GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore - 641 013

Regulations, Curriculum And Syllabi For

M.E. (STRUCTURAL ENGINEERING)

(Full Time / Part Time)

2012

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS,
GOVERNMENT COLLEGE OF TECHNOLOGY
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Curriculum

CURRICULUM FOR CANDIDATES ADMITTED
DURING 2012-2013 AND ONWARDS
BRANCH: M.E. (STRUCTURAL ENGINEERING) - (FULL TIME)

FIRST SEMESTER

S. No.	Subject Code	Course title	Sessional marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
		THEORY							
1.	12SE01	APPLIED MATHEMATICS	25	75	100	3	0	0	3
2.	12SE02	COMPUTER METHODS OF STRUCTURAL ANALYSIS	25	75	100	3	0	0	3
3.	12SE03	STRUCTURAL DYNAMICS	25	75	100	3	0	0	3
4.	12SE04	ADVANCED R.C. STRUCTURES	25	75	100	3	0	0	3
5.		ELECTIVE: 1	25	75	100	3	0	0	3
6.		ELECTIVE: 2	25	75	100	3	0	0	3
		TOTAL			600				18

SECOND SEMESTER

S. No.	Subject Code	Course title	Sessional marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
		THEORY							
1.	12SE05	THEORY OF ELASTICITY AND PLASTICITY	25	75	100	3	0	0	3
2.	12SE06	SUBSTRUCTURE DESIGN	25	75	100	3	0	0	3
3.	12SE07	STABILITY OF STRUCTURES	25	75	100	3	0	0	3
4.	12SE08	FINITE ELEMENT ANALYSIS	25	75	100	3	0	0	3
5.		ELECTIVE: 3	25	75	100	3	0	0	3
6.		ELECTIVE: 4	25	75	100	3	0	0	3
		TOTAL			600				18

THIRD SEMESTER

S. No.	Subject Code	Course title	Sessional marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
		THEORY							
1.	12SE09	STEEL STRUCTURES	25	75	100	3	0	0	3
2.		ELECTIVE: 5	25	75	100	3	0	0	3
3.		ELECTIVE: 6	25	75	100	3	0	0	3
4.	12SE10	PROJECT I	50	150	200	0	0	12	6
		TOTAL			500				15

FOURTH SEMESTER

S. No.	Subject Code	Course title	Sessional marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
1.	12SE11	PROJECT II	100	300	400	0	0	24	12
		TOTAL			400				12

CURRICULUM FOR CANDIDATES ADMITTED
DURING 2012-2013 AND ONWARDS
BRANCH: M.E. (STRUCTURAL ENGINEERING) – PART TIME

FIRST SEMESTER

S. No.	Subject Code	Course title	Sessional marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
1.	12SE01	APPLIED MATHEMATICS	25	75	100	3	0	0	3
2.	12SE02	COMPUTER METHODS OF STRUCTURAL ANALYSIS	25	75	100	3	0	0	3
3.	12SE03	STRUCTURAL DYNAMICS	25	75	100	3	0	0	3
		TOTAL			300				9

SECOND SEMESTER

S. No.	Subject Code	Course title	Sessional marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
1.	12SE05	THEORY OF ELASTICITY AND PLASTICITY	25	75	100	3	0	0	3
2.	12SE06	SUBSTRUCTURE DESIGN	25	75	100	3	0	0	3
3.	12SE07	STABILITY OF STRUCTURES	25	75	100	3	0	0	3
		TOTAL			300				9

THIRD SEMESTER

S. No.	Subject Code	Course title	Sessional marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
1.	12SE04	ADVANCED R.C. STRUCTURES	25	75	100	3	0	0	3
2.		ELECTIVE: 1	25	75	100	3	0	0	3
3.		ELECTIVE: 2	25	75	100	3	0	0	3
		TOTAL			300				9

FOURTH SEMESTER

S. No.	Subject Code	Course title	Sessional marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
		THEORY							
1.	12SE08	FINITE ELEMENT ANALYSIS	25	75	100	3	0	0	3
2.		ELECTIVE: 3	25	75	100	3	0	0	3
3.		ELECTIVE: 4	25	75	100	3	0	0	3
		TOTAL			300				9

FIFTH SEMESTER

S. No.	Subject Code	Course title	Sessional marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
		THEORY							
1.	12SE09	STEEL STRUCTURES	25	75	100	3	0	0	3
2.		ELECTIVE: 5	25	75	100	3	0	0	3
3.		ELECTIVE: 6	25	75	100	3	0	0	3
4.	12SE10	PROJECT I	50	150	200	0	0	12	6
		TOTAL			500				15

SIXTH SEMESTER

S. No.	Subject Code	Course title	Sessional marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
1.	12SE11	PROJECT II	100	300	400	0	0	24	12
		TOTAL			400				12

LIST OF ELECTIVE SUBJECTS

S. No.	Subject Code	Course title	Sessional marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
		THEORY							
1.	12SE12	COMPUTER APPLICATIONS IN STRUCTURAL ENGINEERING	25	75	100	0	0	6	3
2.	12SE13	EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION	25	75	100	3	0	0	3
3.	12SE14	STRUCTURAL OPTIMIZATION	25	75	100	3	0	0	3
4.	12SE15	ADVANCED CONCRETE TECHNOLOGY	25	75	100	3	0	0	3
5.	12SE16	INDUSTRIAL STRUCTURES	25	75	100	3	0	0	3
6.	12SE17	PLASTIC ANALYSIS OF STRUCTURES	25	75	100	3	0	0	3
7.	12SE18	PLATES AND SHELLS	25	75	100	3	0	0	3
8.	12SE19	FRACTURE MECHANICS	25	75	100	3	0	0	3
9.	12SE20	DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES	25	75	100	3	0	0	3
10.	12SE21	MAINTENANCE AND REHABILITATION OF STRUCTURES	25	75	100	3	0	0	3
11.	12SE22	PREFABRICATED STRUCTURES	25	75	100	3	0	0	3
12.	12SE23	CAD IN STRUCTURAL ENGINEERING	25	75	100	3	0	0	3
13.	12SE24	OFFSHORE STRUCTURES	25	75	100	3	0	0	3
14.	12SE25	EARTHQUAKE RESISTANT DESIGN OF STRUCTURES	25	75	100	3	0	0	3
15.	12SE26	DESIGN OF BRIDGES	25	75	100	3	0	0	3
16.	12SE27	DESIGN OF STRUCTURES FOR DYNAMIC LOADS	25	75	100	3	0	0	3
17.	12SE28	DESIGN OF TALL BUILDINGS	25	75	100	3	0	0	3
18.	12SE29	ENVIRONMENTAL ENGINEERING STRUCTURES	25	75	100	3	0	0	3
19.	12SE30	SOIL STRUCTURE INTERACTION	25	75	100	3	0	0	3
20.	12SE31	PRESTRESSED CONCRETE STRUCTURES	25	75	100	3	0	0	3
21.	12SE32	COLD FORMED STEEL STRUCTURES	25	75	100	3	0	0	3
22.	12SE33	SMART MATERIALS AND SMART STRUCTURES	25	75	100	3	0	0	3

12SE01 – APPLIED MATHEMATICS

L	T	P	C
3	0	0	3

CALCULUS OF VARIATION (9)

Maxima and minima of functions of two or more independent variables – Lagrange's method of multipliers - Functionals – variational concept – Euler' s equation for one independent variable- differential equation constraint – functional dependent on higher order derivatives – Euler poissons equation – Integral constraint (Isoparametric problems)- variation problems involving several independent variables – Ostrogradsky equation.

NUMERICAL METHODS (9)

Lagrange, Cubic Spline, Hermite Interpolation – Least squares method to fit $y=ax+b$, $y=ax^2+bx+c$, $y=ae^{bx}$, $y=ax^b$, $y=ab^x$ – Numerical Integration quadrature – Gauss, Legendre quadrature – Double Integration using Trapezoidal and Simpson's rule.

EIGEN VALUE PROBLEMS (9)

Power method of finding the dominant eigen values and eigen vectors of a matrix. Jacobis method, Given's method, House-Holder's method, Rayleigh-Ritz method, Lanczos method.

NETWORK SCHEDULING BY PERT / CPM (9)

Basic concepts – Network – Project scheduling – Inventory and crew scheduling -Constraints in network – Time calculations in networks – Critical path calculations – PERT calculations – Probability of meeting the schedule time.

PARTIAL DIFFERENTIAL EQUATION (9)

Classification of second order PDE – characteristic curves – Canonical reduction of PDE – 2D wave equation of vibration membrane (Cartesian co-ordinates) - Finite difference approach application to one and two dimensional problems – Fourier series solutions.

TOTAL : 45 Hrs

Reference Books

1. *M.K. Venkatraman,* ***Higher Mathematics for Engineering and Science,*** *National Publishing Company, 1998.*
2. *P.K. Gupta and Manmohan,* ***Operation Research*** *by Kantiswarup, Sultan Chand & Sons 1998.*
3. *Sneddan,* ***Partial Differential Equation****, Prentice Hall of India, 1990.*
4. *Elsgoth.L* ***Differential Equation and Calculus of Variations****, Mir Publishing Moscow, 1966.*
5. *Bali,* ***Engineering Mathematics****, Avenger Publishing, 2003.*
6. ***Applied Mathematics for Engineering****, NAD Physicists, McGraw hill, 1990.*
7. *S.Rajasekaran,****Numerical Methods in Science and Engineering*** *– A Practical Approach, S Chand and Company Ltd., 2003.*
8. *Erwin Keeyszig,* ***Advanced Engineering Mathematics,*** *John Wiley, 2007*

12SE02 - COMPUTER METHODS OF STRUCTURAL ANALYSIS

L	T	P	C
3	0	0	3

STRUCTURES – FUNDAMENTAL CONCEPTS (9)

Introduction-Force and displacement measurement–Generalized or Independent measurement–Constrained or Dependent measurements–Behaviour of structures–Principle of superposition–Methods of Structural analysis.

CHARACTERISTICS OF STRUCTURES – STIFFNESS AND FLEXIBILITY

Introduction–structure with single coordinate–Two coordinates–Flexibility and stiffness matrices in n coordinates–Examples, symmetric nature of matrices–Stiffness and flexibility matrices in constrained measurements–Stiffness and flexibility of systems and elements – Computing displacements and forces from virtual work–computing stiffness and flexibility coefficients.

ENERGY CONCEPTS IN STRUCTURES (9)

Strain energy in terms of stiffness & flexibility matrices–Properties of stiffness and flexibility matrices–interpretation of coefficients–Betti's law (forces not at the coordinates)- other energy theorems–using matrix notations.

TRANSFORMATION OF INFORMATION IN STRUCTURES

Determinate- Indeterminate structures–Transformation of system forces to element forces – Element flexibility to system flexibility - System displacement to element displacement – Element stiffness to system stiffness – Transformation of forces and displacements in general – Stiffness and flexibility in general - Normal coordinates and orthogonal transformation – Principle of contragradience.

FLEXIBILITY METHOD (9)

Statically determinate structures – Indeterminate structures – Choice of redundants leading to ill and well conditioned matrices – Automatic choice of redundant- Rank technique – Transformation to one set of redundants to another – Internal forces due to thermal expansion and lack of fit – Reducing the size of flexibility matrix – Application to pin-jointed plane truss – continuous beams – Frames –Grids.

STIFFNESS METHOD (9)

Introduction – Development of the stiffness method – Stiffness matrix for structures with zero force at some coordinates-Analogy between flexibility and stiffness – lack of fit – Stiffness matrix with rigid motions – Application of stiffness approach to pin jointed plane & space trusses – Continuous beams – Frames – Grids – Space frames introduction only – Static condensation technique- Choice of method – Stiffness or flexibility – Direct stiffness approach – Application to two & three dimensional pin- jointed trusses.

ANALYSIS BY SUBSTRUCTURES (9)

Analysis by substructures using the stiffness & the flexibility method with tridiagonalisation.

ANALYSIS BY ITERATION

Iteration method for frames with non-prismatic members – Iteration method applied to rigidly connected members – Computer program for the analysis of rigidly connected beams – Efficiency of the iteration method.

Total : 45Hrs

Reference Books

1. *Rubinstein, FM,* ***Matrix Computer methods of Structural Analysis****, Prentice Hall, 1966*
2. *William Weaver JR. and James M. Gere,* ***Matrix Analysis of framed structures****, CBS Publishers and Distributers, 1986.*
3. *Manicka Selvam V.K,* ***Elements of Matrix Stability Analysis of structures****, Khanna Publishers, 2006.*
4. *Pandit G.S, Gupta S.P,* ***Structural Analysis-A matrix Approch****, Tata McGraw Hill Publishing Company Ltd, 2008.*

12SE03 – STRUCTURAL DYNAMICS

L	T	P	C
3	0	0	3

PRINCIPLES OF DYNAMICS (9)

Vibration and its importance to structural engineering problems – Elements of vibratory systems and simple harmonic motion – Vibration with and without damping – Constraints – generalized mass - D'Alembert's principle– Hamilton principle - Degree of freedom – equation of motion for S.D.O.F - damped and undamped free vibrations - Undamped forced vibration – critical damping – Response to support motion – response to harmonic excitation – damped or undamped – evaluation of damping – resonance – band width method to evaluate damping – force transmitted to foundation – vibration isolation

RESPONSE TO PERIODIC & IMPULSIVE LOADING (9)

Fourier series expression of the loading – Response to Fourier series loading – exponential form of Fourier series solution - General nature of impulsive loads – Rectangular impulse – Triangular impulse - sine wave - Impulse – Shock or Response spectra – approximate analysis of impulsive load response.

RESPONSE TO GENERAL DYNAMIC LOADING (9)

Fourier series expression of the loading – Response to general dynamic loading (blast or earthquake) – Duhamel's integral – numerical evaluation

GENERALISED DISTRIBUTED FLEXIBILITY (9)

Expression for generalized system properties – vibrational analysis with Rayleigh's variational method - Rayleigh Ritz method

MULTIDEGREE FREEDOM SYSTEM (9)

Evaluation of structural property matrices – natural vibration – solution of the Eigen value problem – Vibration due to Holzer and Studola – Transfer matrix method – Orthogonality of natural modes

Distributed Parameter System

Differential equation of motion – Analysis of undamped free vibration of simply supported and cantilever beams – Effect of axial loads – Numerical evaluation of modes – Frequencies and Response system

TOTAL: 45Hrs

Reference Books

1. *Craig .R.R,* ***Structural Dynamics - An Introduction to Computer methods****, John Wiley & Sons, 1989*
2. *Manickaselvam,V.K.,* ***Elementary Structural Dynamics****, Dhanpat Rai & Sons, 2001*
3. *Mario Paz,* ***Structural Dynamics – Theory of computation****, CBS Publishers, 1990*
4. *Clough,R.W., and Penzien,* ***Dynamics of Structures*** *, McGraw Hill Book Co., 1986*

12SE04 – ADVANCED REINFORCED CONCRETE STRUCTURES

L	T	P	C
3	0	0	3

DESIGN FOR SERVICEABILITY AND FIRE RESISTANCE (9)

Design for Serviceability: Calculation of deflection and crack width in RC members. Design for Fire resistance: Introduction-Classification-effect of high temperature on steel, concrete and different structural members – Structural detailing – ultimate bending moment capacity – other considerations.

DESIGN OF SPECIAL RC ELEMENTS (9)

Design of slender columns – design of RC walls – ordinary and shear walls – design of corbels – deep beams

INELASTIC BEHAVIOUR AND DESIGN OF SLABS (9)

Inelastic behaviour of concrete beams, moment rotation curves, moment redistribution – plastic design - Design of slabs using Hillerberg method – yield line theory.

NON LINEAR BEHAVIOUR AND DESIGN OF JOINTS (9)

Nonlinear behaviour of concrete – concrete confined by reinforcement – provision of ties in reinforced concrete slab – Frame system – Design of cast-in-situ joints in frames- Design of grid floors - Design loads other than earthquake loads.

ANALYSIS OF FRAMES (9)

FRAMES: Analysis of frames - vertical loads by substitute frame method - horizontal forces (wind and earth quake) by portal method (unto two storey) - design of corner members .

TOTAL: 45Hrs

Reference Books

1. *Varghese P.C.,* ***Advanced Reinforced Concrete****, Prentice Hall of India, New Delhi, 2001*
2. *Varghese P.C.,* ***Limit state design of Reinforced Concrete,*** *Prentice Hall of India, New Delhi, 1997*
3. *Unnikrishnan Pillai S and Menon D.,* ***Reinforced concrete Design****, Tata McGraw Hill Book Co., New Delhi, 1998.*
4. *N.C.Sinha and S. K.Roy,* ***Fundamentals of Reinforced concrete****, S.Chand & Co Ltd., 2007*
5. *Pankaj Agarwal and Manish Shaikande,* ***Earthquake Resistant Design of structures,*** *Prentice – Hall of India Pvt. Ltd, New Delhi, 2006*
6. *Park and Paulay T,* ***Reinforced concrete Structures****, John Wiley and Sons, New York, 1975.*
7. *Arthur H Nilson,* ***Design of Concrete Structures****, Tata McGraw Hill Book Co.,2009.*

12SE05 – THEORY OF ELASTICITY AND PLASTICITY

L	T	P	C
3	0	0	3

ANALYSIS OF STRESS AND STRAIN (9)

Elasticity approach – definition and notation of stress - components of stress and strain – Generalised Hooke's law – principal stresses and strains for three dimensional element – equations of equilibrium and compatibility conditons for 3-D problems in Cartesian and cylindrical co-ordinates – Transformation of stresses and strains - Boundary conditions.

TWO DIMENSIOINAL PROBLEMS IN CARTESIAN CO-ORDINATES (9)

Plane stress and plane strain problems with practical examples - Equations of equilibrium and compatibility conditions in cartesian co-ordinates – Airy's stress function, bending of a cantilever of narrow rectangular cross section under the action of couples, knife edge and varying distributed loads, bending of simply supported beams by uniform and uniformly varying loads.

TWO DIMENSIONAL PROBLEMS IN POLAR CO-ORDINATES (9)

Equations of equilibrium and compatibility conditions in polar co-ordinates – axisymmetrical problems; thick cylinder under uniform pressure, shrink and force fits, circular arc beams subjected to pure bending – stress concentration due to circular hole in plate – effect of concentrated and uniformly distributed load on straight boundary of semi infinite plates, stresses in circular disc subjected to diametrically opposite concentrated loads.

TORSION (9)

Torsion of various shaped bars, pure torsion of prismatic bars, Prandtl's membrane anology, torsion of rolled profiles, stress concentration at re-entrant corners, torsion of thin walled tubes and hollow shafts, Plastic torsion – elastic-plastic torsion analysis – circular section – sand heap analogy.

INTRODUCTION TO PLASTICITY (9)

Stress-strain diagram – Ideal plastic body – illustration of plastic analysis – yield criteria – Rankine's theory – St. Venant's theory – Tresca criterion – Beltarmis theory – Von mises criterion – Mohr's theory of yielding – yield surface – Flow rule (stress-strain relation for perfectly plastic flow) – Prandtl Reuss equality – Plastic work – stress-strain relation based on Tresca – Plastic potential – uniqueness of a stress distribution – strain hardening.

TOTAL: 45Hrs

Reference Books

1. *Timeshenko.S.P and Goodier.J.N,* ***Theory of Elasticity*** *- McGraw Hill International edition, 1970.*
2. *Mendelson,* ***Plasticity: Theory and Application*** *A McMillan and co, NewYork 1968.*
3. *Sadhu Singh,* ***Theory of plasticity****, Khanna publishers, 2005.*
4. *Hill.R,* ***Mathematical theory of plasticity*** *- Oxford Publishers 1967*
5. *Sadhu Singh,* ***Theory of Elasticity and metal forming processes,*** *Khanna publishers,2005*
6. *Chakrabarthy,* ***Theory of plasticity****, Mc Graw Hill Co., 1988*

12SE06 – SUBSTRUCTURE DESIGN

L	T	P	C
3	0	0	3

INTRODUCTION (9)

Design of soil investigation report for design of foundation structure – Types – Selection of foundation – Basic requirement of foundation – Computation of loads – General principle of design of reinforced concrete shallow and deep foundation.

DESIGN OF SHALLOW FOUNDATION (9)

Shallow foundation – bearing capacity of footings – floating raft – Capacity of footing – Beams on Elastic foundation – Design of raft and buoyancy – Rafts and basement design .

DESIGN OF DEEP FOUNDATION (9)

Deep foundation – Load carrying capacity of different types of piles and detailing of reinforcement according to IS 2911 – Design of pile caps – Uplift capacity of piles – Lateral pile load test.

FOUNDATION FOR BRIDGES AND MACHINES (9)

Foundation for bridges – Well and caisson foundation – Design of pier cap - Design of pier – General principles, planning and design of machine foundation.

TOWER FOUNDATIONS (9)

Introduction – Design of foundation for towers – forces on tower foundation – General design criteria – Structural design of supports for foundation excavation – Design of ground anchors.

TOTAL: 45Hrs

Reference Books

1. *Thomlinson.M.J and Boorman.R,* ***Foundation design and construction,*** *ELBS Longman VI Edition, 1995 .*
2. *Swamisaran,* ***Analysis and design of substructures****, Limit state design Oxford and IBH Publishing Co. Pvt. Ld , NewDelhi, 1996.*
3. *Nayak.N.V,* ***Foundation design manual for practicing engineers****, Dhanpat Rai & Sons, 1982.*

12SE07 – STABILITY OF STRUCTURES

L	T	P	C
3	0	0	3

INTRODUCTION (9)

Concept of stability approaches to stability analysis, characteristics.

Columns

Buckling of columns with various end conditions, imperfect columns, Elastically supported columns, nonprismatic columns, Built up columns, Inelastic buckling, Experimental study of column behaviour, Empirical column formulae, Buckling of bars on elastic foundations, Large deflection of buckled bars.

APPROXIMATE METHODS (9)

Energy methods, Iterative procedures, Finite Difference methods and Matrix methods.

BEAM-COLUMNS (9)

Beam-Column subjected to concentrated lateral loads, distributed lateral loads – Effect of Axial Load on Bending Stiffness - Failure of beam columns- Buckling of frames – Modes of buckling – Calculation of critical loading in frames – Stability of a frame.

TORSIONAL BUCKLING (9)

Torsional Load-Deformation characteristics of Structural members – Strain energy of Torsion – Combined torsional and flexural buckling - Lateral buckling of beams – Pure bending of simply supported baem and cantilever beam – Design simplifications for lateral buckling.

BUCKLING OF PLATES (9)

Buckling of thin plates with various edge conditions – Strain energy of bending in a plate – Calculation of critical load of plates – Inelastic buckling – Post buckling behaviour of axially compressed plates – Ultimate strength of axially compressed plates.

TOTAL: 45Hrs

Reference Books

1. *Chajes. A,* ***Principles of Structural Stability Theory****, Prentice Hall, 1974.*
2. *Ashwini Kumar,* ***Stability Theory of Structures****, Tata McGraw Hill Publishing Company Ltd, N.Delhi, 1985.*
3. *Allen H.G and Bulson.P.S,* ***Background to buckling****, McGraw Hill Publishing Company Ltd, 1980*
4. *Smites,* ***Elastic Stability of Structures****, Prentice Hall, 1974.*
5. *Timoshenko.S, and Gere,* ***Theory of Elastic Stability****, McGraw Hill Publishing Company Ltd, 1961*
6. *Brush and Almorth,* ***Buckling of Bars, Plates and Shells****, McGraw Hill Publishing Company Ltd, 1975*

12SE08 – FINITE ELEMENT ANALYSIS

(Common to 12GE15 M.E. Geotechnical Engineering)

L	T	P	C
3	0	0	3

INTRODUCTION TO ELASTICITY (9)

Basic equations of solid mechanics – Review of equilibrium conditions – Strain Displacement relations – Stress strain relations – Equilibrium – Compatibility - Principle of virtual work and stationary, Potential energy principles - Variational principles - Rayleigh Ritz method

DIRECT METHOD (9)

Steps in direct method – Element stiffness matrix – Global stiffness matrix – Boundary conditions Problems on simple beams. Trusses and plates

ELEMENT PROPERTIES (9)

Discretization – Displacement model – Element properties – convergence and compatibility requirements – Node Numbering procedure – Natural coordinate system - Generalized Coordinates – Shape function – Lagrange, elements –stiffness matrix – Nodal load vector - elements in plane stress and plane strain– Static condensation – Simple problems only

ISOPARAMETRIC ELEMENTS (9)

Basic principles of Shape Functions - Mapping – Uniqueness of mapping - Sub – Iso – Super parametric elements – Numerical integration using Gaussian Quadrature - Examples in one dimension and two dimension

AXISYMMETRIC STRESS ANALYSIS (9)

Analysis of solids of revolution under axisymmetric loading – Formulation of axisymmetric solid element – Simple examples

NONLINEAR ANALYSIS

Types of nonlinearities – Geometric nonlinearity – Material nonlinearity – Introduction to nonlinear solution techniques – Newton Raphson and Modified Newton Raphson methods

TOTAL: 45Hrs

Reference Books

1. *Krishnamurthy,* ***Finite Element Analysis*** *– Theory and programming, Second edition, Tata McGraw Hill Publishing Co.. 1994*
2. *Desai C.S.,* ***Elementary Finite Element Method****, Prentice Hall, INC 1979*
3. *Rajasekaran S .,* ***Finite Element Analysis in Engineering Design,*** *Wheeler publishing,1993*
4. *Chandrapatla Tirupathi.R and Belegundu, Ashok. D.,* ***Introduction to Finite Elements in Engineering****, Second edition, Prentice Hall of India, 1997*

12SE09 – STEEL STRUCTURES

L	T	P	C
3	0	0	3

DESIGN OF CONNECTIONS (9)

Design of high strength friction grip bolts – Framed Connections (Beam Column Connection) – Design of Un-stiffened seated connections – Welded connections – Eccentric connections – Beam end connections – Direct web fillet welded connections – Direct web butt welded connections – Double plate web connection – Double angle web connection – Behaviour of welded connections.

PLASTIC ANALYSIS AND DESIGN OF BEAMS (9)

Static, Kinematic and Uniqueness theorems – Combined mechanism – Analysis and design of continuous beams of single bay and two bay portal frames – Methods of plastic moment distribution – Effect of axial force and shear force on plastic moments – Connections of Moment resisting connection.

TRANSMISSION LINE TOWERS (9)

Transmission Line Towers – Types of bracing patterns – Sag and Tension calculations – Analysis and Design of towers – with and without bracing.

DESIGN OF LIGHT GAUGE STEEL STUCTURES (9)

Types of cross sections – Local buckling and lateral buckling – Concepts of Effective width – Design of compression and tension members, Beams, Deflection of beams and design of beam webs – Combined stresses and connections, Wall studs.

INDUSTRIAL BUILDING (9)

Industrial building frames – General – Framing – Bracing – Crane Girders and Columns – Analysis of trussed bents – Design of rigid joints - Knee or gable frames.

TOTAL: 45Hrs

Reference Books

1. *Horne. M.R. and Morris, L.J.,* ***Plastic Design of Low-rise frames****, Granada Publishing Ltd., 1981.*
2. *Salmon. C.G. and Johnson.J.E.* ***Steel Structure- Design and Behaviour,*** *Harper and Row, 1980.*
3. *Dayarathnam. P.,* ***Design of Steel Structure,****A.H.Wheeler, 1990.*
4. *Kuzamanovic.B.O. and Williams, N.,* ***Steel Design for Structural Engineers****, Prentice Hall, 1977.*
5. *Wie - Wen Yu.,* ***Cold-formed Steel Structures,*** *McGraw Hill Book Company, 1973.*
6. *William McGuire,* ***Steel Structures****, Prentice Hall, Inc., Englewood Cliffs, N.J. 1986.*
7. *Subramanian.N,* ***Design of Steel Structures****, Oxford University press, 2008*
8. *Shiyekar M.R,* ***Limit State Design in Structural Steel****, Prentice Hall of India, 2011.*
9. *Duggal S.K,* ***Limit State Design of Steel Structures****, Tata McGraw Hill, 2010.*

12SE12 – COMPUTER APPLICATIONS IN STRUCTURAL ENGINEERING

L	T	P	C
0	0	6	3

UNIT : 1 **(9)**

Introduction to programming languages and operating systems - hardware and software components - development of algorithms for numerical techniques - introduction to graphics.

UNIT : 2 **(9)**

Matrix methods of structural analysis - Problems for flexibility and stiffness approaches.

UNIT : 3 **(9)**

Developing computer programs for design of simple RCC and steel structural elements subjected to axial force, bending moment, transverse shear , torsional moments and their different combinations. Relevant Indian standard provisions to be followed.

UNIT : 4 **(9)**

Use of SAP, ANSYS, FEAST, GTSTRUDL and STAAD III Pro Software packages for analysis and design of steel, RC and Prestressed structures.

UNIT : 5 **(9)**

Use of Autocad - drawing primitives - display techniques - editing - utilities - Scaling - 3D Frames and solid modeling - hidden line / surface generation algorithms - shading - perspective views - demonstrations of package 'Studio'.

TOTAL:45Hrs

LIST OF EXERCISES

- Structural analysis - flexibility and stiffness approach for simple frames.
- Direct stiffness method for simple frames.
- Finite element method program for trusses and frames.
- Plane stress / strain analysis using CST elements.
- Axisymmetric stress analysis.
- Plane stress / strain analysis using Isoparametric elements.
- Three dimensional stress analysis.
- Plate/ Shell analysis.
- Ansys package for simple structures.
- SAP package for analysis of simple structures.
- FEAST package for analysis of simple structures.
- STAAD III package for analysis and design of simple structures.
- Use of Autocad in drafting.

The examination on this subject will be conducted as a practical over four hours duration

12SE13 – EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION

L	T	P	C
3	0	0	3

FORCE AND STRAIN MEASUREMENT (9)

Strain Gauges, principle, types, performance and uses - Photo elasticity, principle and applications - Moiré fringes hydraulic jacks and pressure gauges - Electrical load cells- proving rings - calibration of testing machines.

VIBRATION MEASUREMENTS (9)

Characteristics of structural vibration - linear variable differential transformer (LVDT) - Transducers for Velocity and acceleration measurements- vibration meter - seismographs - vibration analyzer - display of recording of signals- cathode ray oscilloscope- XY plotter- chart plotters - Digital data acquisition systems.

ACOUSTICS AND WIND FLOW MEASUREMENT (9)

Principles of pressure and flow measurements- pressure transducer- sound level meter - venturimeter and flow meters - Wind tunnel and its use in structural analysis- structural modeling - direct and indirect model analysis.

DISTRESS MEASUREMENTS (9)

Diagnosis of distress in structures - crack observation and measurement - Corrosion of reinforcement in concrete- Half cell, construction and use- damage assessment - controlled blasting for demolition.

NON DESTRUCTIVE TESTING METHODS (9)

Load testing on structures, buildings, bridges and towers - Rebound hammer- Acoustic emission- Ultrasonic testing, Principles and applications - Holography - Use of laser for structural testing- Brittle coatings.

TOTAL:45Hrs

Reference Books

1. *Sadhu Singh,* ***Experimental stress analysis,*** *Khanna publishers, New Delhi, 1996.*

2. Dalley and Riley, ***Experimental stress analysis*** *- McGraw Hill Book Company, New York 1991*

3. L.S.Srinath, ***Experimental stress Analysis,*** *Tata McGraw Hill company Book Ltd., NewDelhi. 1984*

4. Bray and Stanley, ***Non Destructive Evaluation****, McGraw Hill Publishing co., New York,1989*

12SE14 – STRUCTURAL OPTIMIZATION

L	T	P	C
3	0	0	3

OPTIMIZATION FUNDAMENTALS (9)

Optimization methods - Introduction, Problem formulation, Introduction to mathematical principles in optimization - Mathematical models - Activity – Design methodology- Civil engineering case study- Unconstrained functions – single variable- several variable- equality constraints – inequality constraints- optimization- design space- Feasible and Infeasible- Convex and concave – Active constraints- Local and Global optima – differential Calculus- Optimality criteria- Lagrange multiplier method- Kuhn- tucker Criteria.

LINEAR PROGRAMMING (9)

Linear Programming – Formulation of problems- graphical solution- plastic design of frames- analytical methods- Simplex method – Basic ideas and steps- Duality sensitivity analysis – simple LP problems – Transportation Problem – Assignment Method.

NON-LINEAR PROGRAMMING (9)

Introduction to non-linear problems - One dimensional minimization methods – unimodal function - Exhaustive and unrestricted search – Dichotomous search – Fibonacci method- Golden section method - Interpolation methods. Unconstrained multivariable function - univariate method- Cauchy's steepest descent method- conjugate gradient method (Fletcher Reeves) – Variable metric methods (Davison-Fletcher-Powell) - Direct and indirect methods- cutting plane method- Methods of feasible direction- Interior Penality function – External Penalty function method.

GEOMETRIC PROGRAMMING AND DYNAMIC PROGRAMMING (9)

Geometric Programming- Polynomial – Degree of difficulty- Reducing G.P.P. to a set of simultaneous equations – Concepts of solving problems with zero difficulty and one degree of difficulty. Dynamic Programming - Bellman's principle of optimality –Representation of a multi stage decision problem - Concept of sub -optimisation problems – Truss optimization.

NON-TRADITIONAL METHODS (Concepts only) (9)

Genetic Algorithm – Terminology – Natural Law of Evolutions – Genetic operators – steps for solution of problems. Simulated Annealing – Algorithm – Boltzman's equation. ANT Colony optimization – Algorithm – pheromone Trail – Travelling salesman problem. Introduction to TABU search – sample problem.Artificial Neural Network - Basic concepts – Biological systems – Artificial neural network – application characteristics – overview of learning methods.

TOTAL:45Hrs

Reference Books

1. *Rao. S.S.,* ***Optimisation Theory and Applications,*** *New Age International Private Limited Publisher, New Delhi , 2002*
2. *Belegundu, A.D.and Chandrapatla,T.R.,* ***Optimisation Concepts and Applications in Engineering,*** *Pearson Education, 2002.*
3. *K.Deb,* ***Optimisation for Engineering Design : Algorithms and examples,*** *Prentice Hall, New Delhi.*
4. *J.S.Arora,* ***Introduction to Optimum Design****, McGraw –Hill Book Company*
5. *Taha, H.A.,* ***Operations Research – An Introduction,*** *Prentice Hall of India,2002.*
6. *Spunt.L.,* ***Optimum Structural Design****, Prentice Hall, New Jersey, 1971.*
7. *Goldberg.D.E.,* ***Genetic Algorithms in Search, Optimisation and Machine Learning,*** *Addison & Wesley , 1989*
8. *Dorigo.M and Stutzle.T.,* ***Ant Colony Optimisation****, Prentice Hall of India, 2004.*
9. *Kirsch.U,* ***Structural Optimisation :Fundamentals and Applications,*** *Springer-Verlog,1993.*

12SE15 ADVANCED CONCRETE TECHNOLOGY

L	T	P	C
3	0	0	3

INTRODUCTION (9)

Concrete: Past, Present and Future – Constituent Materials – Strength of Concrete – Dimensional Stability of Concrete – Chemical and Mineral Admixtures – Properties of Fresh and hardened concrete – Principles of Concrete Mix Design – Methods of Concrete mix design.

DURABILITY OF CONCRETE (9)

Permeability – chemical attack – Sulphate attack – Quality of water – marine conditions – Thermal properties of concrete – fire resistance – methods of making durable concrete – Mass concrete – Formwork – Structural concrete Block Masonry – Quality control of Concrete construction.

CONCRETING UNDER SPECIAL CIRCUMSTANCES (9)

Underground construction – Concreting in Marine environment – Under water construction – Hot weather and cold weather concreting. Tests on Concrete: Evaluation of strength of existing structures – Investigation Techniques – Tests on Hardened concrete – Non destructive Testing – Semi destructive testing Techniques – Tests on fresh concrete – Load test on Structural components.

SPECIAL CONCRETE (9)

Light weight concrete, Fly ash concrete, Fiber reinforced concrete, Polymer Concrete, Super plasticized concrete, Epoxy resins and screeds for rehabilitation - Properties and Applications - High performance concrete.

CONCRETING METHODS (9)

Process of manufacturing of concrete, methods of transportation, placing and curing - Extreme weather concreting, special concreting methods, Vacuum dewatering - underwater concrete, form work and design.

TOTAL:45Hrs

Reference Books

1. *Neville, A.M.,* ***Properties of Concrete*** *, Pitman Publishing Limited, London, 2002.*

2. Shetty M.S., ***Concrete Technology,*** *S.Chand and Company Ltd. Delhi.2003.,*

3. Gambhir.M.L. ***Concrete Technology****, Tata Mc Graw Hill, Publishing Co. Ltd New Delhi , 2009*

4. Krishnaraju.N, ***Design of Concrete mixes****, Sehgal Educational Consultants Pvt. Ltd., Faridabad.*

5. IS:456:2000, ***Indian Standards Code of Practice for Plain and Reinforced Concrete***

6. IS:10262, ***Recommended Guidelines for Concrete Mix Design,*** *1982.*

7. Santhakumar.A.R., ***Concrete Technology,*** *Oxford University Press, New Delhi, 2007*

12SE16 – INDUSTRIAL STRUCTURES

L	T	P	C
3	0	0	3

PLANNING AND FUNCTIONAL REQUIREMENTS (9)

Classification of Industries and Industrial Structures – planning for layout requirements regarding lighting, ventilation and fire safety – protection against noise and vibration - guidelines from factories act – material handling systems- structural loads.

SINGLE STOREY INDUSTRIAL STRUCTURES (9)

Types of roofing – roofing sheets –light gauge sections – architectural metal roofing – wind uplift ratings of metal roofs – roof trusses – purlins - design of cladding - louver rails – gable columns – gable wind girders - foundation for Industrial structures – pre engineered buildings.

MATERIAL HANDLING SYSTEMS (9)

Cranes – Types – design of EOT overhead travelling cranes – Jib cranes – Goaliath cranes – Design of gantry girders for overhead cranes . Building Cranes – Types and service classification – selection – specifying a building crane.

INDUSTRIAL STORAGE STRUCTURES (9)

Silos, Bins and Bunkers – Design of supporting systems for hoppers and bunkers .

CURRENT DESIGN TRENDS (9)

Multi storey building systems – concepts of shear walls, wall -frames, tubular, cores, outrigger, bundled tubes , diagonal truss, mega tubes. Environmental control structures for industries - Concept of Electro static Precipitators – functioning and components.

TOTAL: 45Hrs

Reference Books

1. *Alexander Newman,* ***Metal building system- Design and specifications****, Second edition, Mc Graw Hill, New Delhi , 2004.*
2. *Gaylord E H and Gaylord N C ,* ***Design of Steel Structures****, McGraw Hill Publication, New York, 1998*
3. *Punmia B.C. , Ashok kumar Jain and Arunkumar Jain,* ***Design of Steel structures****, Laxmi Publications, New Delhi, 2004*
4. *Gaylord E H, Gaylord N C and Stall MeyerJ E,* ***Design of Steel Structures****, Third Edition , McGraw Hill Publication, 1992.*
5. *Arya A.S. and Ajmani J.L.,* ***Design of Steel Structures****, NemChand Brothers, Roorkee, 1987*

12SE17 – PLASTIC ANALYSIS OF STRUCTURES

L	T	P	C
3	0	0	3

BASIC HYPOTHESIS (9)

Introduction to plastic method of structural analysis – basic hypothesis - stress strain relation for mild steel – evaluation of fully plastic hinge assumption for other structural materials. Failure and Yield criteria (Von Mises and Tresca)

METHODS AND THEOREMS OF PLASTIC ANALYSIS (9)

Theorems of plastic analysis – Principle of virtual work – Superposition ofmechanism – Method of inequalities – Moment distribution method – Replacement theorem – The shake down theorem

APPLICATION OF PLASTIC ANALYSIS (9)

Application of the methods to multi storey frames - Beams and frames with concentrated and distributed loads - Virendeel trusses – Gable frames and Grids.

DISPLACEMENTS (9)

Importance of displacements in plastic analysis – Methods of computing displacements – Displacements in beams and frames – Displacement theorem.

AXIAL FORCES IN FRAMES AND ARCHES (9)

Combined axial and bending forces - Effect of axial forces in simple frames – Approximate interaction curves.

TOTAL:45

Reference Books

1. *Neal ,B.G., **Plastic Methods Of Structural Analysis**, Chapman & Hall Ltd & Science Paper Backs, 1965, Reprinted 1970.*
2. *Beedle, L.S . **Plastic Design Of Steel Frame.**,1992*
3. *Hodge, **Plastic Analysis Of Structures** .1993*
4. *Massonet ,C.E., And Save,M.A., **Plastic Analysis And Design,** Vol 1, Blaisdell Publishing Company,London. 1994*
5. *Baker,J.,Heyman,J., **Plastic Design of Frames ,** Cambridge University Press.,1992*

12SE18 – PLATES AND SHELLS

L	T	P	C
3	0	0	3

LATERALLY LOADED PLATES (9)

Thin Plates with Small Defection. Laterally Loaded Thin Plates, Governing Differential Equation, Boundary Conditions. Rectangular Plates, Simply Supported Rectangular Plates, Navier Solution and Levy's Methods, Plates with Various Edge Conditions. Symmetrical Bending of Circular Plates, Plates on Elastic Foundation.

NUMERICAL METHODS (9)

Finite Difference Method – Isotropic Rectangular plates – Boundary Conditions – All-round simply supported square plate, clamped square plate and fixed square plate subjected to uniformly distributed load.

ANISOTROPIC PLATES AND THICK PLATES (9)

Orthotropic Plates and Grids, Moderately Thick Plates.

MEMBRANE THEORY OF SHELLS (9)

Classification of Shells - Types of Shells - Structural Action - Membrane Theory - Shells of Revolution and Shells of Translation - Examples - Limitations of Membrane Theory.

FOLDED PLATES (9)

Folded Plate structures - structural behavior and analysis - Types - Design by ACI - ASCE Task Committee method.

TOTAL:45

Reference Books

1. *Szilard, R.,* ***Theory of Analysis of Plates*** *, Prentice Hall Inc. 1992*

2. *Timoshenko, S. and Krieger S.W.* ***Theory of Plates and Shells*** *, McGraw Hill Book Company,1990*

3. *Wilhelm Flügge,* ***Stresses in shells****, Springer – Verlag, 1988*

4. *Ramasamy, G.S.,* ***Design and Construction of Concrete Shells Roofs,*** *CBS Publishers,1986*

12SE19 – FRACTURE MECHANICS

L	T	P	C
3	0	0	3

INTRODUCTION (9)

Modes of failure – Structural failure caused by fracture - fracture Vs strength of materials-tensors- kinetics-kinematics-fundamental laws of continuum mechanics- constitutive equations- Griffith theory- materials behavior-ductile fracture-cleavage-ductile brittle transition-intergranular fracture.

ELASTICS STRESS ANALYSIS & ENERGY FLOWS (9)

Modes of fracture – Complex variable method for stress analysis of cracks- Westergard approach - Energy flows in elastics fracture- Elastic strain energy- Energy release rate – J integral- Criteria for elastic fracture

DETERMINATION OF K & G (9)

Analytical methods (Elastics theory & energy & Compliance methods) – Experimental methods – Fracture toughness test

ELASTIC PLASTICS FRACTURE (9)

Strip yield (Dugdale) model-introduction to plasticity theory-anti-plane shear cracks in elastics-plastic materials in SSY - model I cracks in elastic –plastic materials - fracture criteria and prediction

FRACTURE MECHANICS OF CONCRETE (9)

Fracture deterioration of analysis of concrete-Fracture mechanics of concrete-Linear elastic fracture models-Non linear fracture models-Comparison-Model selection

TOTAL: 45Hrs

Reference Books

1. *John.M.Barson and Stanley.TRolfe,* ***Fracture and Fatigue control in Structures****, Prentice Hall, Inc, USA 1987.*
2. *David Broek,* ***Elementary Engineering Fracture Mechanics****, Martinus Nijhoff Publishers, The Hague, 1982.*
3. *Jean Lemative and Jean Louis Chboche,* ***Mechanics of Solid Materials****, Cambridge University Press, Cambridge, 1987.*
4. *Gdoutos.E.E,* ***Fracture Mechanics-An Introduction****, Kluwer Academic publishers, Dordrecht, 1993.*
5. *Knott.J.F,* ***Fundamentals of Fracture Mechani****cs, John Wiley & Sons, New York, 1973.*
6. *Suresh.S,* ***Fatigue of materials,*** *Cambridge University Press, Cambridge, 1991.*
7. *Kanninen.M.F & Popelar.C.H,* ***Advances in Fracture Mechanics,*** *Oxford University Press, New York, 1985*
8. *Bhushan.L.Kaerihaloo,* ***Fracture Mechanics and Structural Concrete,*** *Long man Scientific Publishers, USA,1972.*
9. *Prashant Kumar,* ***Elements of Fracture Mechanics****, McGraw Hill Companies, 2010.*

12SE20 – DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES

L	T	P	C
3	0	0	3

FUNDAMENTALS (9)

Introduction to steel-concrete composite construction – Design Philosophy- Advantages – Types of composite construction – Basic concepts of composite structures- Material properties under static loads and dynamic loads. Shear connection- Methods- Properties- Partial interaction- Effect of slip on stresses and deflection – Longitudinal shear in compression slabs.

COMPOSITE SLABS AND BEAMS (9)

Composite floor slabs - conventional composite beams - resistance to sagging bending, longitudinal shear and vertical shear – stresses in service – design examples. Continuous composite beams -Elastic and inelastic design considerations.

COMPOSITE COLUMNS AND FRAMES (9)

Encased columns – concrete filled steel tubes – resistance to axial compression – resistance to combined compression and uniaxial bending. Composite column and frames- Design of beam-column joints and rigid joints - jointed composite frames – Modular co-ordination.

COMPOSITE TRUSSES (9)

Composite Trusses – Behaviour and Design - Design of connections- case studies on steel concrete composite construction in buildings – seismic Behaviour.

SPECIAL STRUCTURES (9)

Steel sandwich construction- Box Girder Bridge- Case studies – seismic Behaviour- Different codal provisions - Fabrication and erection of structures including heavy structures, Prefab construction, Industrialized construction.

TOTAL: 45Hrs

Reference Books

1. *Johnson R.P.,* ***Composite Structures of Steel and Concrete,*** *Blackwell Scientific Publications, UK, 1994.*
2. *Owens G.W. and Knowles P.,* ***Steel Designers Manual****, Fifth Edition, Steel Concrete Institute, UK, Oxford Blackwell Scientific Publications, 1992.*
3. ***Workshop on Steel –concrete Composite Structures,*** *conducted at Anna University, chennai, 2000.*
4. *IS 11384 -1985,* ***Code of Practice for Steel concrete Composite structures,***
5. *Euro Code 4*
6. *BS 5950- Part 3*

12SE21 – MAINTENANCE AND REHABILITATION OF STRUCTURES

L	T	P	C
3	0	0	3

GENERAL **(9)**

Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking and types of cracks.

INFLUENCE ON SERVICEBILITY AND DURABILITY

Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

MAINTENANCE AND REPAIR STRATEGIES **(9)**

Definitions : Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance Preventive measures on various aspects Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.

MATERIALS FOR REPAIR **(9)**

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, Fiber reinforced concrete.

TECHNIQUES FOR REPAIR **(9)**

Rust eliminators and polymers coating for rebars during repair foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shot Crete - Epoxy injection, Mortar repair for cracks, shoring and underpinning.

EXAMPLES OF REPAIR TO STRUCTURES **(9)**

Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure.

DEMOLITION TECHNIQUES

Engineered demolition techniques for Dilapidated structures - case studies

TOTAL: 45 Hrs

Reference Books

1. *Denison Campbell, Allen and Harold Roper,* ***Concrete Structures, Materials, Maintenance and Repair****, Longman Scientific and Technical UK, 1991.*
2. *R.T.Allen and S.C.Edwards,* ***Repair of Concrete Structures*** *, Blakie and Sons, UK, 1987*
3. *M.S.Shetty,* ***Concrete Technology - Theory and Practic****e, S.Chand and Company, NewDelhi, 1992.*
4. *Santhakumar, A.R.,* ***Training Course notes on Damage Assessment and repair in Low Cost Housing "RHDC-NBO"*** *Anna University, July 1992.*
5. *Raikar, R.N.,* ***Learning from failures - Deficiencies in Design, Construction and Service*** *- R & D Centre(SDCPL), Raikar Bhavan, Bombay, 1987.*
6. *N.Palaniappan,* ***Estate Management*** *, Anna Institute of Management, Chennai, 1992*
7. *Lakshmipathy, M. et. al. Lecture notes of Workshop on* ***"Repairs and Rehabilitation of Structures",*** *29 - 30th October 1999.*

12SE22 – PREFABRICATED STRUCTURES

L	T	P	C
3	0	0	3

INTRODUCTION AND DESIGN PRINCIPLES (9)

General Civil Engineering requirements, specific requirements for planning and I layout of prefabricates plant. IS Code specifications. Modular co-ordination, standardization, Disuniting of Prefabricates, production, transportation, erection, stages of loading and codal provisions, safety factors, material properties, Deflection control, Lateral load resistance, Location and types of shear walls.

REINFORCED CONCRETE (9)

Prefabricated structures - Long wall and cross-wall large panel buildings, one way and two way prefabricated slabs, Framed buildings with partial and curtain walls, single storey industrial buildings with trusses and shells, Crane -gantry systems.

FLOORS, STAIRS, ROOFS AND WALLS (9)

Types of floor slabs, analysis and design example of cored and panel types and two -way systems, staircase slab design, types of roof slabs and insulation requirements, Description of joints, their behaviour and reinforcement requirements, Deflection control for short term and long term loads, Ultimate strength calculations in shear and flexure. Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls.

DESIGN OF INDUSTRIAL BUILDINGS (9)

Components of single -storey industrial sheds with crane gantry systems, Design of R.C. Roof Trusses, Roof Panels, Design of R.C.crane -gantry girders, corbels and columns, wind bracing design.

DESIGN OF SHELL ROOFS FOR INDUSTRIAL SHEDS (9)

Cylindrical, Folded plate and hyper -prefabricated shells, Erection and jointing, joint design, hand book based design.

TOTAL:45Hrs

Reference Books

1. ***Structural Design Manual,*** *Precast Concrete Connection Details, Society for the Studies in the use of Precase Concrete, Netherland Betor Verlag, 1978.*
2. *Lasslo Mokk,* ***Prefabricated Concrete for Industrial and Public Sectors*** *, Akademiai Kiado, Budapest, 1964.*
3. *Murashev.V., Sigalov.E., and Bailov.V.,* ***Design of Reinforced Concrete Structures*** *, Mir Publishers, 1968.*
4. *CBRI,* ***Building Materials and Components****, 1990, India.*
5. *Gerostiza. C.Z., Hendrikson, C., Rehat D.R.,* ***Knowledge Based Process Planning for Construction and Manufacturing,*** *Academic Press, Inc., 1989.*
6. *Warszawski, A.,* ***Industrialization and Robotics in Building*** *- A managerial approach, Harper & Row, 1990.*

12SE23 – CAD IN STRUCTURAL ENGINEERING

L	T	P	C
3	0	0	3

COMPUTER GRAPHICS (9)

Graphic primitives - Transformations - Basics of 2-D drafting - Modeling of curves and surfaces – Solid modeling - Graphic standards - Drafting software packages and usage

STRUCTURAL ANALYSIS (9)

Computer methods of structural analysis - Finite Element programming - Analysis through application packages.

STRUCTURAL DESIGN (9)

Computer aided design of steel and RC Structural elements - Detailed drawing - Bill of materials.

OPTIMIZATION (9)

Linear programming - Simplex algorithm - Post-optimality analysis - Project scheduling - CPM and PERT applications Genetic algorithm and applications.

ARTIFICIAL INTELLIGENCE (9)

Introduction - Heuristic search - knowledge based expert systems - Architecture and applications of KBES - Expert system shells - Principles of neural network.

TOTAL:45Hrs

Reference Books

1. *C..S.Krishnamoorthy and S.Rajeev,* ***Computer Aided Design,*** *Narosa Publishing House, New Delhi, 1991.*
2. *H.B.Harrison,* ***Structural Analysis and Design*** *Vol. I & II, Pergamon Press, 1991*
3. *E.Hinton and D.R.J.Owen,* ***Finite Element Programming,*** *Academic Press 1977.*
4. *Billy E.Gillet,* ***Introduction to Operations Research****, A computer oriented algorithmic approach, Tata McGraw Hill 1982.*
5. *Richard Forsyth (Ed.),* ***Expert System Principles and Case studies*** *- Chapman & Hall.1976.*

12SE24 – OFFSHORE STRUCTURES

L	T	P	C
3	0	0	3

WAVE THEORIES **(9)**

Wave generation process, small and finite amplitude wave theories.

FORCES OF OFFSHORE STRUCTURES **(9)**

Wind forces, wave forces on vertical, inclined cylinders, structures - current forces and use of Morison equation.

OFFSHORE SOIL AND STRUCTURE MODELING **(9)**

Different types of offshore structures, foundation modeling, structural modeling.

ANALYSIS OF OFFSHORE STRUCTURES **(9)**

Static method of analysis, foundation analysis and dynamics of offshore structures.

DESIGN OF OFFSHORE STRUCTURES **(9)**

Design of platforms, helipads, Jacket tower and mooring cables and pipe lines.

TOTAL : 45

Reference Books

1. *Chakrabarti, S.K.* ***Hydrodynamics of Offshore Structures,*** *Computational Mechanics Publi- cations, 1987.*
2. *Thomas H. Dawson,* ***Offshore Structural Engineering,*** *Prentice Hall Inc Englewood Cliffs, N.J. 1983*
3. *API, Recommended Practice for Planning,* ***Designing and Constructing Fixed Offshore Plat- forms****, American Petroleum Institute Publication, RP2A, Dalls, Tex.*
4. *Wiegel, R.L.,* ***Oceanographical Engineering****, Prentice Hall Inc, Englewood Cliffs, N.J. 1964.*
5. *Brebia, C.A.Walker, S.,* ***Dynamic Analysis of Offshore Structures ,*** *New-nes Butterworths, U.K. 1979.*
6. *Reddy, D.V. and Arockiasamy, M.,* ***Offshore Structures****, Vol.1, Krieger Publishing Com- pany, Malabar, Florida, 1991.*

12SE25 – EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

L	T	P	C
3	0	0	3

INTRODUCTION (9)

Elements of engineering seismology – causes of earthquakes, seismic waves, magnitude, intensity and energy release – Indian seismology –Earthquake history – Seismic zone Map of India – seismographs – seismogram – accelerograph – strong motion characteristics- initiation into vibration of structures .

SEISMIC DESIGN OF BUILDINGS (9)

Introduction to methods of seismic analysis – Equivalent static analysis IS 1893 provisions – Design horizontal seismic coefficient – design base shear – distribution – idealization of building frames - seismic analysis and modeling – determination of lateral forces – equivalent static lateral force method – response spectrum method – time history method – push over analysis - mathematical modeling of multistorey RC Building.

IS CODE PROVISIONS (9)

Modal response contribution – modal participation factor – response history – spectral analysis – approximate methods for lateral load analysis – IS 1893-2002 provisions – IS 4326 provisions – behavior and design of masonry structures – discussion of codes IS 13827 and 13828.

SEISMIC DESIGN CONCEPTS (9)

Concept of earthquake resistant design – concept of ductility – lateral force resisting systems – strong column weak beam concept - guidelines for seismic resistant construction - beam column joints –effect of structural irregularities – seismo-resistant building architecture – cyclic load behavior of RC, steel and prestressed concrete elements – Earthquake Resistant Design for multi storey RC frames, shear wall, braced frames and their combinations – capacity based design - Ductile detailing of reinforcement in RC Buildings as per IS 13920.

SPECIAL PROBLEMS AND MODERN CONCEPTS (9)

Soil performance - Liquefaction -Modern concepts – base isolation – adaptive system – seismic evaluation- retrofitting and strengthening of structures – seismic retrofitting strategies.

COMPUTER AIDED ANALYSIS AND DESIGN: (For internal assessment only – not for theory examination) computer aided analysis and design of building systems for earthquake loads – response spectrum - time history analysis – capacity based design – hands on session using computer software.

TOTAL:45Hrs

Reference Books

1. *Chopra A K,* ***Dynamics of Structures - Theory and Applications to Earthquake Engineering****, Prentice- Hall of India Pvt. Ltd., New Delhi, 2002.*
2. *Pankaj Agarwal and Manish Shrikhande,* ***Earthquake Resistant Design of Structures****, Prentice – Hall of India Pvt. Ltd., NewDelhi – 110 001, 2006.*
3. *Clough R W and Penzien J,* ***Dynamics of Structures,*** *McGraw Hill, INC, 1993.*
4. *Taranath B S,* ***Wind and Earthquake Resistant Buildings - structural Analysis & Design****, Marcell Decker, NewYork, 2005.*
5. *Chen WF & Scawthorn,* ***Earthquake Engineering Hand book****,CRC Press, 2003.*