

**DEPARTMENT OF CIVIL ENGINEERING
INSTITUTE OF TECHNOLOGY
BANARAS HINDU UNIVERSITY**

**IDD (B.Tech- M.Tech.)
Civil Engineering
(Structural Engineering)**

SYLLABUS

IDD	Part-I	(Effective from	2005-06)
,,	Part-II	(,, ,,
,,	Part-III	(,, ,,
,,	Part-IV	(,, ,,
,,	Part-V	(,, ,,

**IDD (B.Tech. – M.Tech.) Civil Engineering
(Structural Engg.)
Part-II**

Semester – III

Subject		Contact Hours/Week (L & T) P	Credits
<u>THEORY</u>			
1. CE 2101	Mechanics of Solids	4	4
2. CE 2102	Engineering Geology	3	3
3. CE 2103	Building Materials and Construction	4	4
4. AM 2103 A	Mathematical Methods	3	3
5. EE 2103 A	Electrical Engineering	3	3
Total of Theory		17	17
<u>PRACTICAL</u>			
6. CE 2301	Civil Engineering Lab. I	3	2
7. CE 2302	Engineering Geology Lab.	3	2
8. CE 2303	Building Planning, Drawing and Estimation	6	4
Total of Practicals		12	8
Total for the Semester III		29	25

Semester – IV

Subject		Contact Hours/Week (L & T) P	Credits
<u>THEORY</u>			
1. CE 2201	Structural Mechanics I	3	3
2. CE 2202	Fluid Mechanics I	4	4
3. CE 2203	Surveying I	4	4
4. CE 2204	Disaster Mitigation and Earthquake Engg.	3	3
5. AM 2203 A	Numerical Methods	3	3
6. EcE 2203 A	Electronics and Instrumentation	3	3
Total of Theory		20	20
<u>PRACTICAL</u>			
7. CE 2401	Surveying Practice I	4	3*
8. EE 2403 A	Electrical Engineering Lab	3	2
Total of Practicals		7	5
Total for the Semester IV		27	25
Total for Part – II			50

* Includes local/outside Surveying Camp.

**IDD (B.Tech. – M.Tech.) Civil Engineering
(Structural Engg.)
Part-III**

Semester – V

Subject		Contact Hours/Week (L & T) P	Credits
<u>THEORY</u>			
1. CE 3101	Structural Mechanics II	4	4
2. CE 3102	Fluid Mechanics II	3	3
3. CE 3103	Environmental Engg. I	3	3
4. CE 3104	Surveying II	3	3
5. CE 3105	Structural Design I	4	4
Total of Theory		17	17
<u>PRACTICAL</u>			
6. CE 3301	Civil Engineering Lab. II	3	2
7. CE 3302	Surveying Practice II	3	2
8. CE 3303	Civil Engineering Design I	3	2
9. CE 3304	Computer Applications in Civil Engineering	3	2
Total of Practicals		12	8
Total for the Semester - V		29	25

Semester – VI

Subject		Contact Hours/Week (L & T) P	Credits
<u>THEORY</u>			
1. HU	Open Elective (Humanities)	3	3
2. CE 3201	Water Resource Engg. I	4	4
3. CE 3202	Structural Design II	4	4
4. CE 3203	Geotechnical Engg. I	3	3
5. CE 3204	Transportation Engg. I	3	3
6. CE 3205	Construction Economics and Management	3	3
Total of Theory		20	20
<u>PRACTICAL</u>			
7. CE 3401	Civil Engineering Lab. III	6	4
8. CE 3402	Civil Engineering Design II	3	2
Total of Practicals		9	6
Total for the Semester - VI		29	26
Total for Part – III			51

**IDD (B.Tech. – M.Tech.) Civil Engineering
(Structural Engg.)
Part-IV**

SEMESTER - VII

Subject	Contact Hours/Week		Credits
	(L & T)	P	
<u>THEORY</u>			
1. CE 4102 Geotechnical Engg. II	4		4
2. AM 5103 A Mathematics	3		3
3. CE 5121 Matrix Analysis of Structure	3		3
4. Elective I	3		3
5. Elective II	3		3
Total for Theory	16		16
<u>PRACTICAL</u>			
6. CE 4301 Civil Engg. Lab. IV		3	2
7. CE 4302 Project		6	4
8. CE 4303 Seminar& Group Discussion		3	2
9. CE 4304 Training & Educational Tour, Viva-Voce		-	2
Total for Practicals	12		10
Total for Semester VII	28		26

SEMESTER - VIII

Subject	Contact Hours/Week		Credits
	(L&T)	P	
<u>THEORY</u>			
1. CE 4201 Structural Design III	4		4
2. CE 4205 Pre-stressed Concrete Design	3		3
3. CE 5223 Finite Element Method	3		3
4. Elective III	3		3
5. Elective IV	3		3
Total for Theory	16		16
<u>PRACTICAL</u>			
6. CE 4401 Civil Engg. Design III		3	2
7. CE 5403 Project/Dissertation		6	4
8. CE 4403 Comprehensive Viva-Voce		-	2
Total for Practicals	9		8
Total for Semester VIII	25		24
Total for Part-IV			50

Note : 1. Dissertation topic will be allotted during VIII Semester

Summer Semester

Subject :	Dissertation
-----------	--------------

**IDD (B.Tech. – M.Tech.) Civil Engineering
(Structural Engg.)
Part-V**

SEMESTER - IX

Subject	Contact Hours/Week (L&T) P	Credits
<u>THEORY</u>		
1. CE 5122 Concrete Structures	3	3
2. CE 5126 Structural Dynamics	3	3
4. Elective V	3	3
5. Elective VI	3	3
Total for Theory	12	12
<u>PRACTICAL</u>		
6. CE 5303 Laboratory	3	2
7. CE 5305 Structural Dynamics Lab.	3	2
8. CE 5306 Seminar on Dissertation	--	5
9. CE 5307 Dissertation Interim Evaluation	--	5
Total for Practicals	6	14
Total for Semester IX	18	26

SEMESTER - X

Subject	Contact Hours/Week (L&T) P	Credits
1. CE 5407 Seminar	2	1
2. CE 5410 Dissertation, Pre-Submission Seminar	--	5
3. CE 5411 Dissertation Evaluation	--	10
Total for Semester X		16
Total for Part – V		42

(A) List of Subjects for Elective –I

(Opt any one of the following)

1. CE 4105 Rock Mechanics
2. CE 4106 Water Power Engineering
3. CE 4107 Analysis & Design of Pavements
4. CE 4109 Environmental Pollution and Control

(B) List of Subjects for Elective II, V & VI

(Opt any one for each elective II, V & VI)

1. CE 5123 Elasticity and Experimental Stress Analysis
2. CE 5124 Stability of Structures
3. CE 5125 Metal and Cable Structures
4. CE 5127 Advanced Concrete Technology
5. CE 5118 Soil-Structure Interaction
6. AM 5103 B Advanced Numerical Methods

(C) List of Subjects for Elective III & IV

(Opt any one for each elective III & IV)

1. CE 4210 Earthquake Resistant Design of Structures
2. CE 5221 Theory of Plates
3. CE 5222 Shell Structures
4. CE 5224 Plastic Design of Structures
5. CE 5225 Optimization Methods
6. CE 5211 Advanced Foundation Engineering
7. CE 5215 Structural Design of Foundation and Retaining Structures
8. CE 5226 Advanced Aseismic Design of Structures

COURSE OF STUDY
IDD (B.Tech. - M.Tech.) IN CIVIL ENGINEERING
(STRUCTURAL ENGINEERING)

PART-II

SEMESTER – III

CE-2101 : Mechanics of Solids

Stresses and strains, stress-strain diagrams, relation between elastic constants, composite bars in tension and compression, temperature stresses, factor of safety, principal stresses and strains, Mohr's circle. Bending moment and shear force diagrams for beams. Simple theory of bending, bending and shear stresses in beams. Torsion of circular shafts. Slope and deflection of beams by integration, area, moment and conjugate beam methods. Thin and thick cylinders. Theories of elastic failures. Close coiled, open coiled and leaf springs.

Suggested Books:

1. G.H. Ryder, 'Strength of Materials', Macmillan.
2. L.S. Srinath, P. Desayi, N.S. Murthy & Ramu, 'Strength of Materials', Macmillan.

CE-2102 : Engineering Geology

Introduction, Importance of Geology in Civil Engineering. Study of folds and faults with special reference to their classification, genesis and their significance in Civil Engineering projects. Importance of geology in site selection for engineering projects like dams, reservoirs, tunnels and roads. Rock forming and common economic minerals, their chemical composition, physical properties, occurrence and uses. Study of Rocks : Igneous, sedimentary and metamorphic rocks with reference to their origin, texture, structure and classification. Description of common and important rock types and their engineering properties. Suitability of rocks as building and construction materials. Dependence of the bearing strength of rock on texture. Rock weathering and formation of soils, soil groups of India. Streams and its various types. Drainage system and various types of drainage patterns. Under ground water: vertical distribution of ground water, types of aquifers. Earthquakes and significance of aseismic studies in civil engineering projects. Elementary idea about Plate Tectonics. Brief description of physiographic and stratigraphic subdivision of India.

Suggested Books:

1. Parbin Singh, 'Engineering & General Geology'
2. Krynine & Judd, 'Principles of Engineering Geology and Geotechnics'
3. Billings, 'Structural Geology'
4. G.W. Tyrrell, 'The Principles of Petrology'
5. P.K. Mukherjee, 'A Textbook of Geology'

CE-2103 : Building Materials and Construction

Building Materials : Physical and chemical characteristic of commonly used building materials in Civil Engineering construction – Clay, Sand, Stone, Lime, Cement, Concrete, Bricks, Silica, Aluminum and Timber with reference to its specifications. Plywood, asbestos, plastics and polymer based materials. Protective materials : Paints and varnishes. Building construction : Bricks and stone masonry. Setting and laying out a building, safe bearing capacity of soils, types of building foundation. Construction details of foundation, floors, roofs and stairs. Damp proof course, plastering and pointing. Doors and windows of different types.

Suggested Books:

1. Surendra Singh, 'Engineering Materials', Konark Publishers Pvt. Ltd.
2. D.S.Arora, 'Text Book of Engineering Materials', Kalyani Publishers.
3. B.C. Punmia, 'Building Construction' Laxmi Publications Pvt. Ltd.
4. Sushil Kumar, 'Building Construction', Standard Publishers, Delhi.

AM – 2103 A : Mathematical Methods

Differential equations : Solution in series, Bessel functions of first, second and third kind. Legendre and Hermite polynomials and their elementary properties. Orthogonality of $J_n(x)$ and $P_n(x)$. Integral transforms and their applications: Laplace and Fourier transforms, Convolution. Application to ordinary and partial differential equations. Initial and boundary value problems by operational methods. Complex variable: Conformal mapping, Bromwich Contour Integral. Partial differential equations : One dimensional wave and diffusion equations. Laplace equation in cartesian and polar Co-ordinates. Probability and statistics : Probability distributions and their applications, Binomial, Poisson, Normal, Gamma, Weibull and Extreme values. Joint probability distributions of two variables, Simple linear regression and correlation analysis.

Suggested Books:

1. E. Kreyszig, 'Advanced Engineering Mathematics', John Wiley & Sons, Asia
2. J.N.Kapur and H.C. Saxena, 'Mathematical Statistics', S.Chand and Co.Ltd.
3. Irwin Miller and John E. Freund, 'Probability and Statistics for Engineers', Prentice Hall of India Pvt. Ltd.

EE – 2103 A : Electrical Engineering

Electrical Circuits: Network elements: Voltage and current sources, Kirchoff's voltage and current law, loop and nodal analysis, Superposition theorem, Thevenine's theorem, Norton's theorem, Maximum power transfer theorem. Sinusoidal steady state analysis: R, L and C elements, Power and power factor, Phasor diagram, Resonance, Mutual inductance and coefficient of coupling. Three phase circuits: Line

and phase relationship, Power measurement. Electrical Machines: transformer; Principle of working, EMF equation, Equivalent circuit, voltage regulation and efficiency, O.C and S.C. test, Autotransformer. D.C. Machines; Constructional features, D.C. Generators- No-Load Magnetization and External Characteristics, D.C. Motor – Starting, speed torque characteristics, speed control, application. Induction machines; Principle of operation, Constructional details, Torque-Slip characteristics, starting and speed control. Synchronous Machines; Constructional features, Alternators – Voltage regulation and its determination by Synchronous Impedance method, Synchronous motor – Starting, V and Inverted V-curves, Applications. Distribution of Electrical power; Tariff calculation, House and factory wiring. Introduction to electrical measurements: Indicating instruments, voltmeter, ammeter, wattmeters and energymeters.

Suggested Books:

1. Nagrath and Kothari, 'Electric Machines'
2. Vincent Del Toro, 'Fundamentals of Electrical Engineering'
3. H. Cotton, 'Advanced Electrical Engineering'

SEMESTER – IV

CE – 2201 : Structural Mechanics I

Basic concepts, Analysis of statically determinate structures: trusses, frames, three hinged arches, cables and suspension bridges. Moving loads on beams and trusses – influence line. Strain energy due to axial, bending, shear and torsional loads, Castigliano's theorem. Deflection of beams and frames, Williot-Mohr diagram. Maxwell-Betti theorem. Buckling of columns, critical loads, axially and eccentrically loaded columns, initially curved columns, various theories. Analysis of beam columns. Shear center and unsymmetrical bending.

Suggested Books:

1. C.S.Reddy, 'Basic Structural Analysis', Tata McGraw Hill, New Delhi.
2. C.K. Wang, 'Intermediate Structural Analysis', Tata McGraw Hill, New Delhi.

CE-2202 : Fluid Mechanics I

Definitions, properties of fluids, units and dimensions. Fluids pressure on plane and curved surfaces. Pressure measurement, manometers, stability of floating bodies. Metacentre. Elementary concepts of kinematics of fluid flow, steady and unsteady flow, uniform and non-uniform flow, rotational and irrotational flow, free and forced vortices, flownets. Basic equation of flow, one dimensional analysis, equations of continuity, energy and momentum equation, Bernoulli's theorem, applications of energy and momentum equations. Impact of jet on fixed and moving plates and vanes, resistance to flow, elementary concept of viscous shear. Laminar and turbulent flow through pipes and velocity distributions. Elements of Boundary

layer theory, drag and lift, elements of aero-foil theory. Dimensional analysis; parameters of flow and their significance, Hydraulic similitude and scale models. Hagen-Poiseuille's equation for laminar flow, Darcy -Weisbach equation for flow through pipes, losses due to change in pipe-sections. Branching pipes, pipe networks. Flow measurements by pitot tube, venturimeter, orificemeter. Flow through orifices, mouthpieces, notches and weirs.

Suggested Books:

1. Hunter Rouse, 'Elementary Mechanics of Fluids', John Wiley & Sons.
2. V.L. Streeter and E.B. Wylie, 'Fluid Mechanics', McGraw Hill Book Co.
3. P.N. Modi & S.M. Seth, 'Hydraulics & Mechanics', Standard Book House, New Delhi.

CE-2203 : Surveying - I

Introduction : Elements of surveying and mapping, types of surveys and maps. Measurement of Distance, Direction and Elevation. Chain Surveying, Compass Surveying. Levelling and Contouring. Plane Table Surveying. Theodolite Surveying. Tacheometry. Triangulation, grades, baseline, eccentric station, reduction to centre, indivisibility. Theory of error, adjustment of triangulation nets and level nets.

Suggested Books:

1. B.C. Punmia, 'Surveying Vol. I and II', Laxmi Publication Pvt. Ltd., New Delhi.
2. T.P. Kannetkar and S.V. Kulkarni, 'Surveying and Levelling Vol. I and II', Pune Vidyarthi Griha Prakashan.

CE-2204 : Disaster Mitigation and Earthquake Engg.

Natural Disasters : Earthquake, Floods, Drought, Coastal Hazards, Landslides, rockslides and Forest Fires. Elements of Engineering Seismology : Earthquake phenomenon, Earthquake recording instruments. Introduction to Theory of Vibrations : Single degree un-damped and damped systems, elastic response to simple load functions and earthquake response spectras. Performance of Buildings and Structures : Main causes of damage : Intensity of earthquake forces, lack of strength and integrity in buildings, quasi- resonance, lack of ductility, lack of detailing. Earthquake Effects : On ground and soil liquefaction, buildings, structures, power plants, switch yards, equipments and other lifeline structures, release of poisonous gases and radiation. Lessons Learnt from the Past Earthquakes : Case studies of important Indian earthquakes and major world earthquakes. Disaster Management : Salient features of disaster rescue, risk management and casualty management.

Suggested Books:

1. Dr. Indu Prakash., 'Disaster Management', Rashtra Prahari Prakashan, Sahibabad, Gaziabad.
2. P.K. Mukherjee, 'A Text Book of Geology'

3. Jaikrishna, Chandrasekharan and B. Chandra, 'Elements of Earthquake Engg', South Asian Publishers, New Delhi.
4. James L. Stratta, 'Manual of Seismic Design' , Pearson Education, Singapore.
5. V.K. Manickaselvam, 'Introduction to Earthquake Analysis and Design', Dhanpat Rai Publications.

AM-2203 A : Numerical Methods

Absolute, relative, round-off, truncation errors, significant digits. Estimation of errors. Tabulation of a function. Interpolation : Ordinary differences, operators E and D, subtabulation, divided differences; Lagrange's formula; central differences, formula of Gauss, Bessel, Everett; Method of ordinary least squares; cubics splines. Inverse interpolation solution of algebraic and transcendental equations : graphical method, Iterative methods, Newton-Raphson Method; Multiple roots. Solution of systems of liner equations : Methods of elimination, method of relaxation, iterative methods, ill-conditioned systems, computing the inverse matrix, Eigenvalues and eigenvectors, matrix decomposition. Numerical differentiation. A Numerical integration: finite-difference methods; Gaussian quadrature, Euler-Maclaurin series, asymptotic expansions. Newton-Cotes formulae, Numerical solution of ordinary differential equations : Series solution, methods of Milne, Adams-Bashforth, Milne-Simpson multistep and Runge-Kutta methods. Difference equations; numerical solution, relaxation method. Solution of partial differential equations by difference methods. Numerical solutions of elliptic, parabolic and hyperbolic partial differential equations.

Suggested Books:

1. S. S. Sastry, 'Numerical Analysis', Prentice-Hall of India Pvt. Ltd.
2. M.K. Jain, et.al., 'Numerical Methods for Scientific and Engineering Computation', New Age International Publishers.

EcE-2203 A : Electronics and Instrumentation

Semi-conductors Diode; characteristics; Load line, Half wave and full wave rectifiers, Filters and Power supply; Regulators (723). Amplifying devices (BJT, FET), their characteristics with LF equivalent circuits. Single stage and multistage R.C. coupled Amplifiers (including types of coupling); Calculation of Voltage gain; Impedance; Frequency response; Feedback; High input impedance circuits. Oscillators. Operational amplifiers and its application; Filters; V.C.O. and P.L.L. Timer and applications to systems. Logic Gates and basic logic circuits (SSI, MSI and basic systems ICs). Transducers. Cathode ray oscilloscope and multimeters (Analogue and digital); Interail's A/D for instrumentation.

Suggested Books:

1. Malvino, A.P., 'Electronic Principles', Tata McGraw Hill Publishing Co., New Delhi

2. Allen, Mothershead, 'Electronic Devices & Circuits', Prentice Hall of India Pvt. Ltd., New Delhi.
3. Milliman and Helkias, 'Integrated Electronics', McGraw Hill Publishing Co., New Delhi.

IDD (B.Tech. - M.Tech.) IN CIVIL ENGINEERING (STRUCTURAL ENGINEERING)

PART-III

SEMESTER – V

CE-3101 : Structural Mechanics II

Basic concepts, statistical and kinematics indeterminacy. Force and displacement approaches in analysis of indeterminate beams. Trusses, frames and arches. Temperature support displacement and pro-strain effects in indeterminate trusses, frames and arches. Theorem of three moments. Energy methods, Slope deflection, moment distribution and Kani's methods. Clousek's method and method of column analogy. Analysis of frames using approximate methods, influence lines, Muller-Breslau principle.

Suggested Books:

1. C.S. Reddy, 'Basic Structural Analysis', Tata McGraw Hill, New Delhi.
2. C.K. Wang, 'Intermediate Structural Analysis', Tata McGraw Hill, New Delhi.

CE-3102 : Fluid Mechanics II

Steady state open channel flow, uniform flow, critical flow, analysis of rapidly varied flow, hydraulic jump, channel transitions : Gradually varied flow; method of integration of varied flow equation. Elements of particle dynamics. Hydraulic turbines: types, selection, impulse and reaction turbines, governing of turbines, turbine characteristics. Pumps : Centrifugal pumps , Characteristics, Introduction of Modern Pumping machinery, Reciprocating Pumps, Cavitation in turbine and pumps. Unsteady flow through pipe, water hammer.

Suggested Books:

1. R.J. Garde and A.G. Mirajgaokar, 'Engineering Fluid Mechanics (including Hydraulic Machines)', Nemchand Brothers, Roorkee.
2. V.T. Chow, 'Open Channel Hydraulics', MacGrawhill.
3. K. Subramaniam, 'Flow in Open Channels', Tata MacGraw Hill Publication.

CE-3103 : Environmental Engineering I

Ecology, Environment and Human Health - their linkages; Environmental pollution : its origin. Sources of water : surface, ground and others. Ground water engineering : Basic aquifer parameters and hydraulics, well system, ground water pollution and

control. Water quality parameters : Their role and standards. Water demand for various purposes; Estimation of population growth. Basic hydraulics (including pumping) related to water supply & wastewater collection, pipe network design. Sewerage system : Types of collection & disposal system, design approach to sanitary & storm sewers, sewer appurtenances, street inlets, inverted siphon. House plumbing for water supply & wastewater drainage.

Suggested Books:

1. Peavy and Rowe, 'Environmental Engg.'
2. B.C. Punmia, 'Water Supply & Wastewater Engg.'
3. G.S. Birdie, 'Water Supply & Sanitary Engg.'
4. P.D. Sharma, 'Ecology and Environment'

CE 3104 : Surveying II

Field Astronomy. Layout of curves : simple, compound, transitional and vertical curves, Layout of buildings, bridges, tunnels etc. Photogrammetry and photointerpretation, introduction, concept of scale, relief, tilt, rectification, orthophotomap, interpretation elements and keys. Map Numbering. Total Station. Global Positioning System. Introduction to Remote Sensing and Geographical Information System.

Suggested Books:

1. B.C.Punmia , 'Surveying Vol. I, II and III' , Laxmi Publication Pvt. Ltd.,
New Delhi
2. T.P. Kannetkar and S.V. Kulkarni, 'Surveying and Levelling Vol. I and II' Pune
Vidyarthi Griha Prakashan.

CE 3105 : Structural Design I

Materials for reinforced concrete. Concrete mix design. Limit state & working stress concepts for under reinforced balanced and over reinforced sections, rectangular, T-beam and design of singly and doubly reinforced & L beams. One way and two way slabs. Columns, isolated and combined footings, retaining walls, stair cases. Short term and long deflections, estimation of probable maximum crack width.

Suggested Books:

1. Jain A.K., 'Reinforced Concrete Design - Limit State Method', Nemchand Brothers, Roorkee.
2. S.N. Sinha, 'RC Design', Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
3. U. Krishna and Devdas, 'R.C. Design'.

SEMESTER – VI

CE-3201 : Water Resources Engineering I

Hydrologic-cycle, Meteorological aspects of hydrology. Rain-fall, types, measurement, average depth over a basin, depth duration curves. Water losses; Interception, evaporation, transpiration. Runoff, factors affecting. runoff. Stream flow measurement and hydrograph representation, estimation of runoff from rain fall by empirical formulae, rational & infiltration method, unit hydrograph method and S-curve method. Urban runoff: Hydrological models. Construction and use of mass and flow duration curves, Floods, Hydrologic Routing, reservoir routing, channel routing-analytical and graphical methods. Elements of Sediment transportation. River engineering - Stages of river, meanders, river training. Land erosion and control. Ground water: Aquifers, ground water availability and yield. Groundwater withdrawals, infiltration wells and galleries, artesian, open and tubewells. Remote sensing applications in hydrology.

Suggested Books:

1. R.K. Linsley & J.L.H. Paulhus, 'Water Resource Engineering', McGraw Hill Book Co.
2. K. Subramaniya, 'Engineering Hydrology', Tata MacGraw Hill, New Delhi.
3. H.M. Raghunath, 'Ground Water', Wiley Eastern Ltd.
4. Todd, 'Groundwater Hydrology', John Wiley & Sons, New York.

CE-3202 : Structural Design II

Structural Steel & their properties. Rivetted, bolted and welded connections. Tension, compression and flexural members. Roof trusses, plate girders, gantry girders & industrial buildings. Column bases & Grillage foundations. Timber and masonry structures.

Suggested Books:

1. A.S. Arya and J.L. Ajmani, 'Design of Steel Structure', Nemchand & Brothers, Roorkee.
2. S.K. Duggal, 'Design of Steel Structure', Tata McGraw-Hill Publishing Co. Ltd.

CE-3203 : Geotechnical Engineering - I

Introduction to geotechnical problems in civil engineering; Soil types and formation; Simple soil properties, Grain size distribution, Atterberg limits; Soil identification and classification; Total, effective and neutral stresses; Darcy's law; Permeability and capillarity of soil, Seepage, Flow nets, Piping, Design of filters; Stress distribution in soils; Laboratory compaction and field compaction; One-dimensional consolidation and simple settlement analysis; Shear strength; Determination of total

and effective strength parameters; Earth pressure : classical theories, graphical methods; stability of slopes.

Suggested Books:

1. Craig, R.F. (1983). 'Soil Mechanics', ELBS and Van Nostrand Reinhold Co. Ltd., Berkshire.
2. Lambe, T.W. and Whitman, R.V. (1979). 'Soil Mechanics', John Wiley and Sons, New York, USA.
3. Ranjan, G. and Rao, A.S.R. (2000), 'Basic and Applied Soil Mechanics', New Age International Publishers, New Delhi.
4. Singh, Alam (1992), 'Modern Geotechnical Engineering', CBS Publishers, New Delhi.
5. Venkatramaiah, C. (1995., 'Geotechnical Engineering', New Age International Publishers, New Delhi.

CE-3204 : Transportation Engineering - I

Introduction, Importance of various modes of transportation. Highway Engineering. Developments in Road Construction, Highway Planning, Alignment and Surveys, Geometric Design, Materials and Elements of Pavement Design, Construction of Pavements, Construction and Maintenance of Drainage, Aboriculture. Traffic Engineering : Traffic Characteristics, Speed, Journey Time and Delays, Vehicle Volume Counts, Origin and Destination, Analysis and Interpretation of Survey Data, Traffic Operations, Design and Signals and Rotary intersections, Parking Space Design, Lighting, Planning and Administration, Road Accidents and Safety Measures.

Suggested Books:

1. Khanna and Justo, 'Highway Engineering', Nemchand & Bros., Roorkee.
2. Garber, N.J., Hoel, L.A., 'Traffic and Highway Engineering', West Publishing Company, New York.
3. Jones, J.H., 'The Geometric Design of Modern Highways', E & FN SPON Ltd., London.
4. Khistry, C.J., 'Transportation Engineering – An Introduction', Prentice Hall of India Ltd., New Delhi.

CE-3205 : Construction Economics and Management

Engineering Economics :Cash flow diagram, Tune value of money, Inflation, Interest, Depreciation, Present worth and capitalized cost, Equivalent uniform annual cost and rate of return evaluations, Benefit cost analysis, Analysis of variable costs, Types of capital financing, Valuation. Tendering and Contract : Organisational structure, Methods of tendering, Specifications, Conditions of contract, Contract law, Disputes and Arbitrations. Construction Planning and Management : Time, Cost and research management of projects for planning, Scheduling, Control and forecasting using networks with CPM/PERT. Personnel, Material and Finance Management, Safety Engineering. Construction Equipments :Selection, Planning and Cost

Equipments, Earthmoving, Excavating, Hauling, Compacting, Drilling and Blasting, Grouting, Conveying and Dewatering Equipments. Aggregate Cement Concrete and Asphatt Concrete Plants.

Suggested Books:

1. Jebson, J., 'Cost and Optimisation Engineering', McGraw Hill, New York.
2. Moder, J.J. & Phillips, C.R., 'Project Management with CPM and PERT'.
3. Sengupta, B. and Guha, H., 'Construction Management and Planning', Tata McGraw Hill, New Delhi.
4. Srinath, L.S. PERT and CPM, 'Principles and Applications', East West Press, New Delhi.
5. Pilcher, R., 'Appraisal and Control of Project Cost'.

OPEN ELECTIVES (Humanities)

HU-3201 : History of Science and Technology

An overview of prehistoric legacies and implements. Early science, its origin. Magic and science. Views and concept of physical world in ancient civilizations of Egypt, Mesopotamia, Babylonia, Sumaria, China, Greece and India. Theory of element and atom in ancient Indian and Greek literatures and their comparison. Achievement of India in mathematics, astronomy, metallurgy, chemical and pharmaceutical technologies, life sciences, agriculture, medicine and surgery, architecture and transport. Interaction with other contemporary civilizations. Development of science and technology in early and later middle ages – A global overview. Impact of technological achievements in development of science. Renaissance and scientific revolution. Survey of major scientific and technological developments from fifteenth century onwards and rise of modern science.

Suggested Books:

1. Ronan, Colin A., (i) 'Science : Its History and Its Development Among the World's Culture'. (ii) The Cambridge Illustrated History of World's Science', Cambridge University Press, Newnes Books, 1983.
2. D.M. Bose, S.N.Sen & B.V. Subrayappa, 'A Concise History of Science in India' Indian National Science Academy, New Delhi.
3. Ray Spangenburg and Daine K. Moser, (i) The History of Science From the Ancient Greeks to the Scientific Revolution, (ii) The History of Science in the Eighteenth Century, (iii) The History of Science in the Nineteenth Century (iv) The History of Science from 1895 to 1945 & (v) The History of Science from 1946 to 1990s. University Press (India) Limited, 1999.
4. J.G.Landels, University Press (India) Limited, 1999.
5. R.J.Forbes, 'History of Technology', O.U.P., 1956.

HU-3202 : Industrial and Organisational Psychology

Nature and Scope of Psychology. Methods of Psychology. Development of Human Behaviour : Heredity and Environment. Human Abilities: Aptitude and Creativity. Nature and Structure of Organization. Organizational Climate. Psychology in Organization, needs, work, motivation, job satisfaction and moral job anxiety and organizational stores. Supervision and intra and inter-group relations. Job performances, man-machine systems and accidents. Personnel Selection and Psychological Tests.

Suggested Books:

1. Milton L. Blum & James C. Naylor, 'Industrial Psychology: Its Theoretical and Social Foundations'.
2. Edgar H. Satchin, 'Organizational Psychology'.
3. Robins, 'Organizational Behaviour'.
4. Arun Kumar Singh, 'Advanced General Psychology'.

HU-3203 : Intellectual Property Rights

Intellectual Property, Its Origin and Development – An Overview. Concepts and Theories of Intellectual Property Rights. Need for Protecting Intellectual Property; Policy Consideration – National Perspective and International Demand. Protection of Intellectual Property Through Copyrights, Trade Marks and Patents. Copyright and Its Assignment. Trade Mark and Its Assignment. Meaning of Patent, Invention and Concept of Novelty. Inventive Steps and Its Utility. Process, Product and Design Patent. Inventions not Patentable. Acquisition of Patent. Patent Agents and Forms of Application. Rights of Patentees. Indian Patent Law and Patenting Organization. International Patent Law and Patenting Organization. World Intellectual Property Organisation (WIPO). Sources of Patent Information.

Suggested Books:

1. W.R. Cornish, 'Intellectual Property', Universal Law Publishing Co. Ltd., Delhi, 2001.
2. P.S. Narayan, 'Intellectual Property Law in India', Gogia Law Agency, 1999.
3. B.L.Wadehra, 'Law Relating to Patents Trade Marks, Copy Right Design & Geographical Indicators', Universal Law Publishing Co. Ltd., 2002.
4. Avinash Shivade, 'Intellectual Property Manual' , Lexis, Nexis, 2004.

HU-3204 : Energy Management

Perspective on energy resources, Utilisation and projections, World and Indian scene. Pattern of energy consumption. Energy thresholds for subsistence and development. Energy Audit, Energy Analysis, Computer Simulation, Availability Studies. Energy Efficiency Analysis, Energy Inputs, Equipment Processes, Head Recovery – Waste Reduction, Electric Load. Lightning and Power, Energy Confinement. Energy Storage, Integrated Energy System. Energy Economics Life Cycle. Costing Break-even Analysis. Benefit-cost analysis. Pay back period. Annual costs. Assessment and Planning. Case Studies.

Suggested Book:

1. C.B.Smith, "Energy Management Principles", Pergamon Press, 1981.

HU-3205 : Industrial Sociology

Sociology of modern organization. The modern business corporation. Its ownership, control, strategy and structure and some international comparisons. Informal Organization and Its Role in Formal Organization. Organisation of work : Coordination and control at the work place, the effect of technological and socio-economic factors on organizational structure and performance. Work position as social patterns – Gap between Management Theory and Management Practice, Managers : Top, Middle and First Line. The rise of the labour movement, occupational control, industrial relations, institutions and issues with particular reference to India. The individual at work, motivation, satisfaction and performance, groups at work, leadership. Bureaucracies: Structure and Legitimation, Organization and Control and Leadership. The role of techno-structure in modern organizations.

Suggested Books:

1. Amitai Etzioni, 'Modern Organizations', Prentice-Hall of India Pvt. Ltd.
2. Hand Book of Industrial Sociology.

HU-3206 : Human Values

Contemporary Indian Society, Impact of Exposure, Code of conduct : within family in institutions. Modern social institutions and human values: Democracy, secularism, justice. Different aspects of human values: Social, aesthetic, cultural, spiritual. Indian values (on the conceptual framework of Vedas): Purusharth, niskama karma, Sthitaprajna, religion and human values; towards a world religion. Human values in different perceptions: Aspirations, joy and love, achievement, freedom, creativity, wisdom, human rights, dignity. Ethical and moral values: Educational ethics, culture and ethics, society at the roof of ethics and morality. Management by values: Interpersonal relationship in work place, leadership quality development, participatory management, decision making.

Suggested Books:

1. A.N.Tripathi, 'Human Values', New Age International Publishers, New Delhi, 2nd Edition, 2004.
2. Swami Ranganathananda, 'Universal Message of the Bhagavad Gita : An exposition of the Gita in the light of modern thought and modern needs', Vol. I – III, Advaita Ashrama (Publication Department), Kolkata.
3. Peter Singer, 'Practical Ethics', Oxford University Press, 1993.

HU-3207 Entrepreneurship Development

Introduction: Role, importance and opportunities of entrepreneurship, characteristics of an entrepreneur, Identifying and evaluating business opportunities.

Behavioural Aspects: Motivational inputs, communication skills, decision making, strategy formulation – planning and execution. Management: Financial, production, marketing, personal, problem solving. Project : small scale industries, concept and importance, steps to start a small industry, project report, feasibility and financial appraisal, market survey and research, incentives and subsidies, export-import, Govt. guidance and policies. Case studies of successful entrepreneurs.

Suggested Books:

1. Welsh, J.A. & Jerry, F.W., 'Entrepreneur's Master Planning Guide, How to launch a successful business', Prentice Hall, Englewood cliff.
2. Srivastava U.K., 'Project Planning, Financing, Implementation and Evaluation, IIM, Ahmedabad.
3. Rao, T.V. & Pareek U, 'Developing Entrepreneurships: A Handbook'. Learning Systems, New Delhi.
4. Gupta, C.B. & Srivastava, N.P. : Entrepreneurial Development, Sultan Chand & Sons, New Delhi.
5. Colombo Plan Staff College for Technician Education, Manilla. Entrepreneurship Development, Tata McGraw Hill, New Delhi, 1919.
6. Suri, K.B., 'Small Scale Entrepreneurs: Indian experience, Sage Publication, New Delhi, 1988.

IDD (B.Tech. - M.Tech.) IN CIVIL ENGINEERING (STRUCTURAL ENGINEERING)

PART-IV

SEMESTER – VII

CE-4102 : Geotechnical Engineering II

Foundation requirements and selection; Different methods for determining bearing capacity of shallow foundations; Settlement considerations, Allowable, total and differential settlements, Settlement of structures; Eccentrically loaded footings, Methods of proportioning; Raft foundations; Pile foundations, types of Piles; Allowable load of piles, Pile driving, Pile load test, Dynamic formulae, Group action; Well and caisson foundations, Design principles; Bearing capacity analysis and methods of construction; Excavation and bracings; Design of bulk-heads; Dewatering and excavations; Ground improvement techniques; Underpinning of foundations; Elements of machine foundation design; Soil exploration, Types of samples, Location and spacing of boring, Depth of exploration and sample requirements, Boring methods for sample collection.

Suggested Books:

1. Bowles, J.E. (1997). 'Foundation Analysis and Design', The McGraw Hill Co., New York.
2. Ranjan, G. and Rao, A.S.R. (2000), 'Basic and Applied Soil Mechanics', New Age International Publishers, New Delhi.
3. Singh, Alam (1992), 'Modern Geotechnical Engineering', CBS Publishers, New Delhi.
4. Tomlinson, M.J. (1986), 'Foundation Design and Construction', ELBS/Longman, Harlow.
5. Venkatramaiah, C. (1995.), 'Geotechnical Engineering', New Age International Publishers, New Delhi.

AM - 5103 A : Mathematics

Complex Variables : Analytic functions, Cauchy-Reimann equations, Conformal mapping. Cauchy's Integral theorem, Cauchy's formula, Singularities, Taylor's theorem. Laurent's Series. Residues. Matrices : Eigen-values and Eigen-vectors, Cayley Hamilton theorem, Diagonalization of matrices. Jordan Canonical Form of Matrices, Inner product, Unitary and Orthogonal matrices. Calculus of variations : Functionals and their Applications, Euler's equation, Applications to Engineering. Applied Statistics: Analysis of variance, Design of experiments, Linear regression and Multiple regression, Reliability.

CE - 5121 : Matrix Analysis of Structures

Force and displacement methods of analysis, Flexibility and stiffness matrix methods of analysis for beams, trusses, grids and frames. Transfer matrix method. General purpose computer program for analysis of different types of structures by direct stiffness matrix methods. Application of Standard software packages. Introduction to Finite-Element Method.

SEMESTER – VIII**CE-4201 : Structural Design III**

Reinforced Concrete : Flat slabs and domes. Water tanks, circular, rectangular and Intz type, Supporting towers. Introduction to prestressed concrete, Design of Culvert and T-beam bridges. Steel : Plastic analysis and design of beams and frames. Static and Kinematic method of analysis. Minimum weight design.

Suggested Books:

1. P. Dayaratnam, 'Design of Reinforced Concrete Structure', Oxford and IBH Publishing Company Pvt. Ltd.
2. N. Krishna Raju, 'Advanced Reinforced Concrete Design', CBS Publishers & Distributor, New Delhi.

CE-4205 : Prestressed Concrete Design

Materials, prestressing systems, losses in prestress. Analysis and design of simple and continuous beams by working stress and limit-state methods. Deflection and cracking consideration. Anchorage and bond. End block stresses.

CE - 5223 : Finite Element Method

Introduction and basic concepts. Energy approach and variational principles in Finite-Element Method. Various element shapes, Isoparametric elements, Axisymmetric elements, plate bending elements, introduction to 3-D elements, shell elements, interface elements, boundary elements, infinite elements. Direct and variational formulations of element stiffness and loads. Assemblage of elements, Boundary Conditions and Solution of overall problems. Techniques of nonlinear analysis. Mesh generation, graphic display and software packages. Organization of FEM programs, efficient solutions, input/output, pre and post processors.

Suggested Book:

- 1) N. Krishna Raju, 'Prestressed Concrete', Tata McGraw Hill Pvt. Ltd.

**IDD (B.Tech. - M.Tech.) IN CIVIL ENGINEERING
(STRUCTURAL ENGINEERING)**

PART-V

SEMESTER IX**CE - 5122 : Concrete Structures**

Shrinkage and creep effects. Silos, bunkers and chimneys. Multistoried buildings and shear walls. Seismic and wind effects on structures. Design of Box girder and Bow String girder bridges. Cable stayed bridges, Intze tanks and its supporting structures.

CE - 5126 : Structural Dynamics

Vibration of Discrete Systems: Free and forced vibrations of single and multi-degree freedom systems, Damping and Forcing functions, Determination of frequencies and mode shapes, Orthogonal relationship of principal modes, Duhamel's integral, Step-by-step response. Calculation and Response spectra. Vibration of Continuum Systems. Earthquake resistant design of structures and IS recommendations.

Elective -V**Elective VI**

SEMESTER – X

CE 5407 Seminar

CE 5410 Dissertation, Pre-Submission Seminar

CE 5411 – Dissertation Evaluation

(A) List of Subjects for Elective-I

(Opt any one of the following)

CE-4105 : Rock Mechanics

Introduction, Importance and application of rock mechanics to engineering problems; Classification, Lithological classification of rocks, Engineering classification of intact and fissured rocks, Classification of fissures, joints and faults; Engineering properties of rocks; Laboratory and site measurements; Definition of stress in rock, Simple methods of determining in-situ stresses, Borehole over covering technique, Bore hole deformation gauges, Evaluation of rock stresses and deformation around tunnels; Simple methods of tunnel design; Stability of rock slope, Modes of failure in rock mass, Analysis by simple field Bishop's method and use of Hoek's chart; Foundations on rocks, Limit equilibrium methods, Plastic equilibrium of foundations, Elastic solutions for loading and excavation of foundations, Consideration of uplift pressures; Methods of improving the properties of rock masses.

Suggested Books:

1. Goodman, R.E. (1989), 'Introduction to Rock Mechanics', John Wiley, Chichester.
2. Hudson, J.A. and Harrison, J.P. (2000), 'Engineering Rock Mechanics', Pergamon Press, Amsterdam.
3. Roberts, A. (1977)., 'Geotechnology', Pergamon Press, England.
4. Stagg, K.G. and Zienkiewicz (1968)., 'Rock Mechanics in Engineering Practice', John Wiley and Sons, London.

CE-4106 : Water Power Engineering

Water power utilization principles, power from flowing streams, demand for power, role of storage and pondage in water power development, firm power and secondary power. Types of water power developments : Run-off river, storage, pumped storage, tidal and others, characteristics and layout of low, medium and high head hydropower developments. Conveyance of water : Channels, Penstocks, flumes and tunnels. Surges in open channels and water hammer and surges in closed conduits following rapid load changes in the hydro-power plant. Forebays and surge tanks.

Water turbines : Selection of water turbines, scroll castings and draft tubes, Speed regulation and governing of turbines. Power house : Types of power house, substructure and superstructure. General arrangement and space requirements for standard power house facilities.

Suggested Books:

1. W.P. Creager and J.D. Justin, 'Hydro-electric Hand Book', John Wiley.
2. M.M. Dandekar and K.N. Sharma, 'Water Power Engineering', Vikas Publishing House, New Delhi.
3. P.N. Modi, 'Irrigation, Water Resources and Water Power Engg.', Standard Book House, New Delhi.

CE-4107 : Analysis and Design of Pavements

Analysis of Pavements : Pavement Types, Design Factors, Equivalent Single Wheel and Axle Loads, Stresses in Flexible and Rigid Pavements. Design of Pavements : Design of Flexible Pavements – Group Index Method, CBR Method, California Resistance Value Method, Triaxial Method, Burmisters Method, McLeod's Method, IRC Method, Analytical Methods, Design of Rigid Pavements – PCA Method, IRC Methods, Design of Dowel and Tie Bars. Overlay Design : Structural and Functional Distress in Pavements, Flexible and Rigid Pavement Overlay Design, IRC, TRRL, Asphatt Institute Method and Analytical Methods.

Suggested Books:

1. Yoder, E.J. and Witezak, M.W., 'Principles of Pavement Design', John Wiley & Sons.
2. Yang, H. Huang, 'Pavement Analysis and Design', Prentice-Hall, New Jersey.
3. Teng, 'Functional Designing of Pavements', McGraw Hill.
4. E.J. Yoder, 'Principles of Pavement Design', John Wiley & Sons, Inc., New York.
5. Chakraborty and Das, 'Principles of Highway Engineering', Prentice Hall of India, New Delhi.

CE-4109 : Environmental Pollution and Control

Different sources of pollution: Important cases for atmospheric, hydrospheric and land pollution and related control strategies. Water-borne, air-borne and vector-borne common diseases – Transmission modes and control measures. Excreta disposal in unsewered areas- various options and their selection. Noise pollution and engineering approaches for its abatement. Environmental Impact Assessment and Auditing: Few case studies.

Suggested Books:

1. Salvato, 'Environmental Sanitation'.
2. Canter, 'Environmental Impact Assessment' .

3. Peavy, H.S., Rowe D.R. and Techobanoglous, G. 'Environmental Engg'.
4. Sincero and Sincero. 'Environmental Engg. – A Design Approach.' Masters G.M. Environmental Science and Engg.

(B) List of Subjects for Elective – II, V and VI

(Opt any one for each elective II, V and VI)

CE – 5118 : Soil Structure Interaction

Contact pressure distribution; Foundation models; Model parameters and their evaluation; Analysis of beams and plates resting on foundation soils, Soil Structure interaction studies pertaining to buried structures; Analysis and design of deep foundation; Modern trends in design of earth retaining structures

CE – 5123 : Elasticity and Experimental Stress Analysis

Theory of Stress : Stress components, Equilibrium equations, Stress transformation, principal stresses, Boundary conditions. Theory of Strain : Strain components, Strain transformation, Principal Strain, Compatibility. Stress-strain relationship, Generalized Hookes law, Strain-energy, Uniqueness theorem, St. Venant's principle. Plane problems in cartesian and polar coordinates, Stress function, Axisymmetric problems, stress concentration. Stress and strain measurements, different types of strain gauges, rosettes, Wheat Stone bridge, circuit for simple and multiple strain gauges.

CE – 5124 : Stability of Structures

Buckling of beams, columns and frames. Lateral buckling of beams, Torsional buckling. Post-buckling analysis. Buckling of plates and shells. Ritz and Galerkin method for conservative and non-conservative systems.

CE - 5125 : Metal and Cable Structures

Design of light gauge, tubular and aluminium structures. Analysis and design of cables, cable trusses and cable roofs, Design of tower structures. Suspension bridges: Classical and deflection theories, design considerations. Cable-Stayed bridges : Analysis and design, Aero-dynamic consideration in cable structures.

CE - 5126 : Structural Dynamics

Vibration of Discrete Systems: Free and forced vibrations of single and multi-degree freedom systems, Damping and Forcing functions, Determination of frequencies and mode shapes, Orthogonal relationship of principal modes, Duhamel's integral, Step-by-step response. Calculation and Response spectra. Vibration of Continuum Systems. Earthquake resistant design of structures and IS recommendations.

CE - 5127 : Advanced Concrete Technology

Constituent materials and their properties, types of cement, fresh concrete, workability; strength, elasticity and fracture of hardened concrete : Time dependent properties of concrete, durability of concrete ; Concrete admixtures, mix design methods ; Manufacture and processes ; Codal provisions ; Special concretes.

AM - 5103 B : Advanced Numerical Methods

Linear Algebra: Matrices, Matrices decomposition: LU decomposition, Cholesky decomposition, spectral decomposition, Matrix Eigen-value problem, Gerchgorin's theorem, Eignenvalue by iteration, generalized inverse of a matrix, solution of linear system by decomposition method, Jacobi method. Nonlinear system of equations: Newton's method, Powel Hybrid method. Differential equations: Generalised characteristic value problems, phase plane and critical points, stability and phase plane methods in nonlinear equations. Boundary value problems, mixed boundary conditions, boundary conditions at infinity, nonlinear boundary value problems, linear eigen value problems. Partial differential equations: Parabolic, elliptic and hyperbolic partial differential equations subject to Diritechlet, Neumann (or flux) and mixed (or Robin or radiation) boundary conditions, Navier Stock's equation. Approximate Analytic methods: Variational methods, weighted residual methods – Galerkin's method, collocation method, Functional, quadraic functionals. Numerical Integration – Gauss Legendre, Quadrature, Error Analysis, Convergence of solution. Finite element and Boundary element method. Software like MATHEMATICA and MATLAB in addition to programming languages C and C++. Application towards plane stress and plane strain two dimensional problems.

(C) List of Subjects for Elective III & IV

(Opt any one for each elective III & IV)

CE-4210: Earthquake Resistant Design of Structures

Aseismic Design of Structures. Philosophy and principles of earthquake resistance design – Strength and stiffness, ductility design and detailing, design of energy absorbing devices, concepts of seismic base isolation and seismic active control. Building forms and architectural design concepts – Horizontal and vertical eccentricities due to mass and stiffness distribution, structural redundancy and setbacks. Equivalent static lateral earthquake force on building (IS : 1893). Equivalent static method : Seismic coefficients–evaluation, estimation of fundamental time period, base shear and its distribution, Vulnerability Atlas. Use of codes with reference to Masonry Buildings like IS : 4326, IS : 13828, IS : 13827. Use of codes of RC and steel structures like IS : 13920. Detailing of reinforcement and

joints. Restoration and Retrofitting – Evaluation (Seismic qualification) of existing buildings – Aging, weathering, development of cracks, improper load path, asymmetry. Materials and equipments for restoration and retrofitting. Methodologies for retrofitting – For walls, roofs, slabs, columns and foundation of building in stones, brick or reinforced concrete structures.

Suggested Books:

1. James L. Stratta, 'Manual of Seismic Design', Pearson Education.
2. Anil K. Chopra, 'Dynamics of Structures', Pearson Education.

CE 5211: Advanced Foundation Engineering

Bearing capacity: Shallow and deep foundations; Settlement analysis: Shallow and deep foundations; Different types of foundations and their designs: Raft, Piles, and Well foundation; Sheet pile walls: Cantilevered and anchored; Excavation and bracings; Design of retaining walls. Foundations subjected to dynamic loads; Design of machine foundations

CE - 5215: Structural Design of Foundation and Retaining Structures

Shallow foundations: All types of footings and raft subjected to axial, eccentric and lateral loads; Pile foundations: Types, design and placement; Well foundations: Types, design and methods of construction; Retaining Structures: Types and design; Break Waters: Design and methods of construction.

CE - 5221 : Theory of Plates

Classical theories of plates, Analysis of simply supported, clamped and continuous plates by exact and approximate methods. Large deflection theories. Plates on elastic foundation, Thermal stresses in plates, Buckling and post buckling of plates.

CE - 5222 : Shell Structures

Classification of Shell structures. Membrane theory of Cylindrical shells, Shells of revolution, ellpar, hyper and conoidal shells. Bending theory of cylindrical shells, Shells of revolution, Edge perturbation, Shallow shells. Simplified bending theories, Continuity analysis of composite shell structures. Analysis and design of folded plates.

CE - 5224 : Plastic Design of Structures

Introduction to plasticity, Basic Concepts of Limit Analysis, Limit analysis theorems, Analysis and design of frames, Plastic moment distribution, Minimum weight design, Secondary considerations. Yield line theory-its applications and limitations. Advanced theory of limit design-some practical applications to plates and shells. Design of Concrete Structures with minimum reinforcement.

CE - 5225 : Optimization Methods

Formulation of optimization problems, classical optimization methods. Unconstrained and constrained minimization techniques. Penalty functions. Method of feasible directions and gradient projection. Linear programming. Applications to engineering problems.

CE – 5226 Advanced Aseismic Design of Structures

Behaviour of structures in past earthquakes: Lessons learnt with regards to weak/strong aspects of structural systems. Ground motion characteristics: Choice of ground motion for a major project site. Detailed study of IS:1893 – Seismic analysis of buildings using codal provisions, design considerations. Study of IS:13920 – Detailing for ductility. Introduction to seismic design: considerations for bridges, dams, chimneys, base isolation. Vulnerability of buildings: use of Vulnerability Atlas and understanding techno-legal issues with regard to buildings. Concepts in repair, restoration and seismic strengthening: Retrofitting- weakness in existing buildings, aging, weathering, development of cracks, material and equipment for repairs of masonry and concrete structures, study of IS:13935. Methodologies for repairs: for walls, roofs, slabs, column and foundations of buildings in stone, brick or reinforced concrete.
