SIKSHA 'O' ANUSANDHAN UNIVERSITY
INSTITUTE OF TECHNICAL EDUCATION & RESEARCH

CIVIL ENGINEERING

COURSE CURRICULUM – CUM – DETAILED SYLLABI
FOR M.TECH PROGRAMME
(STRUCTURAL ENGINEERING)

SIKSHA 'O' ANUSANDHAN UNIVERSITY
INSTITUTE OF TECHNICAL EDUCATION & RESEARCH
COURSE CURRICULUM FOR M.TECH PROGRAMME IN CIVIL ENGINEERING

(STRUCTURAL ENGINEERING)

1st Semester			
Subject Code	**Theory**	**Contact Hours**	**Credit**
	Departmental Core		
MCET 01	1. Advanced Structural Analysis	4-0-0	4
MCET 02	2. Theory of Elasticity & Plasticity	4-0-0	4
MCET 03	3. Advanced Design of Concrete Structures	4-0-0	4
	Departmental Elective-I (Any one)		
MCET 04	1. Bridge Engineering	3-0-0	3
MCET 05	2. Advanced Foundation Engineering		
MCET 06	3.Stability of Structures		
	Allied Departmental Elective-I (Any one)		
MCAT 03	1. Advanced Computational Technique	3-0-0	3
MECT 16	2. Soft Computing		
MHST 01	Communication Skill (Audit)	0-0-0	00
	Total Credits (Theory)		**18**
	Sessional/Practical		
MCEP 01	Concrete /Structural Lab	0-0-3	2
MCAP 01	Computational Lab	0-0-3	2
	Total Credits (Sessional)		**4**
	Total Credits		**22**

2nd Semester			
Subject Code	**Theory**	**Contact Hours**	**Credit**
	Departmental Core		
MCET 07	1.Structural Dynamics	4-0-0	4
MCET 08	2.Theory of Plates and Shells	4-0-0	4
MCET 09	3. Advanced Steel Structures	4-0-0	4
	Departmental Elective-II (Any one)	3-0-0	3
MCET 10	1. Composite Structures	3-0-0	
MCET 11	2. Prestressed Concrete	3-0-0	
MCET 12	3. Earthquake Engineering		
	Allied Departmental Elective-II		
MCAT 14	1. Optimization Techniques	3-0-0	3
	Total Credits (Theory)		**18**
	Sessional/Practical		
MCEP 02	Design & Detailing of Structures	0-0-3	2
MCEP 03	Mini Design Project	0-0-3	2
MCEP 04	Seminar	0-0-3	2
MCEP 05	Comprehensive Viva-Voce-I	0-0-3	2
	Total Credits (Sessional)		**8**
	Total Credits		**26**

3rd Semester			
Subject Code	**Theory**	**Contact Hours**	**Credit**
MCET 13	**Departmental Core** 1. Finite Element Method	4-0-0	4
MCET 14 MCET 15	Departmental Elective-III (Any one) 1. High Rise Structures 2. Advanced Construction Management	3-0-0 3-0-0	3
	Total Credits (Theory)		**7**
	Sessional/Practical		
MCEP 06	Project – I		10
MCEP 07	Seminar – II	0-0-3	2
MCEP 08	Comprehensive Viva-Voce – II		2
	Total Credits (Sessional)		**14**
	Total Credits		**21**

4th Semester			
Subject Code	**Theory**	**Contact Hours**	**Credit**
MCEP 09	Project & Dissertation		20
MCEP 10	Comprehensive Viva-Voce – III		2
	Total Credits (Sessional)		**22**

Total Credits of the Course = 91

DETAILED SYLLABI FOR M. TECH. PROGRAMME

(STRUCTURAL ENGINEERING)
1ST SEMESTER

MCET 01 ADVANCED STRUCTURAL ANALYSIS 4 Credits [4-0-0]

Static and Kinematics indeterminacy, Principle of virtual work, flexibility and stiffness matrices; Element Matrix, Global Matrix, Transformation, (analysis of trusses, beams and frames).

Plastic analysis of structures

Text Books

1. W. Weaver Jr. and J.M Gere, Matrix analysis of Frames and Structures, CBS Publishers and Distributors
2. Pandit & Gupta, Structural analysis – A Matrix Approach, Tata McGraw Hill

Reference Books

3. B. G. Neal, Plastic analysis of structures – Chapman & Hall
4. Manicka Selvam, Limit analysis of Structures, Dhanpat Rai and Sons

MCET 02 THEORY OF ELASTICITY AND PLASTICITY 4 Credits [4-0-0]

Theory of stresses inifitesimal and finite strains. Strain-displacement relationships. Compatibility, stress-strain relationship. Elastic Constants. Stress and displacement functions. Plane problems in Cartesian and polar coordinates Torsion.

Elements of plasticity, failure and yield criteria, flow rule, velocity field, plastic stress-strain relations. Incremental plasticity.

Text Books

- S.P. Timosenko and J.N. Goodier, "Theory of Elasticity", 3rd Edition, McGraw Hill, 1970.
- N. Filonenko-Borodich, "Theory of Elasticity", MIR Publication, 1965.

Reference Books

- S. Valliappan, "Continuum Mechanics Fundamentals" - Balkema academic and technical publications
- M. Kachanov. "Theory of Plasticity", MIR Publication.
- C.R. Calladine, "Plasticity for Engineers" Ellis Horwood, Chichester, U.K., 1985

MCET 03 ADVANCED DESIGN OF CONCRETE STRUCTURES 4 Credits [4-0-0]

Introduction to limit state of collapse in flexure, shear and torsion – design concept of beams and slabs

Limit state of collapse in compression – uniaxial and biaxial bending of columns. Slender column. Construction of interaction chart.

Limit state of serviceability) Deflection – short term and long term deflection ii) Cracks-Calculation of crack width

Yield line theory for design of slabs. Non planar roof – Design of Pyramidal roof

Design of flat slabs: Direct design method & equivalent frame method. Grid flat slab.

Text Books

1) Design of R.C. Structure – Pillai & Menon, Tata McGraw Hill
2) Advance Design of Concrete Structure – P. C. Varghese, PHI

Reference Books

3) Advanced Concrete Structure Design – Krishna Raju, CBS Publishers

MCET 04 BRIDGE ENGINEERING 3 Credits [3-0-0]

Introduction: Historical review, engineering and aesthetic requirements in bridge design, introduction to bridge codes. Scour – factors affecting & evaluation of scour depth
Bridge foundation – Open, pile, well & caisson, Design of piers, abutments and wing walls
Super Structure – Analysis & design of right, skew & curved slabs.
Girder Bridges – Design of T beam and Box girder bridges. Introduction to balanced cantilever bridges, arch, cable stayed and suspension bridges. Brief approach to prestressed concrete & steel bridges.
(Use of relevant codes of practice are permitted in exam)

Text Books

1. D.J. Victor – Essentials of Bridge Engineering, Oxford & IBH Publishing
2. V.K. Raina – Concrete Bridges Practice, Shroff Publication, New Delhi

Reference Books

3. Vazirani, Ratwani, Aswani – Design of Concrete Bridges, Khanna Publisher
4. Principles of Foundation Engineering - B.M. Das, Thomson Publication
5. IRS Section I, II, III, IRS Code of Practice for Railway Bridges,

MCET 05 ADVANCED FOUNDATION ENGINEERING 3 Credits [3-0-0]

Machine Foundation – Types of Machine Foundation based on different criteria, Design criteria for different foundations subjected to dynamic loading, vibration isolation.

Foundations on difficult soils – Expansive soils, Mechanism of swelling and suitable foundations. Collapsible soil, characteristics & suitable foundation.
Unstable soil – characteristics & suitable foundations.
Caisson & well foundation. Pile foundation.

Text Books

1. Principles of foundation Engineering, B.M. Das. Ceannage Publishers
2. Foundation Design and Principles, M. J.Tomlinson

Reference Books

3. Machine foundation, By B.M. Das , Ceannage Publishers
4. Soil Dynamics and Machine Foundation, Shamsher Prakash
5. A Hand book of Machine foundation, Srinibasulu and Vaidyanathan

MCET 06 STABILITY OF STRUCTURES 3 Credits [3-0-0]

Torsion of thin walled open sections, warping displacements under pure torsion,-Warping constants for rolled steel section. Strain energy in bending and torsion of members of thin walled open section including the effects of warping. Torsional buckling including the effects of Wagner's effect, flexural torsional buckling (with centroid and shear centres coincident); Lateral buckling of beams under pure bending central point load through centre of gravity of the section. Cantilever beams with point load at the free end, Application of Rayleigh-Ritz method; Beam-columns on rigid supports-concentrated and continuous lateral loads with simply supported and built in-ends. Continuous beam with axial loads. Application of trigonometric series. Inplane buckling of bars; Approximate calculation of critical loads for bar structures by energy method- a bar on elastic foundation, a bar with intermediate compressive forces, bar under distributed axial loads, a bar with changes in cross section; Effects of shearing force on the critical load.

Text Books

1. S.P. Timoshenko and J. M. Gere, Theory of Elastic Stability, MC Graw Hill
2. A. Kumar, Stability of Structures, Allied Publishers Ltd., New Delhi, 1998
3. M.R.Horns and W.Merchang, The stability of frames, Porgamon press, 1965.

Reference Books

4. M.Gregory, Elastic Instability, spon's Civil Engineering series, 1967.
5. F.Bleich, Buckling strength of Metal structures,Mc Graw Hill Book co.,1952
6. T.V Galambos, Structural members and frames, Prentice-Hall INC, 1968

2ND SEMESTER

MCET 07 STRUCTURAL DYNAMICS 4 Credits [4-0-0]

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.

Single Degree of Freedom (SDOF) Systems: damped free vibrations, critically damped, under damped & over damped systems, formulation of differential equation of motion: 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. 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.

Text Books/Reference Books

1. K. Chopra – Dynamics of Structures: Theory and applications to earthquake engineering, Prentice Hall of India
2. W.T. Thomson – Theory of Vibrations - Kluwer Academic Pub

MCET 08 THEORY OF PLATES AND SHELLS 4 Credits [4-0-0]

Plate equation and behaviour of thin plates in Cartesian and polar coordinates. Isotropic and orthotropic plates, Bending and twisting of plates, Navier's Solution and energy methods, rectangular and circular plates with various end conditions, Approximate methods, Plates with variable rigidity, Numerical solutions.

Shells behaviour, Shells surfaces and characteristics classification of shells, equilibrium equations in curvilinear coordinates, force displacement relations, Membrane and bending theory of shells of revolution, cylindrical shells and shallow shells. Numerical methods in shell problems.

Text Books/Reference Books

1) S. P. Timoshenko and Woinowsky-Krieger, Theory of plates and shells, Mc Graw Hill International, New Delhi.
2) G. S. Ramaswamy, Design and construction of concrete shells Roofs, CBS Publishers, Delhi.

MCET 09 ADVANCED STEEL STRUCTURE 4 Credits [4-0-0]

Design in light gauge steel, Design of Transmission towers and stacks.
Design of plate girder and gantry girder. Multistoried Buildings
Design of water tanks and stagings
Design of industrial trusses

Text Books

1. P. Dayaratnam – Design of Steel Structure, Oxford & IBH
2. B. C. Punmia, A.K. Jain & A. K. Jain – Comprehensive Design of Steel Structure, Laxmi Publication

Reference Books

3. Arya, Ajmani – Design of Steel Structure , NemChand and Brothers

MCET 10 COMPOSITE STRUCTURES 3 Credits [3-0-0]

Introduction: definition, Classification and characteristics of Composite materials, advantages and limitations, Current Status and Future Prospects; Basic Concepts and characteristics: Homogeneity and Heterogeneity, Isotropy, Orthotropy and Anisotropy; Characteristics and configurations of lamina, laminate, micromechanics and macromechanics. Constituent materials and properties; Elastic behavior of unidirectional lamina: Anisotropic, separately orthotropic and transversely isotropic materials, stress-strain relations for thin lamina, transformation of stress and strain, transformation of elastic parameters; Strength of unidirectional lamina: Macromechanical failure theories- Maximum stress theory, maximum strain theory, Deviatoric strain energy theory (Tsai-Hill), Interactive tensor polynomial theory (Tsai-Wu); Elastic Behavior of multidirectional laminates: Basic assumptions, Stress-strain relations, load deformation relations, symmetric and balanced laminates, laminate engineering properties; Bending and vibration of laminated plates: Governing equations, Deflection of simply supported rectangular symmetric angle-ply, specially orthotropic, anti-symmetric cross-ply laminates; Recent advances: Functionally graded materials, Smart materials.

Text Books

1. R.M. Jones, Mechanics of Composite materials, Taylor and Francis, 1999.
2. I. M. Daniel and O. Ishai, Engineering mechanics of Composite materials, Oxford university press, 1999
3. P.K. Mallick, Fiber-reinforced Composites, Marcel Dekker Inc, 1988.

Reference Books

4. D. Hull and T. W. Clyne, An introduction to composite materials, Cambridge university press, Second Edition, 1996.
5. J.N. Reddy, Mechanics of laminated composite plates and shells-Theory and Analysis, CRC Press, Boca Raton, Second Edition, 2003.
6. M. Mukhopadhyay, Mechanics of Composite Structures, Oxford & IBH

MCET 11 PRESTRESSED CONCRETE 3 Credits [3-0-0]

Materials – Steel, concrete and their properties. Methods of prestressing, Loss of prestress – Shinkage, Creep, friction and other factors, Design of simply supported beams – Basic assumptions, sign convention, stress in concrete and steel due to load and prestress, Cracking moment.

Shear and principal stress in homogeneous elastic beams, Partial prestress and non prestress reinforcement, Beam deflection, cable profiles. Anchorage zone stress in post tensioned beams, Design of continuous beams Principles of design of prismatic continuous beams of two and three equal, unequal spans, Beams with variable moments of inertia. Cap cables, Jaque Mullers theorem. Critical spans, Composite construction of prestressed and in situ concrete, Advantage of construction, method of construction, analysis of stresses. Design of composite beams. Prestressing of rigid frame, Circular tanks and pipes.

Text Books

1) Limit State Design of Prestressed concrete Vol. I & II – Y. Guyon. - Applied Science Publishers Ltd, London
2) Design of Prestressed Concrete Structures – T. Y. Lin – John Wiley & Sons.

Reference Books

3) The Mechanics of Prestressed Concrete Design – S.K. Mallick and K. S. Rangaswami. – Khanna Publishers, Delhi.
4) Prestressed Concrete – N. Krishna Raju – CBS Publishers & Distributors

MCET 12 EARTHQUAKE ENGINEERING 3 Credits [3-0-0]

Characterization of ground motion; Earthquake intensity and magnitude; Recording instruments and base line correction; Predominant period and amplification through soil; Earthquake spectra for elastic and inelastic systems; Idealization of structural systems for low, medium and high rise buildings; Lateral force evaluation by mode superposition and direct integration; Reserve energy technique; Effect of foundation/soil on earthquake response; Analysis for torsion; Review of damages during past earthquakes and remedial measures; Reinforcement detailing for members and joints coupling; Codal provisions.

Text Books

1) Clough R.W. and Penzien J., 'Dynamics of Structures', McGraw-Hill, 2nd edition, 1992
2) Newmark N.M. and Rosenblueth E., 'Fundamentals of Earthquake Engg.', Prentice Hall, 1971.

Reference Books

3) David Key, 'Earthquake Design Practice for Buildings', Thomas Telford, London, 1988.
4) Wiegel R.L., 'Earthquake Engg.', Prentice Hall, 1970.
5) Blume J.A., Newmark N.M., Corning L.H., 'Design of Multi-storied Buildings for Earthquake ground motions', Portland Cement Association, Chicago, 1961.
6) Proc. World Conferences on Earthquake Engg. 1956-1992.
7) I.S. Codes No. 1893, 4326, 13920 etc.

3RD SEMESTER

MCET 13 FINITE ELEMENT METHOD 4 Credits [4-0-0]

Equations of Equilibrium, Strain displacement relations, Stress strain Relations, Plane stress and plane Strain problems, Basics of finite element method (FEM), different steps involved in FEM, Different approaches of FEM, Direct method, Energy approach, Weighted residual Method; Finite Element modeling of one and two dimensional problems. Isoparametric elements, four node, eight node elements. Numerical integration, order of integration; Bending of plates, rectangular elements, triangular elements and quadrilateral elements, Concept of 3D modeling.

Text Books

1. R. D. Cook, Concepts and Applications of Finite Element Analysis, John Wiley, NewYork, 2004.
2. O. C. Zienkiewicz and R. L. Taylor, Finite Element Method, Butterworth Heinemann publication, 2000.

Reference Books

3. C.S. Krishnamoorty, Finite element methods, Tata-Mc Graw Hill, Second Edition, New Delhi, 2002.
4. T. R. Chandupatla & A. D. Belegundu, Introduction to Finite Elements in Engineering, Prentice Hall of India Pvt. Ltd., New Delhi, 5th Reprint, 1999
5. J. N. Reddy, An introduction to Linear Finite Element Method, Oxford University Press, Oxford, 2004.

MCET 14 HIGH RISE STRUCTURES 3 Credits [3-0-0]

Analysis of tall building frames, Lateral load analysis, multi bay frames, gravity loads, settlement of foundation. Analysis of shear walls – plane shear walls, infilled frames, coupled frames, frames with shear walls. Principle of three dimensional analysis of tall buildings; Perforated cores, pure torsion in thin tubes, bending and warping of perforated cores. Analysis of floor system in tall buildings, Vierendal girders, diagrid floors. Elastic and inelastic stability of frames and shear walls. Analysis of thermal stresses.

Text Books/Reference Books

1. B S Smith & A Coull, Tall Building Structures: - John Wiley & Sons.
2. W. Schueller, High Rise Building Structures: John Wiley & Sons.

MCET 15 ADVANCED CONSTRUCTION MANAGEMENT

Project planning and management: general information, construction activities, project network analysis (CPM), Activity-on-Arrow, Activity-on-Node Diagramming, Advanced Network Analysis Techniques, Time-Grid Diagram Method, Integration of Schedule and Cost for “Crushing”, resource scheduling construction project, cash flow, project control during construction.

Factors affecting selection of construction equipments, operation analysis. Probability basics, expected value, motion and time studies, Duration of a time study; Application of theory of queues to determine the most economical Number of Hauling units. Construction equipments, latest construction technology, Introduction to Primavera.

Text Books

1) R.L. Peurifoy & W. B. Ledbetter – Construction Planning, Equipments, and Methods – McGraw Hill Book Company
2) R. Chudley – Construction Technology, Vol. I & Vol. II – Longmen, Scientific & Technical

Reference Books

3) C.M.H. Barritt – Construction Technology, Level. II – Longmen, Scientific & Technical
4) Ahuja, H. N. – "Construction Performance Control by Network" – John Willey, New York.

MCDT 502 OPTIMIZATION TECHNIQUES 4 Credits [4-0-0]

Introduction: Need for engineering optimal design, Optimum design formulation: Design variable, objective function and constraints; Unconstrained optimization methods Single variable optimization methods: Region elimination method – Golden section search, Interval halving method; Gradient based method – Newton-Raphson, bisection and secant method. Multi variable optimization methods: Direct search method: Hooke-Jeeve pattern search, simplex reflection search, Powell's conjugate direction search. Gradient Based methods: Cauchy's steeped descent, Newton's method, Levenberg-Marquardt's method, Fletcher- Reeve method; Constrained optimization methods Kuhn Tucker condition, Penalty function method, Augmented Lagrangian method, sequential unconstrained minimization, cutting plane method; Introduction to Evolutionary algorithms: Need for evolutionary algorithms, Type of evolutionary methods, Introduction to Genetic algorithm (GA), Difference and similarities between GA and traditional methods. Basic operations of GA: reproduction, crossover, mutation and elitism. Binary coded and Real coded GA; Application of Optimization techniques to different Civil Engineering Problems.

Text Books

1. J.S. Arora, Introduction to Optimum Design, Elsevier, 2nd Edition, 2004.
2. K. Deb, Optimization for Engineering. Design: Algorithms & Examples, Prentice Hall India, 2006

Reference Books

3. S.S. Rao, Engineering Optimization: Theory & Practice , New Age International (P) Ltd, 3rd Edition, 1996, Reprint : June, 2008
4. K. Deb, Multi-Objective Optimization Using Evolutionary Algorithms, John Wiley, 2003

MCEP 501 Structural Engineering Laboratory 0-0-3

M.Tech in Civil Engineering

(Structural Engineering)

1) Determination of workability of concrete by

    - Flow table
    - Slump cone
    - Consistometer
    - Compaction factor apparatus

2) Determination of entrapped air in a given sample of concrete.

3) Determination of bulk density of a freshly mixed concrete sample.

4) Determination of permeability of concrete

5) Determination of flexural strength of concrete

6) Mix design of various grades of concrete

7) Determination of strain in a given concrete sample

8) Determination of strength of hardened concrete