MAHATMA GANDHI UNIVERSITY

SCHEME AND SYLLABI

FOR

M. Tech. DEGREE PROGRAMME

IN

CIVIL ENGINEERING

WITH SPECIALIZATION IN

COMPUTER AIDED STRUCTURAL ENGINEERING

(2013 ADMISSION ONWARDS)

SCHEME AND SYLLABI FOR M. Tech. DEGREE PROGRAMME IN CIVIL ENGINEERING WITH SPECIALIZATION IN COMPUTER AIDED STRUCTURAL ENGINEERING

SEMESTER - II

Sl. No.	Course No.	Subject	Hrs / Week			Evaluation Scheme (Marks)					Credits (C)
			L	T	P	Sessional			ESE	Total	
						TA	CT	Sub Total			
1	MCESE 201*	Microstructure and Innovations in Structural Concrete	3	1	0	25	25	50	100	150	4
2	MCESE 202*	Finite Element Analysis	3	1	0	25	25	50	100	150	4
3	MCESE 203*	Theory of Plates and Shells	3	1	0	25	25	50	100	150	4
4	MCESE 204	Bridge Engineering	3	1	0	25	25	50	100	150	4
5	MCESE 205	Elective - III	3	0	0	25	25	50	100	150	3
6	MCESE 206	Elective - IV	3	0	0	25	25	50	100	150	3
7	MCESE 207	Structural Engg. Design Studio	0	0	3	25	25	50	100	150	2
8	MCESE 208	Seminar - II	0	0	2	50	0	50	0	50	1
Total			**18**	**4**	**5**	**225**	**175**	**400**	**700**	**1100**	**25**

Elective – III (MCESE 205)		**Elective – IV (MCESE 206)**	
MCESE 205 – 1*	Earthquake Resistant Design	MCESE 206 – 1*	Structural Stability
MCESE 205 – 2*	Structural Reliability	MCESE 206 – 2*	Advanced Steel Structures
MCESE 205 - 3	Design of Substructures	MCESE 206 – 3*	Maintenance & Rehabilitation of Structures
MCESE 205 - 4	Theory of Plasticity	MCESE 206 - 4	Engineering Fracture Mechanics

L – Lecture, **T** – Tutorial, **P** – Practical

TA – Teachers' Assessment (Quizzes, attendance, group discussion, tutorials, seminar, field visit etc)

CT – Class Test (Minimum of two tests to be conducted by the Institute)

ESE – University End Semester Exam will have to be conducted by the institute through concerned affiliating University.

* – common for MCESE & MCESC

MCESE 201 MICROSTRUCTURE AND INNOVATIONS IN STRUCTURAL CONCRETE

L	T	P	C
3	1	0	4

Module 1

The Structure of Concrete: - Significance and Complexities, Structure of aggregate phase, Structure of hydrated cement paste, Solids in hydrated cement paste, Voids in hydrated cement paste and Water in hydrated cement paste.
Structure property relationships in hydrated cement paste:- Strength, Dimensional stability and Durability.
Transition zone in concrete: - Significance of transition zone, Structure of transition zone, Strength of transition zone and Influence of transition zone on properties of concrete.

Module 2

Self-compacting Concrete:- Introduction, Definition and terms like Addition, Admixture, Binder, Filling ability, Fines (Powder), Flowability, Fluidity, Passing ability, Robustness, Segregation resistance, Slump-flow, Thixotrophy, Viscosity modifying admixture, Constituent materials, Mix design, Test methods and Conformation.
Engineering Properties:- Compressive strength, Tensile strength, Modulus of elasticity, Creep, Shrinkage, Coefficient of thermal expansion, Bond to reinforcement, Shear force capacity, Fire resistance and durability.
Requirements:- Basic and Additional requirements and Requirements in fresh state, Consistence classification, Slump flow, Viscosity, Passing ability and Segregation resistance.

Module 3

Effect of Temperature on Properties of Concrete:- Different approaches for testing-Stressed, Unstressed and Unstressed residual tests.
Important material properties of concrete under temperature:- Thermal Expansion, Thermal Conductivity, Thermal Capacity and Thermal Diffusivity, Modulus of Elasticity, Poisson’s Ratio, Stress-Strain Relationship, Creep Deformation and Strength; Spalling of concrete; Influence of aggregate type.

Module 4

Supplementary Cementitious Materials:- Different materials, Pozzolanic reaction.
Characterization of Concrete (Concept Only):- X-Ray Diffraction Analysis (XRD):- Introduction, Basic Principle, Identification of Major Phases Present in Cement/Clinker, Sample Preparation and X-Ray Diffractometry in Concrete, Hydrated Cement Paste, Aggregate Interface.
Scanning Electron Microscope (SEM) Analysis: Introduction of Scanning Electron Microscopy, Specimen Preparation, Concrete under the SEM, Mineral Admixtures in Concrete.
Thermo Gravimetric Analysis (TGA): - Introduction, Interpreting TGA Curves related to Concrete.

References:

1. P. Kumar Mehta and Paulo J. M. Monteiro, "Concrete, Microstructure, Properties and Materials" Indian Concrete Institute, Chennai.
2. J.A. Purkiss, "Fire Safety Engineering" Butterworth-Heinemann.
3. E.G. Butcher and A.C. Parnell, "Designing for Fire Safety" John Wiley and Sons.
4. E.E. Smith and T.Z. Harmathy, "Design Buildings for Fire Safety" ASTM Special Technical Publication 685, A Symposium Sponsored by ASTM Committee EQ5 on Fire Standards.
5. A.M. Neville, "Properties of Concrete" Addison Wesley Longman Limited, England.
6. A.M. Neville and J.J. Brooks, "Concrete Technology" Pearson Education, Asia.
7. P.C. Varghese, "Advanced Reinforced Concrete Design" PHI Learning Private Limited, New Delhi.
8. EFNARC, "The European Guidelines for Self-Compacting Concrete, Specification, Production and Use" EFNARC-2005, UK.
9. P.J.M. Bartos, M. Sonebi and A.K. Tamimi, "Workability and Rheology of Fresh Concrete: Compendium of Tests" RILEM Publications S.A.R.L,France.
10. V.S. Ramachandran and James J., "Handbook of Analytical Techniques in Concrete Science and Technology, Principles, Techniques and Applications" William Andrew Publishing, U.S.A.
11. George Widmann, "Interpreting TGA Curves" User Com.
12. Jain, V. K., "Fire Safety in Buildings", New Age International (P) Ltd., New Delhi.

MCESE 202* **FINITE ELEMENT ANALYSIS**

L	T	P	C
3	1	0	4

Module 1

Introduction to FEM - Historical development - Idealization of structures -Mathematical model - General procedure of FEA - Displacement approach.

Variational principles weighted residual approach and method of virtual work. Derivation of equilibrium equations.

Module 2

Shape functions – Polynomials - Lagrangian and Hermition Interpolation – Generalised coordinates – Natural coordinates - Compatibility - C^0 and C^1 elements - Convergence criteria - Conforming & nonconforming elements – Patch test.

Module 3

Stiffness matrix - Bar element - Beam element - Plane stress and plane strain and axisymmetric problems -Triangular elements - Constant Strain Triangle - Linear Strain Triangle – Legrangian and Serendipity elements, static condensation - **Isoparametric elements** - Numerical Integration.- Gauss- Quadrature – Computer implementation of finite element method.

Module 4

General plate bending elements - Plate bending theory – Kirchhoff's theory – Mindlin's theory – locking problems - preventive measures – reduced integration – selective integration-spurious modes.

References:

1. O C Zienkiewicz,.”Finite Element Method”, fifth Edition,McGraw Hill, 2002
2. R.D.Cook, “Concepts and Applications of Finite Element Analysis”, John Wiley & Sons.
3. C.S.Krishnamoorthy, ”Finite Element Analysis”,Tata McGraw Hill .New Delhi,1987.
4. S.Rajasekharan, “Finite Element Analysis in Engineering Design”, S Chand & Co. Ltd.1999.
5. T.Kant, “Finite Element Methods in Computational Mechanics”,Pergamons Press.

6. K.J.Bathe, "Finite Element Procedures in Engineering Analysis".,Prentice Hall,
7. Mukhopadhyay M.,Matrix "Finite Element Computer and Structural Analysis",Oxford & IBH,1984.
8. Irving H.Shames,"Energy &Finite Element Methods in Structural Mechanics".
9. Desai C.S. & Abel J.F., "Introduction to Finite Element Methods", East West Press.

MCESE 203* **THEORY OF PLATES AND SHELLS**

L	T	P	C
3	1	0	4

Module 1

Plates:- Introduction- classification of plates- thin plates and thick plates – assumptions in the theory of thin plates- Differential equation for cylindrical bending of rectangular plates.

Pure bending of plates:- slope and curvature of slightly bent plates – relation between bending moment and curvature in pure bending – stresses acting on a plate inclined to x and y axes-Particular cases of pure bending of rectangular plates.

Module 2

Laterally loaded rectangular plates:- Small deflections of Laterally loaded thin plates- Differential equation of plates- derivation of fourth order differential equation -Solution techniques for fourth order differential equation – boundary conditions – simply supported, built- in and free edges.

Simply Supported rectangular plates under sinusoidal Load:- Navier solution for simply supported plates subjected to uniformly distributed - Levy's solution for simply supported rectangular plates – uniformly distributed and concentrated load.

Module 3

Circular plates – polar coordinates – differential equation of symmetrical bending of laterally loaded circular plates- uniformly loaded circular plates with clamped edges and simply supported edges– circular plates loaded at the centre.

Module 4

Classical theory of Shells – Structural behaviour of thin shells – Classification of shells – Singly and doubly curved shells with examples – Membrane theory and bending theory of doubly curved shells.-equilibrium equations.

Folded plates – Introduction, Classification, Structural action and analysis.

References:

1. Lloyd Hamilton Donnell, "Beams, plates and shells", Mc Graw Hill, New York.

2. S.P Timoshenko, S.W Krieger, “Theory of plates and shells”, Mc Graw Hill.
3. Owen F Hughes, “Ship structural design”, John Wiley & Sons, New York, 1983.
4. William Muckle, “Strength of ship structures”, Edqward Arnold Ltd, London, 1967.
5. Gol’oenveizen, “Theory of elastic thin shells”, Pergaman press, 1961.
6. J Ramachandran, “Thin shell theory and problems”, Universities press.
7. Krishna Raju N., “Advanced Reinforced Concrete Design”, CBS Publishers and distributers, New Delhi.
8. G.S Ramaswamy, “Design and Construction of Concrete Shell Roofs”, Tata-McGraw Hill Book Co. Ltd.,.

MCESE 204 BRIDGE ENGINEERING

L	T	P	C
3	1	0	4

Module 1

Planning of bridges:– Investigation for bridges– need for investigation– selection of site– economical span– subsoil exploration– investigation report– importance for proper investigation–Design of RCC bridges– IRC loading– types of bridges– components of bridges– analysis and design of slab bridges and box culvert.

Module 2

Design of girder bridges:– T-beam bridges– Analysis and design of deck slab,longitudinal girders and cross girders–Pigeaud's method– Courbon's method– Morice and Little method– Hendry–Jaegar method– prestressed concrete bridges(simply supported case only).

Module 3

Bearings:– importance of bearings– bearings for slab bridges– bearings for girder bridges–Design of elastomeric bearings –Joints –Appurtenances. Substructure- different types- materials for piers and abutments- substructure design– piers and abutments – shallow footings – well foundation.

Module 4

Construction methods:– Inspection and maintenance and construction of bridges–case studies of recently constructed major bridges–critical studies of failure of major bridges. Features of suspension bridges and cable stay bridges.

References:

1. Raina V.K (1991), "Concrete Bridge Practice– Analysis, design & economics", Tata Mc–GrawHill, publishing company, New Delhi.
2. Raina V.K (1988), "Concrete Bridge Practice– Construction Maintenance & Rehabilitation", Tata Mc–GrawHill, publishing company, New Delhi.
3. Victor D.J (19991), "Essentials of Bridge Engineering", Oxford & IBH publishing company, New Delhi.

4. Ponnuswami S (1993), “Bridge Engineering”, Tata Mc–GrawHill, publishing company, New Delhi.
5. Krishna Raju N (1996), “Design of Bridges”, TataMcGrawHill, publishing company, New Delhi.
6. Relevant IS Codes, and IRC Codes.

MCESE 205 – 1* EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

L	T	P	C
3	0	0	3

Module 1

Seismic Hazards:- Need of special emphasis to earthquake engineering, Ground shaking, structural hazards, Liquefaction, Lateral spreading, Landslides, Life line hazards, Tsunami and Seiche hazards.

The Earth And its Interior: - The Circulation, Continental drift, Plate tectonics, Plate boundaries, Faults and its geometry.

The Earthquake: - Elastic rebound theory, Terminology like hypocenter, epicenter and related distances.

Seismic Waves: - Terminology, Body waves: - P- waves and S- waves, Surface waves: – Love waves and Rayleigh waves. Calculation of wave velocity, measuring instruments, locating epicenter of earthquakes numerically from traces and wave velocity.

Earthquake Size: - Intensity – RF, MMI, JMA and MSK. Comparison of above. Magnitude – Local magnitude, Calculation (Analytically and graphically), Limitations, Surface wave magnitudes, Moment magnitudes and its Calculation, Saturation of magnitude scales.

Module 2

Earthquake Ground Motion: - Parameters: - Amplitude, Frequency and duration. Calculation of duration from traces and energy.

Response Spectra: - Concept, Design Spectra and normalized spectra, Attenuation and Earthquake Occurrence. Guttenberg- Richter Law.

Concept of Earthquake Resistant Design: - Objectives, Design Philosophy, Limit states, Inertia forces in Structure. Response of Structures – Effect of deformations in structure, Lateral Strength, Stiffness, Damping and ductility.

Floor diaphragms: - Flexible and rigid, Effect of inplane and out of plane loading, Numerical example for lateral load distribution

Torsion and Twists in Buildings: - Causes, Effects, Centre of mass and rigidity.Torsionally coupled and uncoupled system, Lateral load distribution, Numerical example based on IS code recommendation.

Building Configurations: - Size of Building, Horizontal and Vertical layout, Vertical irregularities, Adjacency of Building, Open-ground storey and soft storey, short columns. Effect of shear wall on Buildings. Effect of torsion.

Module 3

R.C.C for Earthquake Resistant Structures: - How to make buildings ductile, Concept of capacity design, Strong Column weak beam, Soft Storey. Ductile design and detailing of beams and shear walls. Calculation of Base shear and its distribution by using codel provision. Detailing of columns and Beam joints. Performance of R.C.C. Building. **Ductile detailing:-**Study of IS: 13920-1993.

Repair: - Methods, Materials and retrofitting techniques.

Module 4

Earthquakes in India: - Past earthquakes in India an overview, Behaviour of buildings and structures during past earthquakes and lessons learnt from that.

Seismic Code: - Provisions of IS: 1893-2002.

Masonry Buildings:- Performance during earthquakes, Methods of improving performance of masonry walls, box action, influence of openings, role of horizontal and vertical bands, rocking of masonry piers.

Reduction of Earthquake Effects: - Base Isolation and dampers; Do's and Don'ts During and after Earthquake.

References:

1. Bruce A. Bolt, "Earth quakes", W.H. Freeman and Company, New York
2. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall of India Private Limited, New Delhi, India.
3. Steven L. Kramer, "Geotechnical Earthquake Engineering", Pearson Education, India.
4. S. K. Duggal, "Earthquake Resistant Design of Structures", Oxford University Press, New Delhi.
5. Murthy C. V. R, "Earthquake tips, Building Materials and Technology Promotion Council", NewDelhi, India.
6. Pauly. T and Priestley M.J.N , "Seismic Design of Reinforced Concrete and Masonry Buildings", John Wiley and sons Inc.

7. David A Fanella, “Seismic detailing of Concrete Buildings”, Portland Cement Association, Illinois.
8. Repair and Strengthening of Reinforced Concrete, Stone and Brick Masonry Buildings, United Nations Industrial Development Organization, Vienna.
9. BIS, IS: 1893(Part 1)-2002 and IS : 13920-1993, Bureau of Indian Standards.
10. Anil K. Chopra, “Dynamics of Structures”,. Pearson Education, India.
11. Kamalesh Kumar, “Basic Geotechnical Earthquake Engineering”,

MCESE 205 – 2* **STRUCTURAL RELIABILITY**

L	T	P	C
3	0	0	3

Module 1

Concepts of structural safety:-Basic statistics:-Introduction-data reduction-histograms-sample correlation.

Module 2

Probability theory, resistance distribution and parameters:- Introduction- statistics of properties of concrete and steel, statistics of strength of bricks and mortar, dimensional variations-characterisation of variables of compressive strength of concrete in structures and yield strength of concrete in structures and yield strength of steel – allowable stresses based on specified reliability.

Module 3

Probabilistic analysis of loads: - Gravity load-introduction-load as a stochastic process. Wind load-introduction-wind speed-return period-estimation of lifetime wind speed-probability model of wind load.

Basic structural reliability: - Introduction-computation of structural reliability. Monte carlo study of structural safety and applications.

Module 4

Level-2 Reliability method: - Introduction-basic variables and failure surface-first order second moment methods like Hasofer and Linds method-nonnormal distributions-determination of B for present design-correlated variables.

References:

1. Nobrert Llyd Enrick, “Quality control and reliability”, Industrial press New York.
2. A K Govil, “Reliability engineering”, Tata Mc Graw Hill, New Delhi.
3. Alexander M Mood, “Introduction to the theory of statistics”, Mc Graw Hill, Kogakusha Ltd.
4. Ranganathan, “Reliability of structures”.

MCESE 205 - 3 **DESIGN OF SUBSTRUCTURES**

L	T	P	C
3	0	0	3

Module 1: Substructures

Definition and Purpose – Design principles – Design loads – Permissible settlements – Considerations in seismic design of sub structures.

Raft Foundations

Types of raft – Bearing capacity and settlement of rafts – Beams on elastic foundation – Methods of design of rafts.

Module 2: Pile Foundations

Load capacity of single piles – Static and dynamic formulae – Pile load tests – Cyclic pile load tests – Laterally loaded piles.

Pile groups – Group Efficiency – Design of pile groups – Settlement of single and pile groups in clays and sands – Negative skin friction on single and pile groups.

Module 3: Pier Foundations

Types of piers and Uses – Allowable bearing capacity – Design and construction of Piers – Settlement of Piers.

Well Foundations

Types – Construction of Wells – Failures and Remedies – Bearing capacity Design of well foundations – Lateral stability – sinking of wells.

Module 4 : Substructures in Expansive soils

Characteristics of Expansive soils – Foundation problems – Foundation alternatives – Methods of Foundations – Design and Construction of under reamed piles.

References:

1. J.E.Bowles, "Foundation Analysis and Design", Mc. Graw Hill Publishing Co., New York

2. Tomlinson, "Pile Design and Construction Practice", A View Point Publication.

3. Swami Saran, "Design of Substructures", Oxford & IBH publishers, New Delhi.

4. W.C. Teng, "Foundation Design", Prentice Hall of India, New Delhi .

5. Ninan P. Kurian – "Modern Foundations".

6. Lamb & Whileman – "Soil Mechanics".

MCESE 205 - 4 **THEORY OF PLASTICITY**

L	T	P	C
3	0	0	3

Module 1

Preliminaries: Basic equations of theory of elasticity:– Index notation, equations of equilibrium, constitutive relations for isotropic bodies, strain–displacement relations, compatibility, displacement and traction boundary conditions, admissibility of displacement and stress fields, plane stress and plane strain problems.

Framework of plastic constitutive relations:– Plastic behaviour in simple tension, generalisation of results in simple tension, yield surfaces, uniqueness and stability postulates, convexity of yield surface and normality rule, limit surfaces.

Module 2

Initial yield surfaces for polycrystalline metals:– Summary of general form of plastic constitutive equations, hydrostatic stress states and plastic volume change in metals,shear stress on a plane, the von Mises initial yield condition, the Tresca initial yield condition, consequences of isotropy.

Plastic behaviour under plane stress conditions:– Initial and subsequent yield surfaces in tension–torsion, the isotropic hardening model, the kinematic hardening model, yield surfaces made of two or more yield functions, piecewise linear yield surfaces, elastic perfectly plastic materials.

Module 3

Plastic behaviour of bar structures:– Behaviour of a three bar truss, behaviour of a beam in pure bending, simply supported beam subjected to a central point load, fixed beams of an elastic perfectly plastic material, combined bending and axial force.

The Theorems of Limit Analysis:– Introduction, theorems of limit analysis, alternative statement of the limit theorems, the specific dissipation function.

Module 4

Limit analysis in plane stress and plane strain:– Discontinuities in stress and velocity fields, the Tresca yield condition in plane stress and plane strain, symmetrical internal and external notches in a rectangular bar, the punch problem in plane strain, remarks on friction.

Limit analysis as a programming problem:– Restatement of limit theorems, application to trusses and beams, use of finite elements in programming problem, incremental methods of determining limit load.

References:

1. Martin, J.B., “Plasticity: Fundamentals and General Results”, MIT Press, London.
2. Kachanov, L.M., “Fundamentals of the Theory of Plasticity”, Mir Publishers, Moscow.
3. Chakrabarty, J, “Theory of Plasticity”, McGraw Hill, New York.
4. Hill, R., “Mathematical Theory of Plasticity”, Oxford University Press.
5. Chen, W.F., and Han, D.J., “Plasticity for Structural Engineers”, Springer Verlag.

MCESE 206 – 1* **STRUCTURAL STABILITY**

L	T	P	C
3	0	0	3

Module 1

Introduction to stability analysis:–Stable, unstable and neutral equilibrium–Stability Criteria. Fourth order Elastica – large deflection of bars differential equation for generalized bending problems–elastic instability of columns–Euler's theory–assumptions–limitations. Energy principles.

Module 2

General treatment of column:- Stability problem as an Eigen value problem–various modes of failure for various end conditions– both ends hinged–both ends fixed–one end fixed other end free– one end fixed other end hinged–Energy approach–Rayleigh Ritz–Galarkin's method.

Module 3

Beam column:–beam column equation–solution of differential equation for various lateral loads–udl and concentrated loads– Energy method – solutions for various end conditions–bottom fixed– bottom hinged –horizontal compression members, buckling of frames.

Module 4

Stability of plates:– inplane and lateral loads– boundary conditions–critical buckling pressure–aspect ratio – Introduction to torsional buckling, lateral buckling and inelastic buckling.

Finite element application to stability analysis– finite element stability analysis–element stiffness matrix –geometric stiffness matrix–derivation of element stiffness matrix and geometric stiffness matrix for a beam element.

References:

1. Ziegler H, "Principles of structural stability", Blarsdell, Wallham, Mass, 1963.
2. Thompson J M, G W Hunt, "General stability of elastic stability", Wiley,New York.
3. Timoshenko, Gere, "Theory of elastic stability", Mc Graw Hill, New York.
4. Don O Brush, B O O Almorth, Buckling of Bars, plates and shells,

5. Cox H L, The buckling of plates and shells, Macmillam, New York, 1963.
6. O C Zienkiewicz ,.Finite Element Method ,fourth Edition,McGraw Hill,
7. R.D.Cook, Concepts and Applications of Finite Element Analysis,JohnWiley &Sons.

MCESE 206 – 2*   ADVANCED STEEL STRUCTURES

L	T	P	C
3	0	0	3

Module 1

Design of members subjected to lateral loads and axial loads – Principles of analysis and design of Industrial buildings and bents – Crane gantry girders and crane columns – Bracing of industrial buildings and bents.

Module 2

Analysis and design of steel towers, trestles and masts – Design of industrial stacks – Self supproting and guyed stacks lined and unlined – Stresses due to wind and earthquake forces – Design of foundations.

Module 3

Introduction – Shape factors – Moment redistribution Static, Kinematic and uniqueness theorems – Combined mechanisms – Analysis Portal frames. Method of plastic moment distribution – Connections, moment resisting connections.

Module 4

Design of light gauge sections – Types of cross sections – Local buckling and post buckling – Design of compression and Tension members – Beams – Deflection of beams – Combined stresses and connections.

Types of connections, Design of framed beam connections, Seated beam connection, Unstiffened, Stiffened Seat connections, Continuous beam – to – beam connections and continuous beam–to–column connection both welded and bolted.

References:

1. Punmia B.C, “Comprehensive Deign of Steel structures”, Laxmi publications Ltd, 2000.
2. Arya, A.S, “Design of Steel Structures”, Newchand & bros, Roorkee, 1982
3. Ram Chandra, “Design of Steel Structures II”, Standard Book House, Delhi.
4. Dayaratnam, “Design of steel structures”.
5. Rajagopalan, “Design of Storage structures”.
6. Baker, “Steel skeleton”.

7. S.K.Duggal , “Design of Steel Structures”, McGraw Hill.
8. Lynn S.Beedle, “Plastic Analysis of steel frames”.
9. Relevant IS Codes.

MCESE 206 – 3* **MAINTENANCE AND REHABILITATION OF STRUCTURES**

L	T	P	C
3	0	0	3

Module 1

General:– Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking.

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.

Module 2

Maintenance and repair strategies:– 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.

Module 3

Materials for repair:– Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, Fibre reinforced concrete.

Module 4

Techniques for repair:– Rust eliminators and polymers coating for rebars during repair foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning.

Examples of repair to structures:– Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure–case studies.

References:

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 Practice” , S.Chand and Company, New Delhi, 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.

L	T	P	C
3	0	0	3

MCESE 206 - 4 **ENGINEERING FRACTURE MECHANICS**

Module 1

Introduction:– Significance of fracture mechanics, Griffith energy balance approach, Irwin's modification to the Griffith theory, Stress intensity approach, Crack tip plasticity, Fracture toughness, sub–critical crack growth, Influence of material behaviour, I, II & III modes, Mixed mode problems. **Linear Elastic Fracture Mechanics (LEFM):–** Elastic stress field approach, Mode I elasticstress field equations, Expressions for stresses and strains in the crack tip region, Finitespecimen width, Superposition of stress intensity factors (SIF), SIF solutions for wellknown problems such as centre cracked plate, single edge notched plate and embedded elliptical cracks.

Module 2

Crack tip plasticity:– Irwin plastic zone size, Dugdale approach, Shape of plastic zone, State of stress in the crack tip region, Influence of stress state on fracture behaviour. **Energy Balance Approach:–** Griffith energy balance approach, Relations for practical use,Determination of SIF from compliance, Slow stable crack growth and R–curve concept,Description of crack resistance.**LEFM Testing:–** Plane strain and plane stress fracture toughness testing, Determination of R–curves, Effects of yield strength and specimen thickness on fracture toughness, Practical use of fracture toughness and R–curve data.

Module 3

Elastic plastic fracture mechanics (EPFM):– Development of EPFM, J–integral, Crackopening displacement (COD) approach, COD design curve, Relation between J and COD, Tearing modulus concept, Standard JIc test and COD test. **Fatigue Crack Growth:–** Description of fatigue crack growth using stress intensity factor, Effects of stress ratio and crack tip plasticity – crack closure, Prediction of fatigue crackgrowth under constant amplitude and variable amplitude loading, Fatigue crack growth from notches – the short crack problem.

Module 4

Sustained load fracture:– Time–to–failure (TTF) tests, Crack growth rate testing, Experimental problems, Method of predicting failure of a structural component, Practical significance of sustained load fracture testing. **Practical Problems:–** Through cracks emanating from holes, Corner cracks at holes, Cracks approaching holes, fracture toughness of weldments, Service failure analysis, applications in pressure vessels, pipelines and stiffened sheet structures.

References:

1. Ewalds, H.L. & Wanhill, R.J.H., "Fracture Mechanics" – Edward Arnold
2. David Broek, "Elementary Engineering Fracture Mechanics", Sijthoff and Noordhaff, Alphen Aan Den Rijn, The Netherlands.
3. Ed L. Elfgren and S.P. Shah, "Analysis of Concrete Structure by Fracture Mechanics", Proc of Rilem Workshop, Chapman and Hall, London.

MCESE 207 STRUCTURAL ENGINEERING DESIGN STUDIO

L	T	P	C
0	0	3	2

Application of SAP 2000, ANSYS and NISA in modeling, simulation and analysis of structural components using the concepts given in theory papers. The student has to practice the packages by working out different types of problems mentioned below.

SAP 2000

Linear Static Analysis of Continuous Beams, Portal Frames, Truss (2D and 3D), Multistoried Building.

Loading : Dead Load, Live Load, Wind Load (IS: 875 Part 1 / Part 2 / Part 3), Earth Quake Load (IS: 1893 Part 1) and its Combinations as per codal Provisions

ANSYS and NISA

Linear Static Analysis of Continuous Beams, Portal Frames, Truss (2D and 3D), Plates (Plane Stress and Plane Strain)

MCESE 208 SEMINAR – II

L	T	P	C
0	0	2	1

Each student is required to present a technical paper on a subject approved by the department. The paper should be on a recent advancement/trend in the field of structural engineering. He / she shall submit a report of the paper presented to the department.