M. TECH. CIVIL (STRUCTURAL & FOUNDATION ENGINEERING) 2016 ONWARDS

Total Contact Hours = 26 **Total Marks = 600** **Total Credits = 23**

SEMESTER 1st		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MCIE5-101	Matrix Structural Analysis	3	1	-	40	60	100	4
MCIE5-102	Advanced Foundation Engineering	3	1	-	40	60	100	4
MCIE5-103	Bridge Engineering	3	1	-	40	60	100	4
MCIE5-104	Non Destructive Testing Lab	-	-	6	60	40	100	3
Departmental Elective – I (Select any one)		3	1	0	40	60	100	4
MCIE5-156	Continuum Mechanics							
MCIE5-157	Advanced Numerical Analysis							
Departmental Elective – II (Select any one)		3	1	0	40	60	100	4
MCIE5-158	Pre Stressed Concrete Structures							
MCIE5-159	Behaviour & Design of Steel Structures							
Total	**Theory = 5 Lab = 1**	**15**	**5**	**6**	**260**	**340**	**600**	**23**

Total Contact Hours = 25 **Total Marks = 600** **Total Credits = 22**

SEMESTER 2nd		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MCIE5-205	Direct Stiffness Method	3	1	-	40	60	100	4
MCIE5-206	Structural Dynamics	3	1	-	40	60	100	4
MCIE5-207	CAD Lab	-	-	6	60	40	100	3
Departmental Elective – III (Select any one)		3	1	0	40	60	100	4
MCIE5-260	Analysis and Design of Bridges							
MCIE5-261	Concrete Technology							
Departmental Elective – IV (Select any one)		3	1	0	40	60	100	4
MCIE5-262	Advanced Concrete Design							
MCIE5-263	Composite Materials							
Open Elective – I (Select any one)		3	0	0	40	60	100	3
Total	**Theory = 4 Lab = 1**	**15**	**5**	**6**	**260**	**340**	**600**	**22**

Total Contact Hours = 11 **Total Marks = 500** **Total Credits = 25**

SEMESTER 3rd		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MCIE5-308	Professional Skills	3	1	-	40	60	100	4
MCIE5-309	Seminar	-	-	-	60	40	100	4
MCIE5-310	Project	-	-	-	60	40	100	10
Departmental Elective – V (Select any one)		3	1	0	40	60	100	4
MCIE5-364	Analysis of Plates							
MCIE5-365	Finite Element Analysis							
Open Elective – II (Select any one)		3	0	0	40	60	100	3
Total	**Theory = 3 Lab = 0**	**9**	**2**	**0**	**240**	**260**	**500**	**25**

Total Credits = 20

SEMESTER 4th		Contact Hrs			Evaluation Criteria	Credits
Subject Code	**Subject Name**	**L**	**T**	**P**		
MCIE5- 411	**Thesis**	**0**	**0**	**0**	**Satisfactory/ Unsatisfactory**	20

Overall

Semester	Marks	Credits
1st	600	23
2nd	600	22
3rd	500	25
4th	--	20
Total	**1700**	**90**

MATRIX STRUCTURAL ANALYSIS

Subject Code- MCIE5-101 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (10 Hrs.)

Basic Concepts of Structural Analysis: Static and Kinematic Indeterminacies of Beams, Rigid-Jointed Plane and Space Frames, Pin-Jointed Plane and Space Frames and Hybrid Structures, Actions and Displacements, Action and Displacement Equations, Generalized System of Coordinates, Slope-Deflection Equations in Generalized Coordinates, Relation Between Flexibility and Stiffness Matrices, Basic Definitions and Types Of Matrices, Matrix Operations, Matrix Inversion, Solution of Linear Simultaneous Equations, Matrix Partitioning.

Flexibility Matrix (Physical Approach): Development of Flexibility Matrices for Statically Determinate and Indeterminate Beams, Rigid-Jointed Plane Frames and Pin-Jointed Plane Frames Using Physical Approach.

Stiffness Matrix (Physical Approach): Development of Stiffness Matrices for Statically Determinate and Indeterminate Beams, Rigid-Jointed Plane Frames and Pin-Jointed Plane Frames Using Physical Approach, Reduced Stiffness Matrix, Total Stiffness Matrix, Translational or Lateral Stiffness Matrix.

UNIT-II (10 Hrs.)

Flexibility Matrix (Element Approach): Transformation of System Forces to Element Forces Through Force Transformation Matrix, Development of Flexibility Matrices for Statically Determinate and Indeterminate Beams, Rigid-Jointed Plane Frames and Pin-Jointed Plane Frames Using Element Approach.

Stiffness Matrix (Element Approach): Transformation of System Displacements to Element Displacements through Displacement Transformation Matrix, Development of Stiffness Matrices for Statically Determinate and Indeterminate Beams, Rigid-Jointed Plane Frames and Pin-Jointed Plane Frames Using Element Approach.

UNIT-III (12 Hrs.)

Flexibility Method of Analysis: Analysis of Continuous Beams, Rigid-Jointed Plane Frames and Pin-Jointed Plane Frames Using the Physical and Element Approaches, Effect of Support Settlements, Temperature Stresses and Lack of Fit.

UNIT-IV (12 Hrs.)

Stiffness Method of Analysis: Analysis of Continuous Beams, Rigid-Jointed Plane Frames and Pin-Jointed Plane Frames Using the Physical and Element Approaches, Effect of Support Settlements, Temperature Stresses and Lack of Fit, Comparison of Flexibility and Stiffness Methods of Analysis.

Recommended Books

1. William Weaver, Jr. James M. Gere, 'Matrix Analysis of Framed Structures'.
2. Madhu B. Kanchi, 'Matrix Methods of Structural Analysis', 2nd Edn., Wiley Eastern Ltd. **1993.**
3. K.I. Majeed, 'Non Linear Structure Analysis', Butterworth Ltd. London, **1973.**

ADVANCED FOUNDATION ENGINEERING

Subject Code: MCIE5-102 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (9 Hrs.)

Shallow foundations- Selection of Type and Depth of Foundations, Isolated Footings, Combined Footings, Mat Foundations Including Floating Raft, Settlement Calculations.

UNIT-II (16 Hrs.)

Pile Foundation- Introduction, Estimation of Pile Capacity by Static and Dynamic Formulae, Wave Equation Method of Analysis of Pile Resistance-Load-Transfer Method of Estimating Pile Capacity, Settlement of Single Pile, Elastic Methods. Laterally Loaded Pile- Modulus of Sub Grade Reaction Method, Ultimate Lateral Resistance of Piles. Pile Groups- Consideration Regarding Spacing, Efficiency of Pile Groups, Stresses on Underlying Soil Strata, Approximate Analysis of Pile Groups, Settlement of Pile Groups, Pilecaps, Pile Load Tests, Negative Skin Friction.

UNIT-III (10 Hrs.)

Deep foundations- Well Foundations, Pier Foundations, Caissons

UNIT-IV (10 Hrs.)

Earth Pressure Computation on Retaining Wall by Rankine and Coulomb's Wedge Theory, Cantilever and Anchored Sheet Pile, Coffer Dams

Recommended Books

1. Lambe and Whitman, 'Soil Mechanics', Wiley Eastern, **1976.**
2. B.M. Das, 'Advanced Soil Mechanics', Mc. Graw-Hill, NY, **1985**.
3. H.F. Winterkorn and H.Y. Fang Ed., 'Foundation Engineering Hand Book', Van-Nostrand Reinhold, **1975.**
4. J.E. Bowles, 'Foundation Analysis and Design', 4th Edn., Mc.Graw –Hill, NY, **1996.**
5. H.G. Poulose and E.H. Davis, 'Pile Foundation Analysis and Design', John-Wiley & Sons, NY, **1980.**
6. G. Leonards Ed., 'Foundation Engineering', Mc.Graw-Hill, NY, **1962.**
7. J.E. Bowles, 'Analytical and Computer Methods in Engineering', Mc.Graw-Hill, NY.
8. Sreenivasalu & Varadarajan, 'Handbook of Machine Foundations', Tata McGraw Hill.

BRIDGE ENGINEERING

Subject Code – MCIE5-103 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (10 Hrs.)

Introduction - Definition and Components of Bridges. Layout and Planning of Bridges, Classification, Investigations for Bridges, Preliminary Data Collection, Choice of Type of the Bridges, Hydraulic Design of Bridges, Traffic Design of Bridges.

UNIT-II (12 Hrs.)

Analysis and Design of Superstructure of Straight and Curved Bridge Decks-Loadings Details, Specification-Reinforced Concrete and Steel Decks. Decks of Various Types like Slab, Hollow and Voided Slab, Beam and Slam, Box Girder etc.

UNIT-III (11 Hrs.)

Design of Substructure - Piers and Abutments of Different Types. Analysis and Design of Foundations - Shallow Foundations (Open Foundations), Deep Foundations - Well Foundations and Caisson. Design and Constructional Aspects of Foundations.

UNIT-IV (12 Hrs.)

Modern Methods of Construction of Concrete and Steel Bridges- Their Impact on The Analysis and The Design. Introduction to Analysis and Design of Long Span Bridges like Suspension and Cable Stayed Bridges. Special Aspects in Analysis and Design, Based on Construction Methodology. Inspection and Maintenance and Rehabilitation of Bridges.

Recommended Books

1. Pama & Gusens, 'Bridge Deck Analysis'.
2. Edward V. Hambly, 'Bridge Deck Behaviour'.
3. D. Johnson Vector, 'Essentials of Bridge Engineering'.

NON DESTRUCTIVE TESTING LAB

Subject Code – MCIE5-104 **L T P C**
0 0 6 3

List of Experiments

1. Mix Design of concrete without admixtures as per IS Recommended Guidelines
2. Mix Design of concrete with admixtures as per IS Recommended Guidelines
3. Rebound Hammer Test
4. Ultrasonic Pulse Velocity Test
5. Bar Locator test
6. Split Tensile strength of Concrete.
7. Core Test

Recommended Books

1. M.L. Gambhir, 'Concrete Manua', Dhanpat Rai & Co.
2. P.S. Gahlot, Sanjay Sharma, 'Building Repair and Maintenance Management', CBS Publishers.
3. M.S. Shetty, 'Concrete Technology'.

CONTINUUM MECHANICS

Subject Code – MCIE5-156 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (10 Hrs.)

Vector and Tensors Algebra, Linearization and Directional Derivatives, Stress and Equilibrium, Analysis for Stresses, Translational and Rotational Equilibrium, Principal Stresses and Principal

Planes in 3D, Stress Invariants, Cauchy and Kirchhoff Stress Tensor, Deviatoric and Volumetric Components, Work Conjugancy, Octahedral and Von-Mises Stresses.

UNIT-II (10 Hrs.)

Kinematics, Linearized Kinematics, Strain Quadric of Cauchy, Principal Strains, Invariants, Equations of Compatibility, Finite Deformation, Material (Lagrangian) and Spatial (Eulerian) Descriptions, Deformation Gradient, Polar Decomposition, Volume Change, Distortional Component of Deformation Gradient, Area Change.

UNIT-III (12 Hrs.)

Equations of Elasticity, Hooke's Law, Generalized Hooke's Law, Anisotropic, Orthotropic and Isotropic Elasticity Tensor, Plane Stress and Strain Problems, Airy Stress Functions for Two-Dimensional Problems, Airy Stress Function in Polar Coordinates, Isotropic Hyper Elasticity, Three Dimensional Elasticity.

UNIT-IV (12 Hrs.)

Elasto-Plastic Behavior of Material, Elasto-Plastic Formulations, Material Yield Criteria- Von Mises, Tresca, Mohr-Coulomb, Ducker-Pager, Isotropic and Kinematic Hardening, Normality Principle, Plastic Flow Rule, Plastic Potential, Elasto-Plastic Stress-Strain Relations, Prandtl-Rauss Equations, Levy-Mises Relations, Hardening Modulus, Generalized Elasto-Plastic Stress-Strain Relations.

Recommended Books

1. David M. Potts and Lidija Zdravkovic, Thomas Telford, 'Finite Element Analysis in Geotechnical Engineering Theory', **1999.**
2. C.S. Desai, 'Mechanics of Materials and Interfaces: The Disturbed State Concept', CRC Press LLC, **2000.**
3. A.P.S. Selvadurai, M.J. Boulon, 'Mechanics of Geometrical Interfaces', Elsevier, **1995.**

ADVANCED NUMERICAL ANALYSIS

Subject Code – MCIE5 -157 **L T P C** **Duration: 45 Hrs**

3 1 0 4

UNIT-I (10 Hrs.)

Introduction, roots of a non-linear equation and roots of a polynomial of nth degree [incremental search method, method of successive approximations, Newton's method, bisection method, secant method, Müller's method, synthetic division, Bairstow's method] and convergence study.

UNIT-II (10 Hrs.)

Solution of (Non-Homogeneous) Linear Algebraic Equations, Review of Matrix Algebra, Gauss Elimination Method, Cholesky's Decomposition Method, Householder Method, Gauss-Siedal Iterative Method.

Solution of Non-Linear Algebraic Equations, Method of Successive Approximation, Newton's Method, Modified Newton – Raphson Method, Secant Method.

UNIT-III (12 Hrs.)

Eigen Values and Eigen Vectors, Reduction of Generalized Eigen Value Problem to The Standard Eigen Value Problem, Methods for Obtaining Eigen Values and Eigen Vectors [Polynomial Method, Vector Iteration Method, Mises Power Method, Jacobi Method] 08 6. Time

Marching schemes for solution of problems in time domain, numerical integration (2 – D) [Newton – Cotes method, Gauss – Legendre method]

UNIT-IV (12 Hrs.)

Solution of Ordinary and Partial Differential Equations, Euler's Method, Runge – Kutta Method, Finite Difference Method, Applications to Problems of Beam and Plates on Elastic Foundation, Laplacian Equation, Consolidation Equation, Laterally Loaded Piles Etc.

Recommended Books

1. S.C. Chapra and R.P. Canale, 'Numerical Methods for Engineers', Tata McGraw Hill, **2003.**
2. B. Carnahan, H.A. Luther and J.O. Wilkes, 'Applied Numerical Methods', John Wiley, **1969.**
3. M.T. Heath, 'Scientific Computing: An Introductory Survey', McGraw Hill, **1997.**
4. J. Douglas Faires and Richard Burden, 'Numerical Methods', Thomson, **2003.**
5. S. Rajasekaran, 'Numerical Methods in Science and Engineering', S. Chand, **1999.**

PRE STRESSED CONCRETE STRUCTURES

Subject Code – MCIE5 -158 **L T P C** **Duration: 45 Hrs.**

3 1 0 4

UNIT-I (10 Hrs.)

Limit State Design of Statically Determinate Pre-Stressed Beams- Limit State of Collapse by Flexure, Shear, Torsion Limit State of Serviceability. Anchorage Zone Stresses for Posttensioned Members.

UNIT-II (12 Hrs.)

Statically Indeterminate Structures- Analysis and Design- Continuous Beams and Frames. Choice of Profile, Linear Transformation, Concordancy, Omically Viable Profile. Composite Beam with Precast Prestressed Beams and Cast in Situ RC Slab analysis and Design.

UNIT-III (12 Hrs.)

Time Dependant Effects such as Creep, Shrinkage etc. on Composite Construction Inclusive of Creep Relaxation and Relaxation Creep - Partial Prestressing Principles, Analysis and Design of Simple Beams, Crack and Crack Width Calculations.

UNIT-IV (11 Hrs.)

Analysis and Design of Prestressed Pipes, Tanks and Spatial Structures Slabs, Grids, Folded Plates and Shells.

Recommended Books

1. Lundy, 'Prestressed Concrete Structures'.
2. T.Y. Lin, 'Prestressed Concrete'.
3. N. Krishna Raju, 'Prestressed Concrete'.

BEHAVIOUR & DESIGN OF STEEL STRUCTURES

Subject Code – MCIE5-159 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (09 Hrs.)

Concepts of Stability, Introduction to Buckling Behaviour of Columns, Stability of Beam-Columns and Frames. Lateral Instability of Beams.

UNIT-II (13 Hrs.)

Local Buckling and Post Buckling Behaviour of Plates, Behaviour and Design of Cold Formed Thin Walled Structures Subjected to Flexure and Compression.

UNIT-III (12 Hrs.)

Plastic Analysis and Design of Steel Structures, LRFD approach, Advanced Topics in Bolted and Welded Connections, Behaviour of Steel Concrete Composite Construction and Introduction to Brittle Fracture and Fatigue.

UNIT-IV (08 Hrs.)

Design of Steel Truss Bridges.

Recommended Books

1. S.P. Timoshenko and J.M. Gere, 'Theory of Elastic Stability', McGraw-Hill, **1963.**
2. A.S. Arya and J.L. Ajmani, 'Design of Steel Structures', Nem Chand & Bros. **2000.**
3. N. Subramanian, 'Design of Steel Structures', Oxford University Press, **2008.**
4. M.L. Gambhir, 'Stability Analysis and Design of Structures', Springer, **2005.**

DIRECT STIFFNESS METHOD

Subject Code – MCIE5-205 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (10 Hrs.)

Basic Concepts**:** Introduction, Identification of Members and Nodes, Global and Member Coordinates, Comparison with Classical Methods.

UNIT-II (10 Hrs.)

Element & Global Stiffness Matrices: Stiffness Matrix for Truss Element, Beam Element Stiffness Matrix, Rigid Frame Element Stiffness Matrix, Global Stiffness Matrix, Coordinate Transformation, Rotation Matrix: Displacement Transformation Matrix, Force Transformation Matrix.

UNIT-III (10 Hrs.)

Transformation of Stiffness Matrices: Construction of Structure or Global Stiffness Matrix, Load and Displacement Vectors, Load Vector of Loads Not Applied at Nodes.

UNIT-IV (15 Hrs.)

Analysis of Structures: Continuous Beams, Pin-Jointed Plane Frames and Rigid-Jointed Plane Frames Including Support Settlements using Direct Stiffness Matrix Method and Formalization of Direct Flexibility Matrix Method.

Application to Simple Grids & Trusses: Element Stiffness Matrix, Torsion Constant, Global and Element Forces.

Recommended Books

1. T.S. Thandavamoorthy, Weaver & Gere, 'Structural Analysis', Oxford Higher Education.
2. A.K. Jain, 'Advanced Structural Analysis'.
3. Menon, 'Advanced Structural Analysis'.

STRUCTURAL DYNAMICS

Subject Code – MCIE5-206 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (09 Hrs.)

Overview of Structural Dynamics, Single Degree of Freedom Systems – Analysis of Free Vibrations – undamped and damped systems, estimation of damping by logarithmic decrement method, Formulation of equation of motion for generalized SDOF dynamic problems using virtual work method, Response of SDOFS systems to Harmonic, Periodic, Impulse Loads.

UNIT-II (12 Hrs.)

Formulation of Equation of Motion for Two/Three DOF Systems. Finding Mode Shapes and Frequencies by Solving the Determinantal Equation and Iterative Techniques. Use of Sweeping Matrices for Obtaining Higher Modes. Proof of Convergence. Modal Superposition and Response Spectrum Methods.

UNIT-III (12 Hrs.)

Response of Single and Multiple DOFS Systems to Earthquake Loading using Time stepping Methods Based on Forward Cauchy Euler, Backward Cauchy Euler and Trapezoidal Rule. Accuracy, Stability and Algorithmic Damping in Step-By-Step Methods. Earthquake Response Analysis of Multi-DOF Systems Subjected to Earthquake Ground Motion. Concept of Modal Mass and Mode Participation Factors, etc.

UNIT-IV (09 Hrs.)

Newark & Hall's Linear and Inelastic Response Spectra for Earthquakes 6 6. Introduction to IS Code Provisions Regarding Earthquake.

Recommended Books

1. Ray W. Clough & Penzien, 'Dynamics of Structures', Mc Graw Hill, **1993.**
2. Anil Chopra, 'Dynamics of Structures', Mc Graw Hill, **2001.**

CAD LAB

Subject Code – MCIE5-207 **L T P C**
0 0 6 3

List of Experiments

1. Computer Aided Analysis & Design of Reinforced Concrete Elements Such as Beams, Slabs.
2. Computer Aided Analysis & Design of Steel Elements Such as Connections, Tension Members, Compression Members, Beams, Column Base, and Roof Trusses.
3. To Develop a Complete Self Reliance in Solving Analysis and Design Problems of Engineering with the use of Computers. The Effort Must Culminate with a CAD Program and a Project Report.

4. To Develop a Complete Self Reliance of Software Used for the Structural Analysis & Design.

ANALYSIS AND DESIGN OF BRIDGES

Subject Code – MCIE5-260 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (10 Hrs.)

Structural Forms and Design Loads for Bridges, Effective Width Concept and Load Distribution in Multi-Beam Bridges.

UNIT-II (10 Hrs.)

Grillage Analogy, Design of R.C. and Pre-Stressed Concrete Slab Bridges.

UNIT-III (12 Hrs.)

Design of R.C. and Pre-Stressed Concrete Girder Bridges, Behaviour of Box-Girder Bridges, Introduction to Arch Bridges, Suspension and Cable Stayed Bridges.

UNIT-IV (10 Hrs.)

Different Types of Bearings and Design of Elastomeric Bearings, Introduction to Secondary Effects, Temperature, Shrinkage, Creep. Construction Techniques and Effects of Construction Sequence on Design.

Recommended Books

1. N. Rajagopalan, 'Bridge Superstructure', Narosa Publishing House, **2010.**
2. D.J. Victor, 'Essentials of Bridge Engineering', Oxford & IBH Publishing, **2001.**
3. 'Code of Practice for Concrete Road Bridges - IRC:112-2011', Indian Road Congress. **2011.**
4. 'Standard Specifications and code of Practice for Bridges, Section II- Loads and Stresses - IRC:6-2010', Indian Road Congress, **2010.**
5. E.C. Hambly, 'Bridge Deck Behaviour', Chapman and Hall, London, **1976.**

CONCRETE TECHNOLOGY

Subject Code – MCIE5-261 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (10 Hrs.)

Ingredients of Concrete: Review of Cements including Blended Cements, Manufacture, Chemical Composition, Aggregates: Review of Types; Elementary Mineralogy and Petrology; Sampling and Testing; Effects on Properties of Concretes, Chemical and Physical Processes of Hydration. Mineral Admixtures: Pulverized Fly Ash, Ground Granulated Blast Furnace Slag and Silica Fume; Chemical Composition, Physical Characteristics, Chemical and Physical Processes of Hydration and Interaction, Effects on Properties of Concretes.

UNIT-II (11 Hrs.)

Admixtures: Review of Types and Classification, Chemical Composition, Effects on Properties of Concretes. Fresh-Concrete: Rheology of Mortars and Concretes; Workability, Segregation and Bleeding, Theory and Principles governing the correct transportation, Placing, Compaction and Curing of Concrete. Plastic Settlement and Plastic Shrinkage, Exothermic Characteristics: Early

Age Thermal Movements, Strength Development, Maturity, Accelerated Curing, Hot and Cold Weather Concreting.

UNIT-III (12 Hrs.)

Properties of Hardened Concrete: Strength, Deformation under Load, Elasticity, Creep, Drying Shrinkage and other volume Changes. Thermal Properties, Durability of Concrete and Concrete Construction: Durability Concept, Pore Structure and Transport Processes, Reinforcement Corrosion, Fire Resistance, Frost Damage, Sulfate Attack, Alkali Silica Reaction, Methods of Providing Durable Concrete.

UNIT-IV (12 Hrs.)

Concrete Mix Design: The process of Mix Selection, Factors governing the selection of Mix Proportions, Combining Aggregates to obtain Specified Grading, Different Methods of Mix Design, Concepts of Statistical Quality Control of Concrete Construction, Special Concretes: Lightweight Concrete, No-Fines Concrete, High Performance Concrete, High Density and Radiation-Shielding Concrete, Polymer Concrete, Fibre Reinforced Concrete, Self Compacting Concrete, Roller Compacted Concrete, High Volume Fly Ash Concrete, Ready Mixed Concrete.

Recommended Books

1. A.M. Neville and J.J. Brooks, 'Concrete Technology', 1st Edn., **2002.**
2. P.K. Mehta and Paulo J.M. Monteiro, 'Concrete: Microstructure, Properties and Materials', 3rd Edn., **2006.**

ADVANCED CONCRETE DESIGN

Subject Code – MCIE5-262 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (08 Hrs.)

Plastic Section Theory for Reinforced Concrete Including Interaction of Flexure Shear-Axial Effects, Upper Bound and Lower Bound Plastic Theorems.

UNIT-II (13 Hrs.)

Application of Plastic Analysis to Frames – Instantaneous Centre of Rotations, Introduction to Pushover Analysis, Introduction to Strut-Tie Models, Strut-Tie Models for Deep Beams, Beam-Column Joints & Shear Walls**.**

UNIT-III (12 Hrs.)

Introduction to Yield Line Analysis and Application for Slabs, Raft Foundations etc, Introduction to Pre-Stressed Concrete and Behaviour for Simple Elements.

UNIT-IV (12 Hrs.)

Modelling of Creep/Shrinkage and Long Term Effects for RCC and Prestressed Concrete, Calculation of Crack Widths and Crack Control Designs.

Recommended Books

1. McGregor & White, 'Reinforced Concrete: Mechanics and Design', 6th Edn., **2011.**
2. Edward Nawy, 'Reinforced Concrete: A Fundamental Approach', 6th Edn., **2008**.
3. Arthur H. Nilson, 'Design of Prestressed Concrete', 2nd Edn., **1987.**
4. Darwin & Dolan, 'Design of Concrete Structures', 14th Edn., **2009.**
5. Edward Nawy, 'Prestressed Concrete: A Fundamental Approach', 5th Edn., **2005.**

6. J. Schlaich, K. Schaefer and M. Jennewin, 'Toward a Consistent Design of Structural Concrete', PCI Journal V. 32, No. 2, pp. 72-150, **1987.**
7. Kennedy & Goodchild, 'Practical Yield Line Design', The Concrete Centre, TCC/03/3, **2004.**

COMPOSITE MATERIALS

Subject Code – MCIE5-263 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (10 Hrs.)

FIBRE REINFORCED CONCRETE: Properties of Constituent Materials, Mix Proportions, Mixing and Casting Procedures, Properties of Freshly Mixed Frc, Mechanics and Properties of Fibre Reinforced Concrete, Composite Material Approach, Application of Fibre Reinforced Concrete.

UNIT-II (12 Hrs.)

FLY ASH CONCRETE: Classification of Indian Fly ashes, Properties of Fly ash, Reaction Mechanism, Proportioning of Fly Ash Concretes, Properties of Fly Ash Concrete in Fresh and Hardened State, Durability of Fly Ash Concrete. Ferro Cement: Constituent Materials and Their Properties, Mechanical Properties of Ferro Cement, Construction Techniques and Application of Ferro Cement. Light Weight Concrete: Properties of Light Weight Concretes, Pumice Concrete, Aerated Cement Mortars, No Fines Concrete, Design and Applications of Light Weight Concrete.

UNIT-III (10 Hrs.)

POLYMER CONCRETE: Terminology used in polymer concrete, Properties of constituent materials, Polymer impregnated concrete, Polymer modified concrete, Properties and applications of polymer concrete and polymer impregnated concrete.

HIGH PERFORMANCE CONCRETE: Materials for high performance concrete, Supplementary cementing materials, Properties and durability of high performance concrete, Introduction to silica fume concrete, Properties and applications of silica fume concrete.

UNIT-IV (13 Hrs.)

SULPHUR CONCRETE AND SULPHUR INFILTRATED CONCRETE: Process Technology, Mechanical Properties, Durability and Applications of Sulphur Concrete, Sulphur Infiltrated Concrete, Infiltration Techniques, Mechanical Properties, Durability and Applications Of Sulphur Infiltrated Concrete.

Recommended Books

1. A.M. Nevillie, 'Concrete Technology'.
2. M.L. Gambhir, 'Concrete Technology'.
3. M.S. Shetty, 'Concrete Technology'.

SEMINAR

Subject Code – MCIE5-309 **L T P C**
0 0 0 4

This is an unstructured open-ended course where under the overall supervision of a faculty member of his discipline. Each student must submit a seminar report as a culmination of his Endeavour and investigation. The course will aim to evaluate student's actual ability to use the fundamentals of knowledge and to meet new unknown situations as demonstrated by the students' interaction with the teachers.

PROJECT

Subject code – MCIE5-310 **L T P C**
0 0 0 10

A student can work on the following types of Projects:

1. **Lab Oriented Projects:** These include Projects Involving Laboratory Investigation or Laboratory Development in The Students' Discipline or Interdisciplinary Areas. It Must Co-terminate with A Project Report.
2. **Study Oriented Projects:** These include Projects which are Oriented Towards Readings from Published Literature or Books About New Frontiers of Development or Analysis of Available Data Base. It must Co-terminate with A Project Report.
3. **Computer Oriented Projects:** These are Intended to Impart Practical Training to Students in The Areas of Computer Software and Hardware. The Projects would Be Student-Oriented, Individually Supervised by A Project Guide. It must Co-terminate with a Project Report.
4. **Projects on Organizational Aspects:** These Involve Projects Related to Thrust Areas Where Students re Expected to get Involved with Planning, Organization and Execution of New Ideas and Concepts. It Must co-terminate with a Project Report

ANALYSIS OF PLATES

Subject code – MCIE5-364 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (12 Hrs.)

Introduction to Theory of Elasticity: Introduction to The Elasticity Theory, Stress at a Point: Stress Tensor, Strains and Displacements, Constitutive Equations (Without Derivation), Equilibrium Equations (Without Derivation), Compatibility Equations (Without Derivation)
Rectangular Plates: Introduction, The Governing Equation for Deflection of Plates, bending of a Long, Uniformly Loaded Rectangular Plate (Simply Supported and Clamped Edges), Rectangular Plates Subjected to a Concentrated Load, Bending of Plates with Small Initial Curvature, Problems (Exact Analysis Using Charts/Tables and Approximate Analysis)

UNIT-II (10 Hrs.)

Pure Bending of Plates: Slope and Curvature, Pure Bending in Two Perpendicular Directions, Moment Curvature Relation, Anticlastic and Synclastic Surfaces, Thermal Stresses in Plates, Effect of Transverse Shear Deformation on Bending of Elastic Plates, Triangular Plates.

UNIT-III (12 Hrs.)

Circular Plates: Introduction, Plate Differential Equation, bending of a Circular Plate Subjected to a Lateral Pressure per unit area and a Centrally Placed Concentrated Load (Simply Supported and Clamped Edges), Bending of a Circular Plate Concentrically Loaded (Simply Supported and Clamped Edges), Deflection of a Symmetrically Loaded Circular Plate with a Circular Hole at the Centre, Problems.

UNIT-IV (11 Hrs.)

Orthotropic Plates: Introduction, Analysis by Orthotropic Plate Theory for Both Longitudinal as well as Transverse Structural Actions using the Design Charts Produced by Morice, Little and Rowe for Evaluating Bending Moment and Shear Forces, Problems.

Recommended Books

1. Timoshenko, 'Theory of Plates & Shells'.
2. Timoshenko, 'Theory of Elasticity'.
3. Dr. Sadhu Singh, 'Theory of Elasticity and Plasticity'.
4. N. Rajagopalan, 'Bridge Superstructure', Narosa Publishers.

FINITE ELEMENT ANALYSIS

Subject code –MCIE5-365 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

UNIT-I (11 Hrs.)

Basic Concepts, Discretization; Displacement, Force and Hybrid Models, Interpolation Functions for General Element Formulations: Compatibility and Completeness, Polynomial Forms: One Dimensional Elements, Geometric Isotropy, Triangular Elements, Rectangular Elements, Three Dimensional Elements, Isoperimetric Formulations, Axisymmetric Elements; Numerical Integration.

UNIT-II (11 Hrs.)

Applications in Solid Mechanics: Plane Stress/Strain: FE Formulation: CST, LST; Stiffness Matrix, Load Matrix Formation Rectangular Element Isoparametric Formulation: Plate Elements and Shell Elements, Three Dimensional Elements FE Formulation: Axisymmetric Stress Analysis, Torsion, Interface Elements, Infinite Elements.

UNIT-III (13 Hrs.)

Application in Structural Dynamics and Vibrations: Mass (Consistent and Diagonal) and Damping Matrices; Modal Analysis, Time History Analysis, Explicit Direct Integration/ Implicit Direct Integration and Mixed Methods. Introduction to Nonlinear Problems: Geometric and Material (Elasto-plastic), Solution Methods: Newton Ralphson Method, Modified Newton-Ralphson Method, Arc Method, A Problem of Geometric Nonlinearity**.**

UNIT-IV (10 Hrs.)

Stationary Principles, Rayleigh Ritz Method and Interpolation; Weighted Residual Methods and Variational Methods, Numerical Errors and Convergence

Recommended Books

1. David Hutton, 'Fundamentals of Finite Element Analysis', Tata McGraw Hill, **2005.**
2. R.D. Cook, Malkus and Plesha, 'Concepts and Applications of Finite Element Analysis', 3rd Edn., John Wiley. **1989.**
3. T. J. R. Hughes, 'The Finite Element Method: Linear Static and Dynamic Analysis', Prentice Hall, **1987.**
4. Klaus Juergen Bathe, 'Finite Element Procedures, Prentice Hall of India, **2003.**
5. O.C. Zienkiewicz., R.L. Taylor & J.Z. Zhu., 'The Finite Element Method its Basis & Fundamentals', Elsevier Publication, **2007.**