MAHATMA GANDHI UNIVERSITY

SCHEME AND SYLLABI

FOR

M. Tech. DEGREE PROGRAMME

IN

CIVIL ENGINEERING

WITH SPECIALIZATION IN

COMPUTER AIDED STRUCTURAL ENGINEERING

(2011ADMISSION ONWARDS)

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

SEMESTER - I

Sl. No.	Course No.	Subject	Hrs / Week			Evaluation Scheme (Marks)					Credits (C)
			L	T	P	Sessional			ESE	Total	
						TA	CT	Sub Total			
1	MCESE 101	Analytical Methods in Engineering	3	1	0	25	25	50	100	150	4
2	MCESE 102	Advanced Design of Concrete Structures	3	1	0	25	25	50	100	150	4
3	MCESE 103	Structural Dynamics	3	1	0	25	25	50	100	150	4
4	MCESE 104	Theory of Elasticity	3	1	0	25	25	50	100	150	4
5	MCESE 105	Elective - I	3	0	0	25	25	50	100	150	3
6	MCESE 106	Elective - II	3	0	0	25	25	50	100	150	3
7	MCESE 107	Computer Application Lab	0	0	3	25	25	50	100	150	2
8	MCESE 108	Seminar - I	0	0	2	50	-	50	0	50	1
Total			**18**	**4**	**5**			**400**	**700**	**1100**	**25**

Elective – I (MCESE 105)		**Elective – II (MCESE 106)**	
MCESE 105 - 1	Advanced Analysis of Structures	MCESE 106 - 1	Prestressed Concrete
MCESE 105 - 2	Advanced Theory of Concrete Structures	MCESE 106 - 2	Computer Aided Design
MCESE 105 - 3	Structural Optimization	MCESE 106 - 3	Design of Offshore Structures
MCESE 105 - 4	Experimental Stress Analysis	MCESE 106 - 4	Advanced Concrete Technology

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.

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	Numerical Methods in Engineering	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	Bridge Engineering	3	1	0	25	25	50	100	150	4
4	MCESE 204	Theory of Plates and Shells	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**			**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	Engineering Fracture Mechanics
MCESE 205 - 4	Theory of Plasticity	MCESE 206 - 4	Maintenance & Rehabilitation of Structures

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.

SEMESTER - III

Sl. No.	Course No.	Subject	Hrs / Week			Evaluation Scheme (Marks)					Credits (C)
			L	T	P	Sessional Exam (internal)			ESE** (Oral)	Total	
						TA*	CT	Sub Total			
1	MCESE 301	Industrial Training	0	0	20	50*	0	50	100	150	10
2	MCESE 302	Thesis - Phase I	0	0	10	100***	0	100	0	100	5
Total					**30**	**150**	**0**	**150**	**100**	**250**	**15**

* TA- based on technical report submitted together with a presentation at the end of the industrial training.

** Industrial Training evaluation will be conducted at end of the third semester by a panel of examiners, with at least one external examiner, constituted by the university.

*** 50% of the marks to be awarded by the project guide and the remaining 50% to be awarded by a panel of examiners, including project guide, constituted by the department.

SEMESTER - IV

Sl. No.	Course No.	Subject	Hrs / Week			Evaluation Scheme (Marks)					Credits (C)
			L	T	P	Sessional Exam (internal)			Thesis Evaluation and viva****	Total	
						TA***	CT	Sub Total			
1	MCESE 401	Master's Thesis	0	0	30	100	0	100	100	200	15
2	MCESE 402	Master's Comprehensive Viva							100	100	
Total										**300**	**15**
Grand Total of four Semesters										**2750**	Total credits =**80**

*** 50% of the marks to be awarded by the project guide and the remaining 50% to be awarded by a panel of examiners, including project guide, constituted by the department.

**** Thesis evaluation and Viva-voce will be conducted at end of the fourth semester by a panel of examiners, with at least one external examiner, constituted by the university.

MCESE 101 ANALYTICAL METHODS IN ENGINEERING

L	T	P	C
3	1	0	4

Module 1: Differential equations

Linear differential equations–homogeneous equations–boundary value problems–Cauchy–Euler equations–factoring the operator–nonhomogeneous equations–variation of parameters.

Module 2: Partial differential equations

Ordinary differential equations in more than two variables – first order P.D.E–integral surface passing through a given curve–surfaces orthogonal to given system–compatible systems of first order P.D.E–charpits method–solution satisfying the given conditions–P.D.E second order in physics–linear P .D.E with constant coefficients.

Module 3: Boundary value problems

Elementary solutions of Laplace equations, wave equations, series solution of these equations in two dimensions–related problems in engineering.

Module 4: Numerical solutions of P.D.E

Classification of second order equation– finite difference approximations to partial derivatives–solution of Laplace equation by finite difference method–solution of one dimensional wave equations.

References:

1. Michael D Greenberg, "Advanced Engineering Mathematics", Pearson education.
2. Ian Sneddon, "Elements of Partial Differential Equations", McGraw Hill, International Editions.
3. B.S Grewal, "Numerical Methods in Engineering and Science", Khanna Publications.
4. P Kandasamy, "Numerical Methods", S Chand and company.
5. S.Arumugam,A. Thangapandi Issac, "Numerical methods", Scitech.
6. George.F. Simmons, "Differential Equations with applications and historical notes", TMH Edition

MCESE 102 ADVANCED DESIGN OF CONCRETE STRUCTURES

L	T	P	C
3	1	0	4

Module 1

Yield line method of analysis of slabs – Characteristic features of yield lines– virtual work method – equilibrium method Strip method of analysis of slabs–Design of grid floor – Approximate method– Rigorous method.

Module 2

Design of continuous beams– Redistribution of moments– Design of frames– Bunkers and silos – Airy's theory– Janssen's theory.

Module 3

Design of special RC elements:– Design of slender columns– RC walls–ordinary and shear walls–Corbels– Deep beams.

Module 4

Design of flat slabs:– Introduction–components–IS Code recommendations–design methods–design for flexure and shear–moments in columns.

References:

1. Pippard A J S, "The Analysis of Engineering Structures", Edward Arnold PublishersLtd.
2. Krishna Raju N., "Advanced Reinforced Concrete Design", CBS Publishers and distributers, New Delhi.
3. Krishna Raju., "Design of Reinforced Concrete Structures"
4. Punmia,Ashok K Jain,Arun K Jain,"Reinforced Concrete Vol:II".
5. P C Varghese, "Limit State Design of concrete structures".
6. Rajagopalan, "Design of Storage structures"
7. Reynolds Handbook.
8. Relevant IS Codes.
9. Menon & Pillai – "Design of R.C.C. Structures"

MCESE 103 **STRUCTURAL DYNAMICS**

L	T	P	C
3	1	0	4

Module 1: Introduction

Objectives − types of dynamic problems − degree of freedom - D' Alemberts Principle − principle of virtual displacement − Hamilton's principle.

Module 2: Single Degree of Freedom System

Undamped and damped free and forced vibrations −critical damping − over damping − under damping − logarithmic decrement .

response to harmonic loading − evaluation of damping − vibration isolation − transmissibility − response to periodic forces- vibration measuring equipments. Duhamel integral for undamped system- Response to impulsive loads.

Module 3: Multidegree Freedom Systems and Continuous systems

Natural modes − orthogonality conditions − modal Analysis − free and harmonic vibration − Free longitudinal vibration of bars − flexural vibration of beams with different end conditions − forced vibration.

Module 4: Approximate methods

Rayleigh's method − Dunkerley's method − Stodola's method − Rayleigh –Ritz method − Matrix method.

References:

1. Clough & Penzien, "Dynamics of Structures".
2. Meirovitch.L, "Elements of Vibration Analysis".
3. W.T. Thomson , "Vibration Theory and Applications".
4. M.Mukhopadhyay , "Vibrations, Dynamics & Structural systems".
5. Paz Mario, "Structural Dynamics–Theory and Computation".
6. Denhartog, "Mechanical vibrations".
7. Timoshenko, "Vibration Problems in Engineering".
8. Anil K Chopra, "Dynamics of structures", Pearson Education.

MCESE 104 **THEORY OF ELASTICITY**

L	T	P	C
3	1	0	4

Module 1: Elasticity

Basic concepts– Body force–Surface traction–Stresses and strains–Three dimensional stresses and strains–analysis–transformation equations of 3D stresses & strains–principal stresses & strains–States of stresses & strain–Equilibrium equations–generalised Hooke's Law–Compatibility Conditions–Boundary conditions.

Module 2 : Two dimensional stress–strain problems

Plane stress and plain strain– Analysis–transformation equations–stress–strain relations–equilibrium equations in Cartesian and polar co ordinates Airy's stress function– Biharmonic Equilibrium–St Venant's principle–2D problems in Cartesian coordinate–cantilever with concentrated load at free end– Simply supported With UDL–Cantilever with moment at free end.

Module 3: Analysis of axisymmetric problems and Torsion

General equations in polar co ordinates–Stress distribution symmetric about an axis–Cylinder subjected to external and internal pressures– Rotating disc as a 2D problem. Effect of circular hole in stress distribution of plates.

Torsion of prismatic bar– General solution–Warping function approaches – St. Venant's theory– Membrane analogy– Sand heap analogy– Torsion of Non Circular sections – Torsion of multi celled thin wall open and closed sections.

Module 4: Plasticity

Introduction to plasticity – General concepts – Stress – Strain curves – Ideal plastic body – Plastic flow conditions – theories of failure – plastic work – Plastic potential – Yield criteria – Simple applications – Elasto – plastic analysis for bending and torsion of bars – Residual stresses.

References:

1. Timoshenko S P and Goodier J. N, “Theory of Elasticity”, Tata Mcgraw Hill International Student Edition.
2. Johnson W and Mellor P. B, “Plasticity for mechanical engineers”, Van Nostrand Company Ltd.
3. Sadhu Singh, “Theory of elasticity”, Khanna Publishers, Delhi.
4. Sadhu Singh, “Theory of Plasticity”, Khanna Publishers, Delhi.
5. Srinath L. S, “Advanced mechanics of solids”, Tata McGraw– Hill Publishing Company Ltd., New Delhi.
6. Arthur P Boresi & Omar M SideBottom, “Advanced Mechanics of Materials”, John Wiley & Sons.
7. Sokolnikoff, “Mathematical Theory of Elasticity”.

MCESE 105 - 1 ADVANCED ANALYSIS OF STRUCTURES

L	T	P	C
3	0	0	3

Module 1: Matrix methods

Review of work and energy principles - Maxwell, Betti, Castigliano theorems- principles virtual work- Classification of structures–discrete structures–elements–nodes–degrees of freedom–static& kinematic indeterminacy Stiffness method–coordinate systems–element stiffness matrix.

Module 2: Element approach

Stiffness method – analysis of pin jointed frames (temperature effect, lack of fit), continuous beams (settlement of supports), rigid jointed frames and grids.

Module 3: Direct stiffness approach

Structure stiffness matrix–assembly–equivalent joint load – incorporation of boundary conditions –solutions–Gauss elimination–matrix inversion–analysis of pin jointed frames, continuous beams.

Module 4: Flexibility method

Element Flexibility matrix–truss element–beam element–force transformation matrix – equilibrium–compatibility–analysis of beams & frames (rigid and pin jointed), grids.

References: –

1. Weaver & Gere, “Matrix Analysis of Structures”, East West Press.
2. Moshe F Rubinstein– “Matrix Computer Analysis of Structures”– Prentice Hall, 1969.
3. Meek J.L., “Matrix Structural Analysis”, McGraw Hill, 1971.
4. Reddy C.S., “Basic Structural Analysis”, Tata McGraw Hill Publishing Co.1996.
5. Smith J.C. “Structural Analysis”, Macmillian Pub.Co.1985.
6. Rajesekharan & Sankarasubramanian,G., “Computational Structural Mechanics”, Prentice Hall of India, 2001.
7. Mukhopadhyay M., “Matrix Finite Element Computer and Structural Analysis”, Oxford & IBH, 1984.

8. Wang C.K.& Solomon C.G.," Introductory Structural Analysis", McGraw Hill.1968.
9. Pezemieniecki, J.S, "Theory of Matrix Structural Analysis", McGraw Hill Co.,1984.
10. Seeli F.B.& Smith J.P., "Advanced Mechanics of Materials", John Wiley &Sons, 1993.
11. Norris & Wilbur, "Elementary Structural Analysis", McGraw Hill.
12. Damodar Maity, "Computer Analysis of Framed Structures", I K International.

MCESE 105 - 2 ADVANCED THEORY OF CONCRETE STRUCTURES

L	T	P	C
3	0	0	3

Module 1

The nature of concrete, stress–strain relationships of concrete, stress–strain relationships of reinforcing steel, stress block parameters. Failure criteria for concrete.Behaviour of concrete flexural members, general equations for calculation of moment capacities at ultimate limit state and at limit state of local damage, flexural rigidity, calculation of deflection, redistribution of moments, design examples.

Module 2

Axially loaded compression members, combined axial load and uniaxial bending. Interaction diagrams, combined axial load and biaxial bending, slender compression members, design example using I.S.456–2000.

Module 3

Shear cracking of ordinary reinforced concrete members, web reinforcement, design examples, shear in tapered beams. Development length of reinforcement, anchorage. Significance of Torsion, Torsional resistance of concrete beams, reinforcement for torsion, design examples using I.S. 456-2000.

Module 4

General principles of detailing of reinforcement, effective depth, design of main reinforcement, design of transverse reinforcement, conditions at loads and at supports.

References:

1. Varghese P.C, “Design of Reinforced Concrete Structures”, Prentice hall of India.
2. Krishnamurthy, K.T, Gharpure S.C. and A.B. Kulkarni – “Limit design of reinforced concrete structures”, Khanna Publishers, 1985.

MCESE 105 - 3 **STRUCTURAL OPTIMIZATION**

L	T	P	C
3	0	0	3

Module 1

Introduction –Problem formulation with examples;Single Variable Unconstrained Optimisation Techniques – Optimality Criteria;Bracketing methods– Unrestricted search, Exhaustive search;Region Elimination methods:–Interval Halving methods, Dichotomous search, Fibonacci method, Golden section method;Interpolation methods–Quadratic Interpolation method, Cubic Interpolation method;Gradient Based methods– Newton–Raphson method, Secant method, Bisection method.

Module 2

Multi Variable Unconstrained Optimisation Techniques – Optimality Criteria; Unidirectional Search ; Direct Search methods – Random search, Grid search, Univariate method, Hooke's and Jeeves' pattern search method, Powell's conjugate direction method, Simplex method; Gradient based methods–Cauchy's (Steepest descent) method, Conjugate gradient (Fletcher–Reeves) method, Newton's method, Variable metric (DFP)method, BFGS method.

Module 3

Constrained Optimisation Techniques;Classical methods – Direct substitution method, Constrained variation method, method of Lagrange multipliers, Kuhn–Tucker conditions. Linear programming problem: Standard form, Simplex method; Indirect methods –Elimination of constraints, Transformation techniques, and Penalty function method;Direct methods – Zoutendijk's method of feasible direction, Rosen's gradient Projection method.

Module 4

Specialized Optimisation techniques – Dynamic programming, Geometric programming, Genetic Algorithms.

References:

1. Rao S. S., "Engineering Optimisation – Theory and Practice", New Age International.
2. Deb, K., "Optimisation for Engineering Design – Algorithms and examples", Prentice Hall.
3. Kirsch U., "Optimum Structural Design", McGraw Hill.
4. Arora J S. "Introduction to Optimum Design", McGraw Hill
5. Rajeev S and Krishnamoorthy C. S., "Discrete Optimisation of Structures using Genetic Algorithms", Journal of Structural Engineering, Vol. 118, No. 5, 1992, 1223–1250.

MCESE 105 - 4 EXPERIMENTAL STRESS ANALYSIS

L	T	P	C
3	0	0	3

Module 1

Strain measurement: mechanical, optical acoustical strain gauges. Electrical resistance strain gauges, strain rosettes.

Module 2

Measurement of displacements – potentiometers – linear variable differential transformer (LDVT), Accelero meteres, Measurement of force : Load cells, Electrical resistance based: Ring type force transducer, pressure transducer.

Module 3

Photo elasticity – Light and optics as related to photoelasticity, theory of photo elastic model materials, analysis techniques. Separation and compensation methods. Introduction to 3–dimensional photoelasticity.

Module 4

Methods of measuring sensitivity like cantilever calibration, determination of ultimate strength, refrigeration techniques, relaxation techniques, double crack analysis of brittle coating data– Introduction to moiré fringe techniques of stress analysis.

References:

1. Dalley and Rilley, “Experimental Stress Analysis”.
2. P.H. Adams & R.C. Dove, “Experimental Stress Analysis and motion Measurement”.
3. M. Hetney, Hand book of experimental stress analysis.

MCESE 106 - 1 **PRESTRESSED CONCRETE**

L	T	P	C
3	0	0	3

Module 1

Introduction: - Basic concept of Prestressing, Analysis of prestress and bending stress: - Stress concept, Strength concept: - Pressure line and internal resisting couple and Load balancing concept for extreme fiber stresses for various tendon profile. Systems of Prestressing: - Pre tensioning and Post tensioning, Thermo elastic and Chemical prestressing. Tensioning devises and Systems, Materials for Prestressed concrete: - Need of high strength concrete and steel, Advantages of prestressed concrete over reinforced concrete.

Losses of Prestress: - Losses of Prestress:- Stages of losses,Types of losses in pre-tensioning and post-tensioning due to Elastic shortening, Shrinkage, Creep, Relaxation, Anchorage Slip, Friction and Sudden changes in temperature. Graphical method for friction loss, Methods of overcoming friction losses. Concept of reduction factor.

Deflection of beams: - Short term, Load deflection curve, Importance of control of deflections, factors influencing deflections, Pre- cracking and Post- cracking, Effect of tendon profile on deflections, Prediction of long term (Concept only,)

Module 2

Cracking and Failure: - Micro and visible cracking, Stresses in steel due to loads. Failure: - Flexural failure, Shear failure, other modes of failure.

Elastic Design: - Shear and Torsional Resistance of PSC members: - shear and Principal stresses, Ultimate shear resistance of PSC members: - Section cracked and uncracked, Design for shear using IS code. PSC members in torsion:-Pure torsion, Combined bending moment and torsion, Combined bending moment, shear and torsion: - Codified procedures, Design of reinforcement using IS code provision. Flexural strength: - Simplified code procedure for bonded and unbonded symmetrical and unsymmetrical sections. Behavior under flexure: - Codel provision for Limit state design:-Design stress strain curve for concrete. Design of sections for flexure: - Expressions for minimum section modulus, Prestressing force and Eccentricity. Design: - Analytical and Graphical. Limiting zone for prestressing force.

End blocks: - Anchorage zone Stresses, Stress distribution in end block, Methods of investigation, Anchorage zone reinforcements, Design (IS Code method only)

Module 3

Design of Pretensioned and Post-Tensioned Flexural Members: - Dimensioning of Flexural members, Estimation of Self Weight of Beams, Design of Pre tensioned and Post tensioned members symmetrical about vertical axis.

Design of Compression members (Concepts only, no design expected):-Design of compression members, with and without flexure, its application in the design of Piles, Flag masts and similar structures.

Prestressing of statically indeterminate structures: - Advantages, Effect, Method of achieving continuity, Primary, Secondary and Resultant moments, Pressure line, Concept of Linear transformation, Guyon's theorem, Concordant cable profile.

Module 4

Composite construction of Prestressed and in situ Concrete: - Types, Analysis of stresses, Differential shrinkage, Flexural strength, Shear strength, Design of composite section.

Tension members: - Load factor, Limit state of cracking, Collapse, Design of sections for axial tension.

Design of Special Structures (concept only, no design expected):- Prestressed Folded plates, Cylindrical Shells, Pipes, Circular water tanks.

References:

1. T.Y. Lin and H. Burns Ned., "Design of prestressed concrete structures", John Wiley and sons, New York.
2. N. Krishna Raju, "Prestressed concrete", Tata McGraw Hill Publishing Co.Ltd.
3. BIS, IS: 1343-1980, "Code of Practice for Prestressed Concrete", Bureau of Indian standards, India.
4. R. H. Evans and E. W. Bennet, "Prestressed Concrete Theory and Design", Chapman and Hall, London.
5. N. Rajagopal, "Prestressed Concrete", Narosa Publishing House, New Delhi.
6. S. Ramamrutham, "Prestressed Concrete", Dhanpat Rai Publishing Company (P) Ltd., New Delhi.

7. Y. Guyon, “Prestressed Concrete”, C. R. Books Ltd., London.
8. P.W. Abeles, “An Introduction to prestressed Concrete”, Vol. I & II, Concrete Publications Ltd., London.
9. H. Nilson Arthur, “Design of Prestressed Concrete”, 2nd edn. John Wiley and Sons, New York.
10. F. Leonhardt, “Prestressed Concrete and Construction2nd edn.” Wilhelm Ernst and Sohn, Berlin, Munich.

MCESE 106 - 2 **COMPUTER AIDED DESIGN**

L	T	P	C
3	0	0	3

Module 1

History and overview of CAD– advantages of CAD over manual drafting and design – hardware requirements – computers and workstation, elements of interactive graphics, input/out put display, storage devices in CAD, and an overview of CAD software – 2D Graphics, 3D Graphics.

Module 2

Popular CAD packages, Type of structure, Unit systems, structure geometry and Co-ordinate systems - global co- ordinate system, Local co-ordinate systems –Relationship between Global and Local co-ordinate systems Edit Input-Command Formats-Text Input. Graphical Input Generation-"Concurrent" Verifications- Library-Geometry-Generation–Dimensioning-loading-Analysis.

Module 3

Construction activities:- The critical path method- Definitions of terms and symbols- Steps in critical path scheduling- Developing a critical path schedule - Determining free float-Determining total cost of project - Manual versus Computer analysis of critical path methods– Popular packages in Construction Management and MIS.

Module 4

Information types and uses:- General application software's- Civil engineering packages, Project management software, advanced structural engineering software's, Expert systems for construction.

References:

1. Sujith Kumar Roy & Subrata Chakrabarty, "Fundamentals of Structural Analysis", S Chand $ Company Ltd., New Delhi.
2. B.Sengupta & H. Guha, "Construction Management and Planning", Tata Mc Graw Hill Publishing Co. Ltd, New Dehi.

3. R.L Peurifoy, “Constuction Planning, Equipment and methods”, Tata Mc Graw Hill Publishing Co. Ltd, Kogakusha.
4. Mikell P. Groover & Emroy W Zimmers,Jr, “CAD/CAM Computer Aided Design and Computer Aided Manufacturing”
5. Reference Manuals of Packages.
6. L S Sreenath, CPM – PERT.
7. C.S. Krishnamoorthy, S.Rajeev, A Rajaraman, “Computer Aided Design – Software and Analytical Tools”, Narosa Publishing House, New Delhi

MCESE 106 - 3 **DESIGN OF OFFSHORE STRUCTURES**

L	T	P	C
3	0	0	3

Module 1

Wave Theories:–Wave generation process, small and finite amplitude wave theories.

Forces of Offshore Structures:–Wind forces, wave forces on vertical, inclined cylinders, structures – current forces and use of Morison equation.

Module 2

Subsea Soil and Offshore Structure Modeling:–Different types of offshore structures, foundation modeling, structural modeling of fixed offshore structures like jacket & jackups.

Module 3

Analysis of Offshore Structures:–Static method of analysis, foundation analysis and dynamics of offshore structures – Numerical examples of jacket structures.

Module 4

Design of Offshore Structures:–Design of platforms, helipads, Jacket tower and mooring cables and pipe lines.

References:

1. Chakrabarti, S.K. ,"Hydrodynamics of Offshore Structures", Computational Mechanics Publications, 1987.
2. Thomas H. Dawson, "Offshore Structural Engineering", Prentice Hall Inc Englewood Cliffs, N.J. 1983
3. API, Recommended Practice for Planning, "Designing and Constructing Fixed Offshore Platforms", American Petroleum Institute Publication, RP2A, Dalls, Tex.
4. Wiegel, R.L., "Oceanographical Engineering", Prentice Hall Inc, Englewood Cliffs, N.J. 1964.
5. Brebia, C.A.Walker, S., "Dynamic Analysis of Offshore Structures", New–nes Butterworths, U.K. 1979.
6. Reddy, D.V. and Arockiasamy, M., "Offshore Structures", Vol.1, Krieger Publishing Company, Florida, 1991.

MCESE 106 - 4 ADVANCED CONCRETE TECHNOLOGY

L	T	P	C
3	0	0	3

Module 1

Aggregate classification, Testing Aggregates, fibres. Cement, garde of Cement, chemical composition, Hydration of Cement, Structure of hydrated Cement, Special Cement, Water, Chemical and Mineral Admixtures.

Module 2

Principles of Concrete mix design, methods of Concrete mix design, Design of high strength and high performance concrete.

Rheological behaviour of fresh Concrete, Properties of fresh and hardened concrete, Strength, Elastic properties, Creep and Shrinkage, Variability of concrete strength. Non destructive testing and quality control, Durability, corrosion protection and fire resistance.

Module 3

Modern trends in concrete manufacture and placement techniques, Methods of trnsportataion, Placing and curing–extreme whether concreting, Special concreting methods, Vaccum dewatering of concrete– Under water concreting.

Module 4

Light weight Concrete, Fly–ash Concrete, Fibre reinforced Concrete, Polymer Concrete, Epoxy resins and screeds for rehabilitation – properties and application – Emerging trends in replacement of fine aggregates.

References:

1. Krishnaraju, N., ”Advanced Concrete Technology”, CBS Publishers.
2. Nevile, A. M., “Concrete Technology”, Prentice Hall, Newyork, 1985.
3. Santhakumar A.R. – “Concrete Technology”.

MCESE 107 COMPUTER APPLICATION LAB

L	T	P	C
0	0	3	2

Application of Structural analysis & design software like STRAP, STAAD and management software like SURETRACK. The student has to practice the packages by working out different types of problems.

MCESE 108 SEMINAR - I

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.

MCESE 201 NUMERICAL METHODS IN ENGINEERING

L	T	P	C
3	1	0	4

Module 1

Solution of Linear and Non–linear Equations:– Review of Gaussian Elimination and Cholesky methods – Storage schemes – Substructure concept – submatrix equation solver. Non linear system of equations: Newton Raphson , modified Newton Raphson Methods.

Module 2

Solution Techniques for Eigen Value Problems:– Introduction – Forward iteration, inverse iteration, Jacobi, Given's method. Transformation of generalized Eigen value problem to a standard form – Sturm sequence property – Subspace iteration method.

Module 3

Interpolation and integration:– Lagrange – Hermitian and cubic spline methods – Isoparametric style of interpolation. Numerical Integration –Newton-Cotes quadrature– Gaussian quadrature – Weights and Gauss points – Application to deflection of beams and plates.

Module 4

Finite difference technique:– Initial and Boundary value problems of ordinary and partial differential equations applicable to beams and plates only, Finite difference method, Newton' s Method, Variational and weighted residual methods.

References:

1. Rajasekaran S, "Numerical Methods in Science and Engineering – A practical approach", AH Wheeler & Co.
2. Bathe K J, "Finite Element Procedures in Engineering Analysis", Prentice Hall Inc.
3. James M L, Smith G M, and Wolford J C, "Applied Numerical Methods for Digital computation", Harper and Row Publishers.
4. Krishnamoorthy E V and Sen S K, "Computer Based Numerical algorithms", Afiliated East West Press.
5. Stanton R C, "Numerical Methods for Science and Engineering", Prentice Hall of India.

6. M.K Jain,S.R.K Iyengar,R.K Jain “Numerical Methods for Scientific and Engineering Computation”.
7. R.W. Hamming, “Numerical methods for scientist and engineers”, McGraw Hill, 1998.

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 **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 204 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 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 **ENGINEERING FRACTURE MECHANICS**

L	T	P	C
3	0	0	3

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 206 - 4 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.

MCESE 207 STRUCTURAL ENGINEERING DESIGN STUDIO

L	T	P	C
0	0	3	2

Application of software like SAP, ANSYS, NISA, etc. in modeling, simulation, analysis, design and drafting of structural components using the concepts given in theory papers. The student has to practice the packages by working out different types of problems. The student has to carry out a mini project work which will be evaluated for internal assessment.

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.

MCESE 301 **INDUSTRIAL TRAINING**

L	T	P	C
0	0	20	10

The student shall undergo an industrial training of 12 weeks duration in an industry / company approved by the institution and under the guidance of a staff member in the concerned field. At the end of the training he / she has to submit a report on the work being carried out.

MCESE 302 **THESIS (PHASE- I)**

L	T	P	C
0	0	10	5

The thesis (Phase-I) shall consist of research work done by the candidate or a comprehensive and critical review of any recent development in the subject or a detailed report of project work consisting of experimentation/numerical work, design and or development work that the candidate has executed.

In Phase-I of the thesis it is expected that the student should decide a topic of thesis, which is useful in the field or practical life. It is expected that students should refer national and international journals, proceedings of national and international seminars. Emphasis should be given to the introduction to the topic, literature review, and scope of the proposed work along with some preliminary work / experimentation carried out on the thesis topic.

Student should submit Phase-I thesis report in two copies covering the content discussed above and highlighting the features of work to be carried out in part-I of the thesis. Student should follow standard practice of thesis writing.

The candidate will deliver a talk on the topic and the assessment will be made on the basis of the term work and talks there on by a panel of internal examiners one of which will be the internal guide. These examiners should give suggestions in writing to the student to be incorporated in thesis work Phase-II.

L	T	P	C
0	0	30	15

MCESE 401 MASTER'S THESIS

In the fourth semester the student has continue the thesis work and present the report. At the end of successfully finishing the work he / she has to submit a detailed report and has to present for a viva–voce.

The work carried out should lead to a publication in a National / International Conference. They should submit the paper before the evaluation of the thesis and specific weightage will be given to accepted papers in reputed conferences.

MCESE 402 MASTER'S COMPREHENSIVE VIVA

A comprehensive viva voce examination will be conducted at the end of the fourth semester by an internal and external examiners appointed by the university to asses the candidates overall knowledge in the specified field of specialization.