Introduction, standard penetration test, dynamic cone penetration test, static cone penetration test, field vane shear test, large shear box test, field permeability test, Geophysical Tests, Dynamics properties of soil planning of soil exploration programme.

Foundation Design-General Principles: Types of foundations, selection of type of foundation, basic requirements of a foundation, computation of loads, Design steps.

Shallow Foundations: Introduction, bearing capacity of footings, skemptons bearing capacity factor, footings on layered soils, allowable bearing pressure, raft foundations floating raft, uplift capacity of footing, beams on elastic foundation, analysis of footing by finite difference.

Pile Foundations: Introduction, bearing capacity of piles, vertical piles subjected to lateral loads, proportioning and design of pile foundations, lateral load capacity of single pile, batter piles under lateral load, uplift capacity of piles ultimate lateral load resistance of a pile group.

Drilled Piers: Introduction, current construction methods, use of Drilled Piers, analysis and design of drilled piers, settlements of drilled piers, structural design of drilled piers, laterally loaded drilled pier analysis.

Bridge Sub Structures: Definitions, elements of substructures, maximum depth of scour, depth of foundation allowable bearing pressure, loads to be considered, lateral stability, design of pier cap & pier, sinking stresses in wells, design of well cap, well staining, well curb, cutting edge, bottom plug.

Sheet Piles and Coffer Dams: Types of sheet piles structures, design of cantilerer sheet pile wall, design of anchored bulkheads, anchorage methods design of braced sheetings in cuts, Design of cellular coffer dams.

Foundations of Transmission Line Towers: Necessary information, forces on Tower foundations, General Design Criteria, choice & type of Foundation Design procedure.

Foundation in Expansive Soils: Introduction, Material structure, identification of expansive soils, Indian expansive soils, swell potential and sewelling pressure, traditional Indian practice, methods of foundations in expansive soils, replacement of soils and CNS concept. Under reamed pile foundations, remedial measures for cracked buildings.

Books Recommended

1.   Peck R B, Hanson W B and Thorn burn T H "Foundation Engineering" John Wiley and Sons Inc, New York, 1974
2.   Teng W C "Foundation Design" Prentice Hall of India Pvt. Ltd., New Delhi, 1988.
3.   Bowles J E "Foundation Analysis and Design" McGraw Hill, New York, 1988.
4.   Ranjan G and Rao A S R "Basic and Applied Soil Mechanics" New Age Internation Pvt. Ltd., Publishers, New Delhi, 2000
5.   Saran S "Analysis and Design of Substructures", Oxford & IBH Publishing Co. (P) Ltd., New Delhi, 1996

CE 433   **Ecology and Environment**   **[3 0 0 3]**

Ecology: introduction – Biosphere, scope, Ecosystem, population regulation, earth of organisms, relationships natural cycles – Hydrological cycle, carbon cycle, Nitrogen cycle, sulpher cycle, energy flow, forests & wild life, human activities.

Environmental Sanitation: Community Health – significance, disease transmission principles of Sanitation, vector control, housing needs, community sanitation measures, and health education.

Occupational safety: Hazards in various types occupation, objectives of occupational Health plan prevention and control.

Soil & Agricultural Pollution: Top soil, pollution, parameter of soil analysis, remedial measures, noise control ill effects, noise measurement, preventive & control measures.

Waste Water from Industries: Pollution – harmful effects, waste characteristics, mixing of industrial & domestic wastes. Pre-treatment of industrial waste – reduction of waste strength & volume equalization & neutralization.

Various Industries: Dairy plant, cane sugar & distilleries, fertilizer industry, paper industry, refineries & petro chemicals, tanneries, textile units & other industrial units.

Metrology & Natural Purification Process: Scales of motion, heat, pressure, wind, moisture, relative humidity**.** Lapse rates & dispersion, pressure systems and dispersion, modeling.

Engineering System for Solid Waste Management: Solid waste generation, on-site handling, storage and proceeding, collection of solid wastes. Transfer & Transport, processing techniques, ultimate disposal.

Environmental Management: Environmental impact Assessment, introduction project detail.

Environmental Audit –Meaning of Environmental audit, audit items, audit procedure, safety audit.

Pollution Control Board – Legal aspects, court judgments, function of pollution control board.

Books Recommended

1.   Linsey R K "Water Resources and Environmental Engineering" McGraw Hill, New Delhi, 1978
2.   Garg S K "Environmental Engineering" Vol. II, Khanna Publishers(P) Ltd., Delhi, 2002
3.   Punmia B C "Environmental Engineering" Vol. II, Laxmi Publication (P) Ltd., Delhi, 2003
4.   Peavy H S and Rowe D R "Environmental Engineering" McGraw Hill Book Company, 1995
5.   Rao P V "Environmental Engineering" Prentice Hall of India (P), New Delhi, 2002

CE 435   **Industrial Structures**   **[3 0 0 3]**

Bunkers and Silos: Introduction, Analysis of Bunkers and Silos, Janssen's and W. Airy's formulas for design of silos, Bunker with a hopper bottom.

Shell Roofs: Introduction, Terminology, classification and general specifications. Analysis of shells by different methods.

Machine Foundations: Introduction, General requirements, foundations for reciprocating, impact type and rotary type machines. Type of connections.

Braced Industrial Buildings: Introduction, design of goodowns, small Industrial shed with a gantry girder.

Virendeel Girders: General features, analysis of virendeel girders. Design of members.

R. C. C. Chimneys: Introduction, Design for Stresses due to self-weighs, wind, load, stress due to temperature gradient, combined effects of self load, wind load & temperature.

Books Recommended

1. Raju N K "Advanced R. C. C. Design" Tata McGraw Hill, New Delhi, 2000.
2. Chandra R "Design of Steel Structures" Vol. II Standard Publication House, New Delhi, 1991.
3. Syal I C "Behaviour Analysis and Design of R. C. C. Structure" S. Chand & company, New Delhi, 2003.
4. Ramaswamy G S "Design and Construction of Concrete Shell Roofs" CBS Publication House, New Delhi.
5. Arya A S and Ajmani J L "Design of Steel Structures" Nem Chand & Bros, Roorkee.1992.

CE 437   **Prestressed Concrete Design**   **[3 0 0 3]**

Introduction: Basis concepts, Materials used, advantages of prestressed Concrete, Applications of prestressed concrete.

Materials for prestressed Concrete: High strength concrete, strength requirements permissible stresses in concrete, creip & shrinkage, deformation characteristics, high strength steel, strength requirements, permissible stress in steel.

Prestressing Systems: Introduction, prestensioning systems, post-tensioning systems, chemical prestressing.

Losses of Prestress: Nature of losses, different types of losses and their assessment.

Analysis of Prestress & Bending Stress: Basic assumptions, Resistant stresses at a section, pressure line, and concept of land balancing, stresses in grading moment.

Flexural Shear Strength of Prestressed Concrete Sections: Types of flexural failure, strain compatibility method, code procedures, shear and principal stresses, ultimate shear resistance of pressed concrete members, prestressed concrete members in torsion.

Transfers of Prestress in Pre-tensioned and Post-tensioned members: Transmission Length, bond structures, Transverse tensile stress End-zone reinforcement, stress distribution in end block.

Design Prestressed Concrete Sections: Design of section for flexure, Axial tension compression & bending, shear, bond and torsion.

Design of concrete Pipes & Tanks: Circular prestressing type of prestressed concrete pipes, design of prestressed concrete pipes, Analysis and design of prestressed concrete tanks.

Books Recommended

1. Raju N K "Prestressed Concrete" Tata McGraw Hill, New Delhi, 2001.
2. Rajagopalan N "Prestressed Concrete" Narosa, New Delhi, 2001.
3. Dayaratnam P "Prestressed Concrete" Oxford & IBH, New Delhi, 1999.
4. Lin T Y "Prestressed Concrete" McGraw Hill, New York, 1985.
5. Edward G. nawy, "Prestressed Concrete-A Fundamental Approach" Prentice Hall Publishers, NY, 2000.

CE 439   **Finite Element Methods in Engineering**   **[3 0 0 3]**

Introduction, background and applications, general description of the method, summary of the analysis procedure, matrix theory, differential equations.

Review of Solid mechanics: Equations of equilibrium, stresses and strains, strain displacement relations, linear constitutive relations, two – dimensional elasticity, non-linear material behaviour, material characterization.

One – dimensional finite elements: The concept of an element, various element shapes, displacement models, finite element modelling, coordinates and shape functions, stiffness matrix, the finite element equations and treatment of boundary conditions.

Two-dimensional finite elements: Introduction, two-dimensional boundary value problems, various element shapes, constant strain triangular elements, quadrilateral elements, natural coordinates, connectivity and nodal coordinates, problem modelling and boundary conditions.

Two-dimensional Isoparametric Elements: Introduction, the four-nodded quadrilateral element, numerical integration, interpolation formulas and shape function formulas, computations of element stiffness matrix.

Beams and Frames: Introduction, finite element formulation, load vector, boundary conditions, displacement method for beam analysis, beam finite elements, shear force and bending moment, plane frames.

Books Recommended

1. Desai C S and Abel J F " Introduction to the finite element method" CBS Publishers and Distributions, Delhi, 2004.
2. Buchanan G R "Schaum's Outline Series, Theory and Problems of Finite Element Analysis" McGraw Hill International Edition/Tata McGraw Hill, New Delhi, 2004.
3. Chandrupta T R and Belegundu A D "Introduction to Finite Elements in Engineering" PH I, New Delhi,1997.
4. Krishnamoorthy C S "Finite Element Analysis – Theory and Programming" TMH Publishing Co. Ltd. New Delhi, 2002.
5. Bathe K.J., "Finite Element Procedures", Prentice Hall of India, New Delhi, 1997.

CE 441   **Architecture and Town planning**   **[3 0 0 3]**

Elements of Design: Line direction. Shape, size, texture, value and colour, balance, scale and proportion.

Principles of Design: Repetition, gradation, harmony, contrast and unity, creation of 2 D and 3 D compositions.

The Industrial Revolution: The age of revivals, the emergence of engineer, new materials and techniques and the evolution of balloon frame and steel frame.

Origin of Modern Architecture: definition and concept of modern architecture, various pioneers of modern architecture.

Town Planning: Definition and meaning, age of planning, scope and motives of planning, brief history of town planning – its origin and growth, historically development of town planning in ancient valley civilizations. Indus Nile Tigris and Euphrates, Greek Roman, Medieval and Renaissance town planning

New Concepts: Garden city movement, Linear city and concentric city concepts, Neighbourhood and Radburm, La-cite industrille, Radiant city to present day planning.

Planning Principles: Types of town and their functions, types of town planning – Grid Iron, Radial, Spider webs, Irregular and Mixed, their advantages and disadvantages.

Planning Practice and Techniques: Zoning – its definition, procedure and districts, height and bulk zoning, F. A. R., Master Plan – Meaning, preparation and realization, the scope of city planning – city rehabilitation and slum clearance.

Books Recommended

1. Cherry, Gordon,"Urban Planning Problems",Board Hill, London,1974.
2. Sundaram,K.V.,"Urban and Regional Planning in India" Vikas Publishing house(P) Ltd.,New Delhi,2000.
3. Gallion A B.,Eisner S., "The Urban Pattern" Van Nostrand reinhold,New York,1993.
4. Jon Lang,"A concise history of Modern Architecture in India",Permanent Black Publishers,New York,1998.
5. Taurus Parke,"A City with view Florence", I.B.Taurus Publishers, New York, 1994.

CE -432   Bridge Engineering   [3 0 0 3]

Introduction: Definition, components of a bridge, classifications, importance of bridge

Investigation of Bridges: Need for investigations, selection of bridge site, preliminary data to be collected, design discharge and its determination, linear waterway, economical span, vertical clearance above HFL, scour depth, choice of bridge type.

Standard Specifications: For road bridges, I.R.C. loadings, code provisions on width of carriage way, clearances, loads considered etc. standard specifications for railway bridges, Railway bridge code.

Reinforced Concrete Bridges: T-beam bridge, Courbon's theory for load distribution, balanced cantilever bridges, illustrative examples, pre-stressed concrete bridges, (General discussions). Slab Bridges

Sub Structure: Types of piers and abutments, design forces, design of piers and abutments.

Bearing and Joints : Various types of expansion bearing and fixed bearings, elastomeric bearings, joints and their types. Introduction to construction, inspection and maintenance of bridges.

Books recommended

1. Victor D J "Essentials of Bridge Engineering" Oxford and IBH Publishers, New Delhi, 2003.
2. Vazirani & Ratwani "Design of Concrete Bridges, Khanna Publishers, New Delhi, 1986.
3. Bindra S P "Principles and Practice of Bridge Engineering" Dhanpat Rai & sons, New Delhi, 1999.
4. Ponnuswamy S.," Bridge Engineering" Tata McGraw Hill, New Delhi, 2003.
5. Punmia B.C.,Jain A.k.,Jain A.K.,"RCC Designs", Laxmi Pub.(P) Ltd.,2003

CE 434   Soil Dynamics   [3 0 0 3]

Introduction, Nature of Dynamic Loads

Theory of vibrations.

Dynamic Earth pressure and dynamic bearing capacity of shallow foundations.   Liquefaction of Soils

Wave propagation in an elastic, homogeneous and isotropic medium

Determining dynamic soil parameters.

Machine foundations for reciprocating, impact type and Rotary machines.

Vibration isolation and screening.

Books Recommended

1.   Barken D D "Dynamics of bases and foundations" McGraw Hill, New York, 1962
2.   Saran S "Soil Dynamics and Machine Foundations", Galogotia Publications Pvt. Ltd,New Delhi, 1999

3. Rao N D V K "Vibration Analysis and Foundation Dynamics" Wheeler Publishing Div. of A. H. Wheeler & Co. Ltd. New Delhi, 1998
4. Krammer S "Geotechnical Earthquake Engineering" Pearson Education Pvt. Ltd. New Delhi, 2003.
5. Prakash S "Soil Dynamics" McGraw Hill Book Company, New York, 1981.

CE 436   **Hydro Power Engineering**   **[3 0 0 3]**

Introduction: Waterpower Development – its types, distribution and use

World's largest hydropower generating plants, Estimate of flow rate and waterpower, Peak Load hydropower plants,

Dams: Classifications, types, site selection for dams.

Gravity Dams: Forces acting on gravity dams, Modes of failure, principal and shear stresses, Elementary profile of a gravity dam, high and low gravity dams, profile of a dam from practical considerations, stability analysis methods.

Joints and galleries in gravity dams

Arch Dams: Types, methods for design of arch dam.

Buttress Dams: Types, forces acting on Buttress dam, stability analysis.

Spillways: Spillway capacity, classification of Spillways, Design of Ogee Spillway, Stilling Basins, Spillway crest gates.

Intake structures: functions, location, intake type, trash rack, dimension, design, spacing of bars, method of cleaning, shape of inlet, power canal, location, site, forebay, size, capacity, gates and valves.

Tunnels: geometric and hydraulic design, penstock, location, type, Economical diameter of penstock.

Surge tank: Functions, type, Design of Surge tank, methods of surge analysis, Restricted orifice and differential surge tanks, downstream surge tanks.

Power House: Location, site and general arrangements, draft tubes, tail trace and their hydraulic design, turbines, number, make, size, type, characteristics and efficiency, pumps, Generators, exciters, switchboard, transformers and other accessories.

Books Recommended

1. Barrows H K "Water Power Engineering" Tata McGraw Hill Publishing Company Ltd. New Delhi, 1999.
2. Varshney R S "Hydro Power Structures" Nem Chand & Bros., Roorkee, 2000.
3. Garg S K "Irrigation Engineering and Hydraulic Structures" Khanna Publishers, New Delhi, 1998.
4. Galce A A "Handbook of Dam Engineering" Van Nostrang Rheinhold Co., New York, 2000.
5. Justin J D and Creager W P "Engineering for Dams" Vols. 1 to 3, John Wiley & Sons, New York, 1998.

CE 438   **Software Applications in Structural Engineering**   **[3 0 0 3]**

Introduction: Software and software engineering, software metrics Estimation and planning.

System and Software Requirements Analysis: Computer based systems, computer systems engineering, system analysis, requirements analysis fundamentals, structured analysis and its extensions, object oriented analysis and data modeling.

Design and Implementation of Software: Software design fundamentals, data-flow oriented design, object oriented design, data oriented design methods, programming languages and coding.

Software Quality Assurance: Software quality and software quality assurance, software testing techniques, software Testing strategies, software maintenance, reverse engineering techniques.

Application Software in Civil Engineering: Introduction and application of softwars like STAAD III, STAAD PRO, ATENA, ADINA, ANSYS, DIANA, project work and application to practical problems.

Books Recommended

1. Pressman R S "Software Engineering A Practitioner's Approach" McGraw Hill International, New York, 2001.
2. Broeton P "Software Engineering Environments" Wiley, New York, 2002.
3. Blum I B "Software Engineering A Holistic View" Oxford University Press, 2001.
4. Blanchard B S and Fabrycky W J "Systems Engineering and Analysis" Prentice-Hall International, New York1998.
5. Roy S K and Chakrabarty S "Fundamentals of Structural Analysis with Computer Analysis & applications" S. Chand & Company, New Delhi, 2002.

CE 440   **Ground Improvement and Ground Engineering**   **[3 0 0 3]**

1) The mechanics of soil stabilization, Principles and techniques.

2) Grouting and injection methods.

3) Reinforced earth methods.

4) Dynamic consolidation, deep compaction, sand drains.

5) Laboratory and field studies.

6) Geo-textiles and geo-membranes.

Books Recommended

1. Bell F G (edited) "Foundation Engineering in difficult Ground" Newnes Butterworth, USA, 1978
2. Civil Engineering and Construction Review – A combination of reprints from "Foundations, Geosynthetics & Ground Improvement". CE & CR, New Delhi, 1999
3. Kolrner R M "Designing with Geosynthetics" Prentice-Hall, N.J., U. S. A, 1986
4. Rao V G and Raju N S "Engineering with Geosynthetics" Tata McGraw Hill Publications Co. Ltd. New Delhi, 1999.
5. Raj P P "Ground Improvement Techniques" Tata McGraw Hill, New Delhi.

CE 442   **Railways, Airports and Harbour Engineering**   **[3 0 0 3]**

Introduction: History of development of Railways, Permanent Way,Requirement of ideal permanent way, cross-sections of single and double tracks in embankment and cutting.

Points and Crossing: Simple types currently in use: points and crossing terminology, layout plans of simple cross over, turnouts, diamond crossing, geometric design of a simple turn out design of crossings & switches.

Stations and yards: Selection of site for station and yards, different types of stations and yards and their layouts-way side station,

Permanent way Construction and Maintenance: Laying of track, relaying and dismantling, maintenance of track.

Signaling and Interlocking: Objects of signaling, types of signals, Interlocking and devices used in interlocking.

Introduction: Airport classification, classification of flying activities. Characteristics & airport size.

Airport Planning: Types of runway patterns, Running layout effect of metrological conditions, wind rose, specifications for runway clearances and other airport utilities.

 Airport Grading & drainage: General considerations, master plan, grading design, selective grading, classification of excavation, drainage purpose & data required, drainage structures & materials, drainage system.

Pavement Design: Factors affecting pavement design, design method for flexible pavement (CBR, MC-leads, bur misters) design method for rigid pavements (water guard's analysis, I.R.C. methods)Joints in concrete pavements, design of level bars, tie bars, distribution steel, airport pavement overlays.

Docks and Harbours: Definition, location & layout of docks, classification of docks Simple description, frequent dealing with natural and artificial harbour, their classification & requirement, action of wind, water, tides and lateral drift on harbour structures.

Books Recommended

1.   Rangawal S C "Railway Engineering" Charotar Publishers, Anand ,2002.
2.   Arora S P and Saxena (2001), "Railway Engineering", Dhanpat Rai Publishers, New Delhi, 2001
3.   Khanna, Arora and Jain "Airport Planning & Design" Nem Chand & Bros., Roorkee 2002
4.   Horren Jeff, "Airport, Planning & Design"
5.   Srinivasan R and Rangwala S C "Harbours" Charotar Publishers, Anand, 1999

CE 444   **Quantitative Methods in Construction Management**   **[3 0 0 3]**

Introduction and concepts of probability and statistics, Optimization through Linear programming-Need for linear programming, Linear programming model, dual problem, dynamic programming.

Transportation model, solution of Transportation model, Assignment problems, solution of assignment problem. Queuing theory- waiting line models, deterministic model, probabilistic model, Decision theory- decision analysis, decision under uncertainity, Nature of Games, Games model, solution of Games model, simulations as applied to construction- simulation models, steps in simulation, Monte carlo simulation. Modifications and improvement on CPM/PERT techniques.

Books Recommended:

1. Verma M "Construction Planning and Management Through System Techniques" Metropolitan Book Company, New Delhi, 1985.
2. Chitkara K K "Construction Project Management – Planning, Scheduling and Controlling" Tata McGraw Hill, New Delhi, 2000.
3. O'Brien J "CPM in Construction Management" McGraw Hill, New York, 1999.
4. Harris R B "Precedence and Arrow Networking Techniques for Construction" John Wiley & sons, New York, 1999.
5. Levy S "Project Management in Construction" McGraw hill, New York, 2000.

CE 446   Structural Analysis-III   [3 0 0 3]

Review of Determinants and Matrices: Introduction, summation convention, determinants and their properties, Cramer's rule, matrices and their properties, solution of non-homogeneous equations by matrix methods, differentiation and integration of a matrix.

Flexibility method of Analysis: Introduction, method of consistent deformation, application to pin jointed frames, effect of temperature and pre-strain, displacements and forces in members of indeterminate structures, flexibility matrix of a plane member.

Stiffness Method of Analysis: Introduction, relation between slope deflection method and stiffness method, choice between flexibility and stiffness method, stiffness method for members with relative displacement of supports, analysis of indeterminate structures, analysis of pin-Jointed frames.

Computer Applications: Matrix structural analysis using spreadsheets, MS Excel Matrix Commands, MS Excel procedure for stiffness method of analysis, analysis of single span beams, continuous beams, plane trusses and plane frames.

Books Recommended:
1. Gere W and Weaver J M "Matrix Analysis of Structures" CBS Publishers, New Delhi, 1986.
2. Kanchi M B "Matrix Methods of Structural Analysis" Wiley Eastern Limited, New Delhi, 2002.
3. Ganju T N "Matrix Structural Analysis using Spreadsheets" TMH Publishing Co. Ltd. New Delhi,2002.
4. Vazirani V N and Ratwani M M "Advanced Theory of Structures and Matrix Methods" Khanna Publishers, New Delhi, 1995.
5. Pandit G S and Gupta S P "Structural Analysis A Matrix Approach" Tata McGraw Hill, New Delhi, 1994.

CE 448   **Advanced Construction Practices**   **[3 0 0 3]**

Concrete Construction Methods, Formwork Design and Scaffolding; Slip Forms and other moving forms; Pumping of Concrete; Grouting and Mass Concreting Operations(roller compacted concrete); Ready-Mix Concrete; Various Methods of Handling and Placing Concrete, Accelerated curing, Hot and cold weather concreting, Under water concreting, Prestressing. Steel and Composite Construction Methods, Fabrication and erection of structures including heavy structures, Prefab construction, Industrialised construction and Modular coordination. Special Construction Methods, Construction in Marine Environments, High Rise Construction, Bridge Construction including Segmental Construction, Incremental Construction and Push Launching Techniques; Geosynthetics; Safety, Quality Measures and Reliability

Books Recommended:

1. Neville A M and Brooks J J "Concrete Technology",Pearson Education Asia, Singapore, 1994.
2. Neville A M "Properties of Concrete", Pearson Education, New Delhi, 2004.
3. Peurifoy R L "Construction Planning, Equipment and Methods" McGraw Hill Ltd., New York, 2002.