M.TECH IN SE -(STRUCTURAL ENGINEERING)
(REGULAR)

SEMESTER I

Subject Code	Name of Subject	Teaching Period			Credit Points
		L	T	P	
01MSE 101	Matrix Structural Analysis	4	1	0	5
01MSE 102	Dynamics of Structures	4	1	0	5
01MSE 103	Concrete Technology	4	1	0	5
01MSE 104	Hydraulic structures	4	1	0	5
01MSE 105.1 01MSE 105.2	Elective-1(Any one) Numerical Methods Computer Applications	4	1	0	5
01MSE3101	Discipline & Extra Curriculum Activities	0	0	4	1
	TOTAL	20	5	4	26

SEMESTER II

Subject Code	Name of Subject	Teaching Period			Credit Points
		L	T	P	
02MSE 101	Finite Element Analysis	4	1	0	5
02MSE 102	Earthquake Resistant Design	4	1	0	5
02MSE 103	Advanced Concrete Design	4	1	0	5
02MSE 104	Construction Techniques and Management	4	1	0	5
02MSE 105.1 02MSE 105.2	Elective-II(Anyone) Foundation Engineering Solid Mechanics	4	1	0	5
02MSE 301	Discipline & Extra Curriculum Activities	0	0	4	1
	TOTAL	20	5	4	26

SEMESTER III

Subject Code	Name of Subject	Teaching Period			Credit Points
		L	T	P	
03MSE 101	Design of Industrial Structures	4	1	0	5
03MSE 102	Bridge Analysis and Design	4	1	0	5
03MSE 201	Project	0	0	5	3
03MSE 202	Seminar	0	0	3	2
03MSE 301	Discipline & Extra Curriculum Activities	0	0	4	1
	TOTAL	8	2	12	16

SEMESTER IV

Subject code	Name of Subject	TEACHING PERIODS			Credit Points
		L	**T**	**P**	
04MSE 201	DISSERTATION a) Continuous Evaluation b) Project Report c) Viva Voice	 5 6 6	0	0	 5 6 6
04MSE 301	DISCIPLINE & EXTRA CURRICULAR ACTIVITIES	0	0	4	1
	Total	17	0	4	18

MATRIX STRUCTURAL ANALYSIS

Course/Paper: 01MSE101
Semester-I

1. **General Introduction.** A Few Historical Remarks. Matrix Methods of Analysis of Skeletal Structures. Methods of Analysis. Displacement Method: Stiffness Relationships.

2. The Matrix Displacement Approach. Introduction. Stiffness Matrix of a Bar Element subjected to Axial Force. Co-ordinate Transformations. Global Stiffness Matrix. Application to Pin-Jointed Frames. Stiffness Matrix of a Beam Element. Application to Continuous Beams.

3. Matrix Displacement Analysis of Planar Rigid-Jointed Frames. Neglect of Axial Strain in the Analysis of Planar Rigid-Jointed Frames. Inclined Supports. Other Kinds of Loading & Other Kinds of Frames.

4. Matrix Displacement Analysis of Grillage or Grid. Co-ordinate Transformations. Element Stiffness Matrix & its Application.

5. Matrix Displacement Analysis of Three-Dimensional Structures. Co-ordinate Transformations. Application to Space Trusses & Space Frames.

6. Computer Applications & Use of Computer Packages.

Books Recommended

Matrix & Finite Element Displacement
Analysis of Structures: D.J.Dawe.
Computer Analysis of Structural Systems: John F. Fleming.
Matrix Methods of Structural Analysis: C.K.Wang.
Matrix Analysis of Framed Structures: Gere & Weaver.
Introduction to Matrix Methods of Structural Analysis: Martin,H.C.

DYNAMICS OF STRUCTURES

Course/Paper: 01MSE102
MSE Semester-I

Nature of dynamic loading: Harmonic, Earthquake and blast loading, Single degree of freedom systems, Free vibrations and Forced vibrations: Harmonic force, Periodic force, Impulse, and General type of loading. Multi-degree of freedom system: Free and Forced vibrations of lumped MDOF Systems, numerical techniques for finding natural frequencies and mode shapes, orthogonality relationships of principal modes, Rayleighs Principal and its application for determination of fundamental frequency. Evaluation of dynamic response by mode superposition method.
Continuous Systems: Equation of motion: Undamped Free vibrations: Forced Vibration of bars and beams. Introduction to wind loads.

Books recommended:

Dynamics of Structures By Anil K. Chopra
Dynamics of Structures By Clough and Penzien
Structural Dynamics By Mario Paz
Dynamics of Structures By J. L. Humour

CONCRETE TECHNOLOGY

Course/Paper: 01MSE103
MSE Semester-I

Concrete Making Materials:

Aggregates – Classification, IS specifications, Properties, Grading, Methods of combining aggregates, specified gradings, Testing of aggregates.

2. Cement:

Chemical compoisition, Hydration of cement, structure of hydrated cement, special cements, water chemical admixtures.

Concrete:

Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep and Shrinkage, Variability of concrete strength.

Mix Design:

Principles of concrete mix design, Methods of concrete mix design, Testing of concrete.

Special Concretes:
Light weight concrete, Fibre reinforced concrete, Polymer concrete, Super plasticized concrete, Properties and applicatons.

Concreting Methods:
Process of manufacturing of concrete, Methods of Transportation, placing and curing. Extreme weather concreting, Special concreting methods.

REFERENCES:
1. Neville, A.M. and Brookes, J.J. "Concrete Technology", Pearson Publishers,New Delhi,1994.
2. Neville, A.M. "Properties of Concrete" Pearson Publishers,New Delhi, 2004.
3. Shetty,M.S. "Concrete Technology", S.Chand & Company, New Delhi,2002.
4. Gambhir, M.L. "Concrete Technology", Tata McGraw Hill New Delhi, 1995.
5. Rudhani,G."Light Weight Concrete", Academic Kiado Publishing Home of Hungarian Academy of Sciences,1963.

HYDRAULIC STRUCTURES

Course/Paper: 01MSE104
MSE Semester-I
Design procedure for irrigation channels, Irrigation outlets, Canal masonary works, - principles of design, use of flow net, Khosla's theory , Regulation works - Falls, distributory head regulators, Cross regulators, Cross drainage works, Canal head Works, Earth Dams, Gravity Dams, Spillways and Energy dissipators , Escapes , Trench weirs , Supply channel and head regulator.

Books recommended:
R.S. Varshney, S.C. Gupta and R.L. Gupta; Theory and Design of Irrigation Structures, Nemchand & Brothers ,Roorkee, 1992.
R.k. Sharma; Irrigation Engineering and Hydraulic Structures, Oxford and IBH Publishing Co., New Delhi, 1984.
Arora, K.R. " Irrigation water power and Water Resources Engineering", Standard Publishers Distributors, Delhi,2002.

NUMERICAL METHODS

Course/Paper: 01MSE105.1
MSE Semester-I
Numerical analysis, finite differences, interpolation, numerical solution of algebraic and transcendental equations, iterative algorithms, convergence, Newton-Rapjson procedure, solution of polynomial and simultaneous linear equations, numerical integration, Euler-Maclaurin formula, Newton-Cotes formula, error estimates, numerical solutions of ordinary differential equations: method of Euler, Taylor, Adams Runge-Kutta and predictor-corrector procedures, stability of solution, solution of boundary value problems, finite differences techniques, stability and convergence of solution, finite element method. **Special functions.** Legendre's special function, Rodrigue's formula, generating functions for Legendre's polynomials and recurrence formulae, Bessel's function, recurrence formulae, Bessel's function of integral order.

Books recommended:
Numerical methods for Scientists and Engineers by M.K. Jain, S.R. Iyengar & R.K. Jain, Wiley Eastern Ltd.
Mathematical Numerical Analyis By S.C. Scarborough, Oxford and IBH Publishing Company.
Introductory methods in Numerical Analysis by S.S. Sastry, Prentice Hall of India.
Theory and problems in Numerical Methods by T. Veeranjan and T. Ramachandran, Tata McGraw-Hill Publishing Company, New Delhi-2004.
Numerical Methods for Mathematics Sciences and Engineering 2nd ed. By John H. Mathews, Prentice Hall of India, New Delhi 2003.
Advanced Engineering Mathematics by R.K. Jain & S.R.K. Iyengar, Narosa-2001.

COMPUTER APPLICATIONS

Course/Paper: 01MSE105.2
MSE Semester-I
Introduction: Digital Computer Systems, problem solving techniques, introduction to programming languages, computer language and C++, source programme, Compilation and debugging.

C++ Programming Basics:
Using Turbo C++ , Basic program construction, preprocessor directive, #include, #define, Header and Library functions, Keywords, INPUT-OUTPUT Statements, comments, Constants, Variables, and operators, Formatting statements, ENDL and SETW manipulators.
Loops, Decision and Arrays:
WHILE, DO-WHILE and FOR loops, general structure and control. IF, IF-ELSE statements, SWITCH, BREAK, CONTINUE statements, GOTO and labels, ARRAY fundamentals, types, use and manipulation of 2-D arrays as Matrices.
FUNCTIONS:
Concept of modularization of structured programming. Basics of functions, their types declaration, definition and structure.
Object Oriented Programming Concept:
General concepts of Object Oriented Programming , Objects and Classes, Member Functions , user defined data , Pointers ,etc.
File Processing:
Streams , String I/O, Character I/O, Object I/O, input-output with Multiple objects, File Pointers, Disk I/O with Member Functions, Error Handing, Printer Output.
Practical Applications:
Programming for mathematical models of Civil Engineering problems and Management information systems, use of general purpose programmes.
Books recommended:
1 Object Oriented Programming with C++ by Robert Lafore
2. Object Oriented Programming with C++ by S.K. Panday.

SEMESTER II

FINITE ELEMENT ANALYSIS

Course/Paper: 02MSE101
MSE Semester-II
Introduction to Finite Element Method. Brief History of the Development. Advantages & Disadvantages of Finite Element Method. Finite Element Method- The Displacement Approach.
Foundations of the FEM- Energy Principles.
One Dimensional Finite Elements. Stiffness Matrix for the basic Bar & Beam Element Representation of Distributed Loading. The Assembly Process within the PMPE Approach. Element Stresses.
Shape Functions & Interpolation Polynomials. Refined One Dimensional Elements.
Finite Elements for Two Dimensional Planar Bodies. Triangular Elements for Plane Stress or Strain Conditions. Higher Order Triangular Elements. Rectangular Elements for Plane Stress or Strain Conditions. Higher Order Rectangular Elements : Lagrange Element Family.
Finite Elements for Three Dimensional Analysis. Tetrahedral Elements. Higher-Order Tetrahedra. Rectangular Hexahedral Elements. Higher-Order Rectangular Hexehedra: Lagrange Element Family.
Advanced Concepts In The Formulation of Two & Three Dimensional Elasticity Elements. Natural Co-ordinates. Area or Triangular Co-ordinates. Serendipity Rectangles & Hexahedra. The Isoparametric Concept. Properties of Isoparametric Elements. Numerical Integration.
Finite Elements For Plate Bending Analysis. A 12-Degree-Of-Freedom Rectangular Element (R1). Triangular Elements.
Books recommended:
Matrix & Finite Element Displacement Analysis of Structures: D.J.Dawe.
Matrix Finite Element Computer & Structural Analysis: M.Mukhopadhyay.
Finite Element Structural Analysis: T.Y.Yang.
Concepts & Applications of Finite Element Analysis: Robert D.Cook.

EARTHQUAKE RESISTANT DESIGN

Course/Paper: 02MSE102
MSE Semester-II

Introduction to Seismicity, Earthquake Motion and Response, Response Spectra, Philosophy of Capacity Design.
Concepts of seismic design: Earthquake resistant design of R.C.C Structures and IS:1893.
Earthquake resistant construction of R.C.C. Elements: Detailing aspects and IS:13920
Earthquake resistant design of Brick Masonry Structures and IS: 4326
Introduction to Indian Standards, related to Earthquake Engineering.
Earthquake resistant design of Bridges.

Books recommended:

1. Fundamentals of earthquake engineering Newmark N.M. and Rosenblueth E.
2. Earthquake Design practice for Buildings Key, D
3. Dynamics of Structures Anil K. Chopra
4. Dynamics of Structures Clough and Penzien
5. Seismic design of R.C.C & Masonry Structures

Pauley, T. and Priestley
6. Bridge Engineering: Seismic Design W.F. Chen & Lian Duan

ADVANCED CONCRETE DESIGN

Course/Paper: 02MSE103
MSE Semester-II

OVERALL REVIEW:
Review of Limit State Design of Beams, Slabs & Columns according to IS 456-2000. Calculation of Deflection & Crack Width according to IS 456-2000.

DESIGN OF SPECIAL RC ELEMENTS:
Design of Slender Columns, Grid Floors, Curved Beams, Deep Beams, Plain & Reinforced Concrete Walls, Corbels & Edge (Spandrel) Beams.

SLABS:
Design of Circular & Flat Slabs . Yield Line Analysis of Slabs.

FOLDED PLATES:
General Features . Structural Behaviour, Analysis & Design of Folded Plates.

Books recommended:
Advanced Reinforced Concrete Design, N.Krishna Raju (CBS Publishers & Distributors),
Advanced Reinforced Concrete Design, P.C.Varghese(Prentice Hall of India)

CONSTRUCTION TECHNIQUES AND MANAGEMENT

Course/Paper: 02MSE104
MSE Semester-II

Construction planning-Construction facilities, Schedules, Layout of Plant utilities, Construction methods: Excavation and handling of Earth and Rock; Production and handling of Aggregartes and Concrete , cooling of concrete in dams, Drainage treatment of aquifers/sub-terrainean reservoirs; Tunneling, Tunneling in soft rocks- Grouting , chimney formation,etc ; Construction control and management-CPM/PERT, Human Factors, Organisation.

References:

1. Peurifoy, R.L. and Ledbetter, W.B.; Construction Planning ,Equipment and Methods, McGraw Hill Singapore, 1986.
2. Robertwade Brown; Practical Foundation Engineering Handbook, McGraw Hill Publications , 1995.
3. Joy, P.K.; Total Project Management- The Indian Context, New Delhi, MacMillan India Ltd., 1992.
4. Uliman, John.E, et al; Handbook of Engineering Management, Wiley, New York , 1986.
5. Neville, A.M.; Properties of Concerte, Pitman Publishing Ltd.,London, 1978.

FOUNDATION ENGINEERING

Course/Paper: 02MSE105.1
MSE Semester-II
Overview of basic principles of geotechnical engineering, Geotechnical site investigations,
Introduction to Foundation Engineering

- Construction materials, Engineered structures, foundation materials.
- Load transfer device/interfacing element, superstructures, foundation structures/sub-structures, Need for load transfer device , objectives.
- Principles of foundation Engineering, challenging problems.
- Design requirements/ information needed for foundation design.
- Classification of foundations (Flexible, rigid, shallow and deep foundations).

Terminology involved in Foundation Analysis and Design
Gross bearing capacity, ultimate bearing capacity, net-ultimate bearing capacity, safe bearing capacity, net safe bearing capacity, safe bearing pressure, allowable bearing pressure.
Design Criteria for Foundation Design
Locatoin and depth criteria, shear failure criteria (safe bearing capacity criteria), settlement criteria (safe bearing pressure criteria).
Factors for Selection of Type of Foundation
Function of the structure and the loads it must carry, sub-surface condition of the soil, cost of super-structure.
Basic Design parameters for safe foundation design

- service loads (DL,LL,WL,EQL,SL,etc and their combination and reduction factors)
- safe bearing capacity
- size of footing (structural design by limit state design as in case of other RC members)
- soil pressure on foundation
- conventional analysis of foundations subjected to vertical loads and moments
- thickness of footing and its requirements
- minimum reinforcement requirement (IS:456)

Bearing Capacity of Shallow foundations
1. Bearing capacity based on the classical earth pressure theory of Rankine
2. Semi-empirical solutions based on theory of plasticity

(a). Prandtl's theory (b). Terzaghi's theory (c). Meyerhof's theory
(d). Brinch Hansen's theory (e). Vesic's theory (f). Balla's theory
(g). Skempton's theory (h). Caquot & Kerisel's theory
(i). Frochlicl's theory
3. Exact methods based on theory of plasticity:
(a). Sokolovski's theory (1960) (b). KO etal's (1973) Non-dimensional sol.
4. Semigraphical methods of :
(a). Fellinius for clay soils, and
(b). Button, Brown, Meyerhof and Vesic for two layer stratified deposits.
5. Penetration Tests (insitu-tests):
(a). SPT- Standard penetration test,
(b). SCPT- Static cone penetration test
(c). DCPT- Dynamic cone penetration test
(d). PMT- pressure meter test.
(e). VST- vane shear test.
(f). PLT- plate load test (Insitu- test).
Settlement of shallow foundations, Need for Raft foundations and design methods.
Pile Foundations
Types of piles, selection and installation, behaviour of single pile under vertical load : load transfer mechanism, methods of determining ultimate load bearing capacity of a single pile (c, c-ϕ & ϕ soils)- skin resistance (straight shaft, tapered piles) point bearing capacity, vertical bearing capacity of pile groups, settlement of pile groups, effect of negative skin friction on bearing capacity.
Vertical Piles Subjected to lateral loads:
Solution for laterally loaded single pile, closed form solution for pile of infinite length, P-y curves for the solution of laterally loaded piles in sand and clay, modulous of subgrade reaction, finite difference method,

Pile groups subjected to vertical and lateral loads.
Design and construction of well foundations/caissons
Foundations on expansive and collapsible soils.
Foundation soil improvements.

Books Recommended:

Kasmalkar, J.B. (1997). Foundation Engineering, Pune Vidyarthi Graha Prakashan-1786, Pune-411030.
Bowels, Joseph E.(1996). Practical Foundation Engineering Handbook. 5th edition, McGraw-Hill, New York.
Das, Braja M. (1999). Principles of foundation Engineering, 4th edition, PWS publishing, Pacific Grov. Calif.
Peck, Ralph B., Hansen, Walter E., and Thornburn, Thomas H. (1974). Foundation Engineering. John Wiley & Sons, New York.
Praksh, Shamsher, and Sharma, Hari D. (1990). Pile foundation in Engineering Practice, John Wiley & Sons, New York.
Som, N.N., and Das, S.C. (2003). Foundation Engineering: Principles and Practice. Prentice –Hall of India Pvt. Ltd. New Delhi-001.
Varghese, P.C. (2005). Foundation Engineering Prentice –Hall of India Pvt. Ltd. New Delhi-001.
Tomlonson, Michael J. (1995). Foundation Design and Construction. 6th edition. John Wiley & Sons, New York.

SOLID MECHANICS

Course/Paper: 02MSE105.2
MSE Semester-II

two dimensional problems in Cartesian and polar co-ordinates for simple problems.

Torsion:

Torsion of non-circular sections: methods of analysis- membrane analogy- torsion of thin rectangular and hollow thin walled sections.

Energy methods:

Energy methods: Principles of virtual work- energy theorm- Rayleigh-Ritz method- Finite difference method.

Introduction to problem in Plasticity:

Physical assumptions – criterion of yielding, yield surface, Flow rule (Plastic stress and strain relationship). Elastic plastic problems of beams in bending – plastic torsion.

Books recommended:

Theory of Elasticity By Timoshenko, S. and Goodier T.N.,
Theory of Elasticity By Chenn, W. P and Henry D. J
Theory of Elasticity By Sadhu Singh.

SEMESER III

DESIGN OF INDUSTRIAL STRUCTURES

Analysis of Stress and Strain:

Analysis of stress and strain, stress-strain relationship. Generalized Hook's law. Plane stress and plain strain.

2D Problems:

Course/Paper: 03MSE101
MSE Semester-III

1. Planning of Industrial Structures.
2. Design of Single & Multi-bay Industrial Structures in Concrete & Steel.
3. Bunkers & Silos.
4. Chimneys.
5. Towers.
6. Hyperbolic Cooling Towers.

Books recommended:

1. Advanced Reinforced Concrete Design, By N. Krishna Raju (CBS Publishers & Distributors).
2. Design of Steel Structures, By Ram Chandra.
3. Design of Steel Structures, By Duggal.

BRIDGE ANALYSIS AND DESIGN

Course/Paper: 03MSE102
MSE Semester-III
Introduction and selection of type of Bridges, Loads and forces, Theories of Lateral Load distribution, and design of Super-Structure. Grillage Analogy. Design of Composite Bridges (Steel and Conc.), Box girder bridges in concrete. Design of Abutments, Piers and their foundations. Design of Bearings. Construction methods and maintenance of Bridges.
Books recommended:
Concrete Bridge Design By Rowe, R.E
Design of Bridges By Victor Johnson
Concrete Bridge Practice Analysis,
Design and Economics By Raina V.K.

SEMESTER IV

DISSERTATION

Course/Paper: 01MSE201
MCE Semester IV

The student will submit a synopsis at the beginning of the semester for the approval from the University project committee in a specified format. Synopsis must be submitted within a two weeks. The first defense, for the dissertation work, should be held with in a one month. Dissertation Report must be submitted in a specified format to the University for evaluation purpose.