RAJASTHAN TECHNICAL UNIVERSITY

Teaching Scheme : M.Tech. (Structural Engineering) **:** Civil Engineering Department

PART TIME Self Financed 6 Semester Course w.e.f. **2007-08**

SUBJECT/ SEMESTER	Teaching Hrs/week		Examination Scheme		
	L	T/P	Max. Marks		Total Marks
			Theory	Sessional	
FIRST SEMESTER					
MSE101 : Computer Programming & Graphics	3	2	100	50	150
MSE102 : Advanced Analysis of Structures	3	2	100	50	150
MSE103 : Design of Concrete Structures	3	2	100	50	150
TOTAL	**09**	**06**	**300**	**150**	**450**
SECOND SEMESTER					
MSE104 : Design of Steel Structures	3	2	100	50	150
MSE105 :Structural Dynamics	3	2	100	50	150
MSE106 : Numerical Methods & Analysis	3	2	100	50	150
TOTAL	**09**	**06**	**300**	**150**	**450**
THIRD SEMESTER					
MSE107 : Finite Element Methods	3	2	100	50	150
MSE108 : Elective-I	3	2	100	50	150
MSE109 : Seminar	-	3	-	100	100
TOTAL	**06**	**07**	**200**	**200**	**400**
FOURTH SEMESTER					
MSE110 : Bridge Engineering	3	2	100	50	150
MSE111 : Elective-II	3	2	100	50	150
MSE112 : Project	-	3	-	100	100
TOTAL	**06**	**07**	**200**	**200**	**400**
FIFTH SEMESTER					
MSE113 : Dissertation	-	12	-	-	-
TOTAL	**-**	**-**	**-**	**-**	**-**
SIXTH SEMESTER					
MSE113 : Dissertation	-	12	-	300	300
TOTAL	**-**	**-**	**-**	**300**	**300**
GRAND TOTAL	**30**	**50**	**1000**	**1000**	**2000**

List of Electives & Detailed Syllabus are Enclosed.

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LIST OF ELECTIVES

MSE108: ELECTIVE – I

- MSE108.1 : Advanced Strength of Materials
- MSE108.2 : Earthquake Engineering
- MSE108.3 : Advanced Foundation Design

MSE111 : ELECTIVE – II

- MSE111.1 : Theory of Plates & Shells
- MSE111.2 : Tall Buildings
- MSE111.3 : Repair and Rehabilitation of Structures

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SYLLABUS

MSE-101 : COMPUTER PROGRAMMING AND GRAPHICS

Definition of a program, Programming methodology, Concept of Structural Programming, Definition and operations on arrays, stacks, queues, lists, evaluation of arithmetic expressions using stacks, list representation. Recursive and non-recursive definitions of tree structures, operations of recursive and non-recursive algorithms. Introduction to C language, operators and expressions, data input and output, control statement, use of while, do-while, nested loops, if-else, switch, pointers, continue and goto statements. Writing a complete C program on structural analysis and design problems. Introduction to computer graphics, application of two dimensional and three dimensional graphics

MSE-102 : ADVANCED ANALYSIS OF STRUCTURES

Static and kinematic indeterminacy, Principle of virtual work, Force-displacement methods, element approach. Application to continuous beams, and space frame problems. Nonlinear analysis, incremental procedures, material and geometrical nonlinearities, large deformation elasto-plastic analysis of frames.

MSE-103 : DESIGN OF CONCRETE STRUCTURES

Limit State concept: Design philosophy, statistical basis for loads and strengths. Design and analysis of sections for flexure, shear and torsion. Beams curved in plan. Yield line theory for slabs, yield line mechanisms, equilibrium and virtual work methods, special aspects, Hillerborg's strip method. Code provision of design of water tanks. Design of circular and rectangular water tanks.

MSE-104 : DESIGN OF STEEL STRUCTURES

Torsion of open and closed sections. Buckling and warping. Stability of frames. Discussions of design specifications for compression elements including those made with light gauge steel. Different types of steel and metallic alloys. Moment resistance connections. Behavior of material under repetitive loads and temperature effects. Fundamentals of limit state design. Applications of steel cables in large span roofs, non-linearity. Tubular sections. Orthotropic decks. Light gauge steel.

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MSE-105 : STRUCTURAL DYNAMICS

Dynamics of Structures: Objectives and importance. Types of dynamic loads, Dynamic degree of freedom, Mathematical modeling, Damping and stiffness, Torsional stiffness, Equivalent stiffness, Free and forced vibrations. Single Degree of Freedom (SDOF) Systems: Undamped free vibrations, formulation of differential equation of motion: Newton's law of motion, D'Alembert's principle and energy approach. Natural frequency. Vibration response. Forced vibration response of SDOF damped and undamped systems to harmonic loading, rotating and reciprocating unbalance, support motion and impulsive type forcing function. Vibration isolation and transmissibility. Dynamic load factor. Seismic Instruments. Vibrations of two degree of freedom systems, matrix formulation of equations of motion, principal modes of vibrations. Extension of the concept to MDOF systems. Introduction to Rayleigh's principle, modal analysis. Codal provisions of Earthquake resistant Design.

MSE-106 : NUMERICAL METHODS & ANALYSIS

Error analysis, significant figures, absolute and relative errors, accuracy and precision, computational errors, stability in numerical analysis. Interpolation and integration, general interpolation formulae, polynomial interpolation, Lagrange interpolation, Newton's interpolation, Hermit interpolation, Gregory, Newton's and Gaussian interpolation, Gauss and Hermite quadratic and quadrature rules for multiple integral, computer sub routine. Solution of large system of linear simultaneous equations, algorithm based on Gauss elimination for symmetric and unsymmetric bonded equations, solution : in core and out of core, methods based on band width and its variants Solution methods for Eigen problems, Vector interaction methods, transformation methods, polynomial interaction techniques, methods based on sequence property, determinant search method and sub-space interaction method, large eigen problems, eigen value economizer scheme, computer programs. Numerical solution of parabolic, elliptic, and hyperbolic partial differential equations.

MSE-107 : FINITE ELEMENT METHODS

Finite element techniques: One dimensional Problems, FEM modeling, coordinates & shape functions, discretization, energy and variational approaches, basic theory, use of parametric and local coordinates, convergence criteria, numerical integration.

Element formulations, 2-D elements, plate bending elements, introduction to three dimensional elements. Applications, plane stress and plain strain problems, axi-symmetric solids, plates and shell structures, temperature problems.

Finite element equation treatment & boundary conditions, quadratic shape function, effect of temperature.

Nonlinear problems: Review of iterative and incremental procedures for material and geometrically nonlinear problems examples from plane stress and plane strain.

Introduction to programming, organization of FEM programs, equation solving techniques, input/output plotting and mesh generation aspects.

MSE-108.1 : ADVANCED STRENGTH OF MATERIAL

Elastic and plastic behavior of materials creep and fatigue, bending of bars with initial curvature, rings hoops etc. Torsion of non circular section, unsymmetrical bending, beams on elastic foundation, shear centre, shear flow, shear lag.

MSE-108.2 : EARTHQUAKE ENGINEERING

Engineering seismology: Structure of the earth, causes of earthquakes/tsunami: plate tectonics, types of faults and basic terms related with earthquakes. Seismic waves:, surface waves, body waves & their characteristics.

Characteristics & types of earthquake. Magnitude of earthquake, local magnitude, body wave magnitude, surface wave magnitude, seismic moment magnitude.

Energy release, Relationship between magnitude & Energy.

Intensity of earthquake, seismicity and seismic zoning.

Effect of earthquake on structures in general. Planning/architectural concepts: size & plan of building, vertical layout & adjacency of buildings.

Seismic damages: Typical seismic behaviour & damages of masonary structures: in plane & out of plane failure, lack of integrity. Earthquake resistance provisions as per IS 4326.

Typical seismic behaviour & damages of R.C. structures. Soft storey effect & short column effect.

Earthquake resistant design philosophy: Torsion in buildings, calculation of centre of mass & centre of rigidity. Basic concepts of structural dynamics, Response spectrum concept, Construction of response

spectrum. Use of response spectrum in earthquake resistant design, IS codal provisions for seismic analysis using given modes/coefficients and simple cases by static and dynamic analysis as per code. Codal provisions for Ductile detailing in RC constructions.

MSE-108.3 : ADVANCED FOUNDATION DESIGN

Critical study of conventional methods of foundation design, analysis of settlement of soil and foundations, foundations of in expensive and swelling soils, dynamic soil properties, dynamic bearing capacity of shallow foundations, liquefaction of soils, machine foundations for reciprocating and rotary type machines, vibration isolation. Raft foundations, well foundations, special footings and beams on elastic foundations,

MSE-110: BRIDGE ENGINEERING

Types of bridges, choice of bridge type, longitudinal arrangement and economic spans. Deck slab, orthotropic bridge deck. Rigid portal frame bridges, analysis and design. Load distribution theories: Courbons method, Hendry Jaeger method, Morice Little method, Grillage analogy, Design of T-type bridges. Box girder bridges in concrete and steel, behavior and structural section, analysis, design in reinforced and prestressed concrete, special features of design in steel. Cable stayed bridges, historical development, materials and arrangements, analysis, non-linearity, design of cables and towers. Design of bearings, Methods of construction and rehabilitation of bridges.

MSE-111.1 : THEORY OF PLATES AND SHELLS

Plates: Pure bending of plates, Symmetrical bending of circular plates, plates with concentric hole loaded symmetrically. Rectangular plates. The plate equation, boundary conditions, Navier solution and alternate solutions for plate problems, Sinusoidal, uniforms, concentrated, triangular and partially loaded under various edge conditions. Shells: definition of shell, classification of shells. Membrane theory for shells of revolution: typical cases, Loads with or without symmetry, distributed and edge loads. Membrane theory for cylindrical shells, tubes and pipes and barred vaults. Approximate analysis of cylindrical shells.

MSE-111.2 : TALL BUILDINGS

Structural systems of tall buildings; Moment resistant. frames, braced frames, eccentrically braced frames, shear walls, coupled shear walls, frame shear wall interaction, tubular structures; approximate and matrix oriented methods of design of tall buildings;

MSE-111.3 : REPAIR AND REHABILITATION OF STRUCTURES

Introduction to Repair, Restoration and rehabilitation/strengthening of existing buildings. Causes of deterioration/decay and flexural & shear distress of concrete structures. Diagnostic methods & analysis, preliminary investigations, experimental investigations using NDT, load testing, corrosion mapping, core drilling and other instrumental methods. Cracks: structural & surface cracks, their identification & causes, methods of repair of small & large cracks: Gunite and Shot Crete, Epoxy injection, Mortar repair for cracks Corrosion mechanism: corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection. Strengthening of existing walls & RCC members, stitching, routing & Sealing, Jacketing Materials for Repair: Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro-cement, Fiber reinforced concrete.