Dr. Mahalingam College of Engineering and Technology

(An Autonomous Institution)

Pollachi – 642 003

Curriculum and Syllabus for

M.E. Structural Engineering

Semester I to II

With effect from 2016 – 17

REGULATIONS 2014

DR MAHALINGAM

MCET

COLLEGE OF ENGINEERING AND TECHNOLOGY

Enlightening Technical Minds

Programme : M.E. Structural Engineering
Curriculum and Syllabus : Semesters I - II
Approved by Academic Council on 14th May 2016

Action	Responsibility	Signature of Authorised Signatory
Designed and Developed by	BoS Civil Engineering	
Complied by	Office of the Controller of Examinations	
Approved by	Principal	

Department of Civil Engineering

Curriculum & Syllabi 2014 Regulations for M.E. Structural Engineering

SEMESTER I

S.No	Course Code	Course Name	L	T	P	C	M
1	141ST0101	Higher Engineering Mathematics	3	1	0	4	100
2	141ST0102	Experimental Methods and Model Analysis	3	0	0	3	100
3	141ST0103	Dynamics of Structures	3	1	0	4	100
4	141ST0104	Design of RCC Structures	3	1	0	4	100
5	141ST0105	Theory of Elasticity and Plasticity	3	1	0	4	100
6	XXX	Elective I	3	0	0	3	100
7	141ST0107	Structural Engineering Laboratory	0	0	3	2	100
Total			**18**	**4**	**3**	**24**	**700**

SEMESTER II

S.No	Course Code	Course Name	L	T	P	C	M
8	141ST0201	Finite Element Techniques	3	1	0	4	100
9	141ST0202	Earthquake Resistant Design	3	0	0	3	100
10	141ST0203	Design of Steel Structures	3	1	0	4	100
11	141ST0204	Design of foundations	3	1	0	4	100
12	XXX	Elective II	3	0	0	3	100
13	XXX	Elective III	3	0	0	3	100
14	141ST0207	Computer Aided Structural Design Laboratory	0	0	3	2	100
Total			**18**	**3**	**3**	**23**	**700**

SEMESTER III

S.No	Course Code	Course Name	L	T	P	C	M
15	XXX	Elective IV	3	0	0	3	100
16	XXX	Elective V	3	0	0	3	100
17	XXX	Elective VI	3	0	0	3	100
18	141ST0307	Project Work Phase I	0	0	12	6	200
Total			**9**	**0**	**12**	**15**	**500**

SEMESTER IV

19	141ST0407	Project Work Phase II	0	0	24	12	400
Total			**0**	**0**	**24**	**12**	**400**

L: Lecture T: Tutorial P: Practical C: Credits M: Marks

List of Elective

S.No	Course Code	Course Name	L	T	P	C	M
1	141ST9111	Structural Optimization	3	0	0	3	100
2	141ST9112	Theory of Plates and shells	3	0	0	3	100
3	141ST9113	Concrete Technology	3	0	0	3	100
4	141ST9114	Design of Bridges	3	0	0	3	100
5	141ST9115	Stability Analysis Of Structures	3	0	0	3	100
6	141ST9116	Nonlinear Structural Analysis	3	0	0	3	100
7	141ST9117	Construction Techniques and Management	3	0	0	3	100
8	141ST9118	Design of Tall Structures	3	0	0	3	100
9	141ST9119	Design of Industrial Structures	3	0	0	3	100
10	141ST9120	Special Concretes	3	0	0	3	100
11	141ST9121	Pre-stressed Concrete Structures	3	0	0	3	100
12	141ST9122	Prefabricated Structures	3	0	0	3	100
13	141ST9123	Energy Efficient Buildings	3	0	0	3	100
14	141ST9124	Soil Structures Interaction	3	0	0	3	100
15	141ST9125	Off Shore Structures	3	0	0	3	100
16	141ST9126	Mechanics of Composite Materials	3	0	0	3	100

BOS CHAIRMAN

BOS CHAIRMAN

Course Code:141ST0101	Course Title:HIGHER ENGINEERING MATHEMATICS
Core/Elective:General	L : T : P : C : M – 3 : 1 : 0 : 4 : 100
Type: Lecture	Total Contact Hours:60

COURSE OUTCOMES

At the end of the course Students will be able to,

CO.1. Solve systems of linear and non-linear equations.
CO.2. Solve boundary value problems.
CO.3. Solve the variational problems with prescribed (or) free boundary conditions.
CO.4. Solve partial differential equations.
CO.5. Use probability and statistics concepts

UNIT I SIMULTANEOUS EQUATIONS AND NUMERICAL INTEGRATION 9+3

Solving set of equations- Gauss elimination method, Choleski method, Iterative methods, Relaxation method. System of non-linear equations- Newton Raphson method -Newton-Cotes integration formulae. Trapezoidal rule, Simpson's rule, Gaussian quadrature, Adaptive integration.

UNIT II BOUNDARY VALUE AND CHARACTERISTIC VALUE PROBLEMS 9+3

Shooting method, solution through a set of equations, derivative boundary conditions, Rayleigh-Ritzmethod, characteristic value problems, solution using Characteristic polynomial method, Jacobi method, Power method and Inverse power method.

UNIT III CALCULUS OF VARIATIONS 9+3

Variation and its properties –Euler's equation – Functionals dependent on first and higher order derivatives - Functionals dependent on functions of several independent variables – Rayleigh Ritz method- Galerkin method.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS 9+3

Method of separation of variables- Classification of second order linear Partial differential equations, Solutions of one dimensional wave equation –heat conduction - Steady state solution of two- dimensional equation of heat conduction, solutions by Fourier series and Fourier transform method.

UNIT V PROBABILITY THEORY AND DISTRIBUTIONS 9+3

Probability theory - axiomatic definition - Conditional probability - Independent events- Total probability - Baye'sTheorem - Random variables-Probability density function-cumulative distribution function - Mean and variance of Binomial distribution-Poison distribution - Normal distribution .

TEXT BOOKS:

1. Venkataraman M.K., Higher Mathematics for Engineering and Science, National publishing company, 2000.
2. Grewal B.S, Higher Engineering Mathematics, 40th Edition, Khanna publishers, Delhi, 2007.

REFERENCES:

1. Ramana B. V., Higher Engineering Mathematics, Tata Mc-Graw Hill Publishing Company limited, New Delhi, 2007.
2. ErwinKreyszig, Advanced Engineering Mathematics, 8th edition, Wiley India, 2007.
3. Curtis F. Gerald Applied Numerical Analysis, 7th Edition, PearsonEducation Ltd, New Delhi, 2007.
4. StevenChapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, 2nd Edition, Tata Mcgraw Hill Education Private Limited, New Delhi, 2010.

BOS CHAIRMAN

Course Code:141ST0102	Course Title: EXPERIMENTAL METHODS AND MODEL ANALYSIS
Core/Elective:Core	L : T : P : C : M – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours:45

COURSE OUTCOMES

At the end of this course students will be able to,

CO.1. Illustrate forces, strains and pressure using strain gauges and load cells and explain their principle of operation.
CO.2. Describe vibration measurement devices and use them to study structural vibrations.
CO.3. Diagnose distress in structure and apply remedial measures.
CO.4. Explain principles of various NDT equipments and use them for testing.
CO.5. Investigate various structural problems using model analysis.

UNIT I FORCE AND STRAIN MEASUREMENTS 9

Choice of Experimental stress analysis methods, Errors in measurements –strain measurements-Strain gauge-Wheatstone bridge-principle, types, performance and uses-strain rosette, Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – calibration-Calibration of Testing Machines.

UNIT II VIBRATION MEASUREMENTS 9

Characteristics of Structural Vibrations – Linear Variable Differential Transformer (LVDT) – Transducersfor velocity and acceleration measurements.Vibration meter – Seismographs – Vibration Analyzer –Display and recording of signals – Cathode Ray Oscilloscope – Digitaldata Acquisition systems.

UNIT III DISTRESS MEASUREMENTS AND REMEDIAL MEASURES 9

Diagnosis of distress in structures – Crack observation and measurements – corrosion of reinforcement in concrete – Half cell, construction and use, damage assessment – remedial measures for distressed concrete, controlled blasting for demolition – Techniques for residual stress measurements – Structural Health Monitoring.

UNIT IV NON DESTRUCTIVE TESTING METHODS 9

Load testing on structures, buildings, bridges and towers – Rebound Hammer, acoustic emission technique – principles and application, ultrasonic pulse velocity technique-principles and application – Impact echo testing-Principle and application, Ground penetrating radar (GPR)-principle and application, Brittle coating-principle and application.

UNIT V MODEL ANALYSIS 9

Necessity for Model analysis – Advantages – Applications - Model Laws – Laws of similitude –Types of similitude – Model materials –Scale effect in models – variables in structural behavior, dimensional analysis-Buckingham π theorem, Indirect model study – Direct model study - Limitations of models – investigations – structural problems – Usage of influence lines in model studies.

REFERENCES:

1. Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, New Delhi, 1996.
2. Ganesan T.P., Model Analysis of Structures, Universities Press, Hyderabad, 2000.
3. Srinath.L.S., M.R. Raghavan, K. Lingaiah, G. Gargesa, B. Pant, and K. Ramachandra, Experimental Stress Analysis, Tata McGraw Hill company Ltd., New Delhi, 1984.

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4. Dalley .J.W and Riley.W.F, Experimental Stress Analysis, McGraw Hill Book Co, New York, 19911.
5. Sirohi.R.S.,RadhaKrishna.H.C., Mechanical Measurements, New Age International (P) Ltd, 1997.
6. Bray.D.E., and Stanley.R.K. Non-Destructive Evaluation, McGraw Hill Pub. Co, New York, 1989.

BOS CHAIRMAN

Course Code:141ST0103	Course Title:DYNAMICS OF STRUCTURES
Core/Elective:Core	L : T : P : C : M – 3 : 1 : 0 : 4 : 100
Type: Lecture	Total Contact Hours: 60

COURSE OUTCOMES

At the end of this course students will be able to,

CO.1. Apply the concept of vibration and solve problems on Single Degree of Freedom systems (SDOF)
CO.2. Solve problems on two degree of freedom systems.
CO.3. Solve dynamic problems on multi-degree of freedom (MDOF) systems.
CO.4. Apply concepts on practical structures and analyze structures subjected to dynamic loading.
CO.5. Analyze the Multi-Storey building using response spectrum and static correction

UNIT I THEORY OF VIBRATIONS 9 + 3

Objectives of dynamic analysis - Elements of vibratory system - Types of dynamic loadings - Degrees of Freedom – continuous mass - Lumped mass idealization D'Alembert's principle - Formulation of equations of motion by different methods - Mathematical models of single degree of freedom systems - free and forced vibration of SDOF to special form of Duhamel integral, Effect of damping, Transmissibility.

UNIT II DYNAMIC RESPONSE OF TWO DEGREE OF FREEDOM SYSTEMS 9 + 3

Mathematical models of two degree of freedom systems, free and forced vibrations of two degree of freedom systems, Eigen values and Eigen vectors, normal modes of vibration, applications.

UNIT III MULTI DEGREE OF FREEDOM SYSTEMS 9 + 3

Selection of degrees of Freedom - Evaluation of structural property matrices - formulation of the MDOF equations of motion-Static condensation -Undamped free vibrations – Solutions of Eigen value problem for natural frequencies and mode shapes - Dynamic response analysis– Modal Analysis- Orthogonal properties of normal modes, uncoupled equations of motion, approximate method-Rayleigh quotient method, stodola.

UNIT IV DYNAMIC RESPONSE OF CONTINUOUS SYSTEMS 9 + 3

Introduction - Flexural vibrations of beams - Elementary case - Derivation of governing differential equation or motion -Analysis of undamped free vibrations of beams in flexure-natural frequencies and mode-shapes of simple beams with different end conditions-Principles of application to continuous beams, approximate method-Rayleigh method, Rayleigh Ritz method.

UNIT V INTRODUCTION TO EARTHQUAKE ANALYSIS 9 + 3

Exitation rigid base translation –Lumped mass approach –SDOF and MDOF system-Response spectrum-Generation and use-Response spectrum method of analysis of multi storey buildings-Combination of nodal response-model mass-Static correction.

REFERENCES:

1. Anil K. Chropra, Dynamics of Structures: Theory and Applications to Earthquake Engineering, 3rd Edition, Dorling Kindersley Pub Inc., New Delhi, 2007.
2. Mario Paz, Structural Dynamics: Theory and Computation, 2nd Edition, CBS publishers, New Delhi, 2004.
3. Patrick Paultre, Dynamics Of Structures, Wiley India Pvt Ltd, New Delhi, 2011.
4. Hurty W.C. Jr., and M. F. Rubinstein, Dynamics of Structures, PHI, New Delhi, 2007.

BOS CHAIRMAN

5. Damodarasamy S.R and Kavitha S, Basics of Structural Dynamics and A seismic Design, PHI publishers, 2009.
6. Clough, R.W.; and Penzien, J., Dynamics of structures. 3rd Edition, Computer and Structures, Inc., Berkeley, USA, 2003.

BOS CHAIRMAN

Course Code:141ST0104	Course Title: DESIGN OF RCC STRUCTURES
Core/Elective:Core	L : T : P : C : M – 3 : 1 : 0 : 4 : 100
Type: Lecture	Total Contact Hours: 60

COURSE OUTCOMES

At the end of this course students will be able to,

CO.1. Design of RCC beams and columns using limit state design method
CO.2. Design multistoried RC Frames
CO.3. Develop an idea of designing special R.C. elements
CO.4. Design and detailing of flat slabs and grid floors
CO.5. Apply the concepts of ductile detailing of R.C. members as per IS Codes

UNIT I REVIEW OF LIMIT STATE DESIGN 9 + 3

Design for limit state of collapse - Design of beams for combined effect of shear, bending moment and torsion - Design of slabs - Design of short and slender columns including biaxial bending – detailing of reinforcements - Design for limit state of serviceability - Calculation of deflection and crack width as per IS : 456 – 2000, Comparative study with BS8110 & ACI318.

UNIT II DESIGN OF CONTINUOUS BEAMS AND FRAME 9 + 3

Design and detailing of continuous beams and portal frames-design of multibay, multistoreyed R.C. frames: preliminary design-use of substitute frames for calculating stress resultants caused by gravity loading-portal and cantilever methods for lateral loads -detailing of reinforcements.

UNIT III DESIGN OF SPECIAL R.C. ELEMENTS 9 + 3

Design of R.C. walls - Shear walls- Classification and design principles, Design of curved beams, Design of deep beams- Checking for Local Failures- Detailing of Deep Beams- Design of Corbels--detailing of reinforcements.

UNIT IV DESIGN OF FLAT SLABS AND GRID FLOORS 9 + 3

Hillerborg's strip method of design of slab-Design of flat slab- Equivalent frame method of design- ACI method Approximate analysis and Design of grid floors-detailing of reinforcements.

UNIT V INELASTIC BEHAVIOUR OF CONCRETE BEAMS AND FRAMES 9 + 3

Inelastic behaviour of concrete beams-moment-rotation curves-moment redistribution in continuous beams- Design of cast-in-situ joints in frames. Detailing requirements for ductility, durability and fire resistance.

REFERENCES:

1. UnnikrishnaPillai and DevdasMenon, Reinforced concrete Design, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2006.
2. Krishna Raju N., Advanced Reinforced Concrete Design, 2nd Edition, CBS Publishers and Distributors, New Delhi, 2005.
3. Park R. and Paulay T., Reinforced Concrete Structures, Wiley India Pvt Ltd, New Delhi, 2009.
4. Purushothaman P., Reinforced concrete Structural Elements: Behavior, Analysis and Design, TataMcGraw Hill, New Delhi, 2009.
5. Nilson A.H., Design of Concrete Structures, Tata McGraw-Hill, New Delhi, 2003.

BOS CHAIRMAN

Course Code:141ST0105	Course Title:THEORY OF ELASTICITY AND PLASTICITY
Core/Elective:Core	L : T : P : C : M – 3 : 1 : 0 : 4 : 100
Type: Lecture	Total Contact Hours: 60

COURSE OUTCOMES

At the end of this course students will be able to,

CO.1. Develop systematic - knowledge of stress strain concept
CO.2. Solve two dimensional problems in Cartesian coordinates
CO.3. Solve two dimensional problems in Polar coordinates
CO.4. Develop the knowledge about torsion for shapes like ellipse triangular and rectangular
CO.5. Apply the concepts of theories of failures and study the basics of plasticity

UNIT I ANALYSIS OF STRESS AND STRAIN IN CARTESIAN COORDINATES 9+3

Analysis of stress (two and three dimension)- Body force, surface force - Uniform state of stress – Principal stresses - stress transformation laws - Differential equations of equilibrium. Analysis of strain (two and three dimension) Strain displacement relations - Compatibility equations - state of strain at a point – strain transformation - principal strain - principle of superposition. Stress - strain relations - generalized Hook's law - Lame's constants - methods of formulation of elasticity problems – Equilibrium equations in terms of displacements - compatibility equations in terms of stresses - Boundary value problems.

UNIT II TWO DIMENSIONAL PROBLEMS IN CARTESIAN COORDINATES 9+3

Introduction - Analysis of stress and strain, Equilibrium equations - Compatibility equations - stress strain relationship. Generalized Hooke's law - Plane stress and Plane strain problems - Airy's stress function - polynomials – Direct method of determining Airy's polynomial stress function - solution of Biharmonic equation by fourier series - St. Venant principle.

UNIT III TWO DIMENSIONAL PROBLEMS IN POLAR COORDINATES 9+3

General equations in polar coordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar coordinates - displacements for symmetrical stress distribution - Rotating Disc - Bending of a curved bar by force at the end - Effect of circular hole on stress distribution - concentrated force at a point of a straight boundary - circular disc with diametric loading.

UNIT IV TORSION OF PRISMATIC BARS 9+3

General solutions of the problem by displacement (St. Venant's warping function) and force (Prandtl's stress function) approaches - Membrane analogy - Torsion of shafts of circular and noncircular (elliptic, triangular and rectangular) cross sectional shapes. Torsion of thin rectangular section and hollow thin walled single and multicelled sections.

UNIT V INTRODUCTION TO PLASTICITY 9+3

Introduction to stress - physical Assumptions - strain curve - Ideal plastic body - criterion of yielding - Rankine's theory - St.Venant's theory - Tresca's criterion - Beltramis theory - Von-mises criterion - Mohr's theory of yielding - yield surface - Flow rule (plastic stress- strain relation) PrandtlReuss equations - Plastic work – Plastic potential - Applications of thick cylinder - Elasto-plastic problems in bending and torsion.

REFERENCES:

1. Sadhu Singh, Theory of Elasticity, Khanna Publishers, New Delhi, 2005.
2. Sadhu Singh, Theory of Plasticity, Khanna Publishers, New Delhi, 2008.

BOS CHAIRMAN

3. Timoshenko S. and Goodier J.N., Theory of Elasticity, 3rd Edition, Tata Mcgraw Hill Education Pvt Ltd, 2010.
4. Chakrabarthy T, Theory of Plasticity, McGraw Hill Book Co., New Delhi, 2006.
5. Wang C.T., Applied Elasticity, McGraw Hill, New Delhi, 1990.
6. Sadd M.H., Elasticity: Theory, Applications, AndNumerics, 2nd Edition, Elsevier India Pvt. Ltd.-New Delhi, 2011.

BOS CHAIRMAN

Course Code:141ST0107	Course Title: STRUCTURAL ENGINEERING LABORATORY
Core/Elective: Core	**L : T : P : C : M** – 0 : 0 : 3 : 2 : 100
Type: Practical	**Total Contact Hours:** 45

COURSE OUTCOMES

At the end of this course students will be able to,

CO.1. Verify the behaviour of different materials
CO.2. Verify deflections, stresses in structural elements
CO.3. Apply the knowledge on measuring devices with data acquisition system
CO.4. Analysis and verification of shear stress, bending stress distribution in beam
CO.5. Analyse the Natural frequency of structural model using shake table.

LIST OF EXPERIMENTS:

1. Effect of admixtures in concrete for workability, strength and durability.
2. Study of the constitutive behavior of structural materials (concrete, steel and Aluminium)
3. Study on Bond strength of steel with concrete - Pull out test on concrete cube specimens embedded with Mild steel and RTS bars as per Indian Standards.
4. Strength assessment of concrete -NDT Techniques- Ultrasonic pulse velocity method, Rebound Hammer test, Impact-Echo method.
5. Testing of RC concrete beam in a testing frame.
6. Analysis and verification of forces in plane truss for various loads.
7. Large deflection behaviour of a steel strip.
8. Analysis and verification of shear stress, bending stress distribution in beam for cantilever simply supported beam.
9. Calibration for strain gauge-LVDT-measurement using cantilever.
10. Natural frequency of structural model using shake table.

REFERENCES:

1. Kukreja C.B. and V.V. Shastry, Experimental methods in structural mechanics, Standard Publishers Distributors, New Delhi, 2009.
2. Structural Engineering Laboratory Manual of Civil Engineering department, MCET, Pollachi, 2016.

BOS CHAIRMAN

Course Code:141ST0201	Course Title:FINITE ELEMENT TECHNIQUES
Core/Elective:Core	L : T : P : C : M – 3 : 1 : 0 : 4 : 100
Type: Lecture	Total Contact Hours:60

COURSE OUTCOMES

At the end of the course students will be able to,

CO.1. Explain various methods of finite element formulation.
CO.2. Formulate one dimensional element properties.
CO.3. Formulatetwo and three dimensional element properties.
CO.4. Apply finite element method to static analysis.
CO.5. Apply finite element method to dynamic problems.

UNIT I INTRODUCTION **9 + 3**

Historical Background - Basic Concept of FEM - Engineering problems and governing differential equations – Finite element modeling – Discretisation - Node, Element - different types of element – Approximate Solutions – Principal of minimum potential energy, Rayleigh-Ritz method and Galerkins methods.

UNIT II ANALYSIS OF ONE DIMENSIONAL PROBLEMS **9 + 3**

One dimensional problems - Coordinate systems – global, local and natural coordinate systems, shape functions – Bar, beam and truss element - Generation of Stiffness Matrix and Load Vector – Application to trusses, beams and plane frames – Convergence requirements, P and H methods.

UNIT III ANALYSIS OF TWO DIMENSIONAL INPLANE PROBLEMS **9 + 3**

Two Dimensional problems – Plane Stress, Plane Strain Problems – Triangular and Quadrilateral Elements – Isoparametric Formulation - Natural Coordinates, Shape function, stiffness matrix - Axisymmetric Problems - Higher Order Elements - Numerical Integration – Application to solve in plane problems – Convergence – Ill conditioned elements.

UNIT IV PLATES AND SHELLS **9 + 3**

Kirchoff plate theory, Mindlin plate theory, Assumptions and Limitations, Triangular and rectangular plate elements – Isoparametric formulation strain – Displacement relation – Stiffness matrix, Shell elements – Application to solve plate problems.

UNIT V STRUCTURAL DYNAMICS APPLICATIONS **9 + 3**

Dynamic equations – Mass and damping matrices – Natural frequencies and modes – Reduction of number of DOF-Formulation for point mass and distributed masses, Consistent element mass matrix of one dimensional bar element, beam element and quadrilatateral element. Lumped mass matrix, Evaluation of eigen values and eigen vectors, Applications to bars and beams.

REFERENCES:

1. Reddy J.N., An Introduction to the Finite Element Method, 3rd Edition, Tata Mcgraw Hill Education Private Ltd, New Delhi, 2005.
2. Shames I.H., Dym C.I., Energy and Finite Element Methods in Structural Mechanics, New Age International pvt ltd, New Delhi, 1992.
3. Cook, R. D., Malkus, D. S., Plesha, M. E., and Witt, R. J., Concepts and Applications of Finite Element Analysis, 4th Edition, Wiley India Pvt Ltd, New Delhi, 2007.
4. Krishnamoorthy C.S, Finite Element Analysis: Theory and Programming, 2nd Edition, Tata Mcgraw Hill Education Pvt Ltd, New Delhi, 2005.

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5. Rao S.S., The Finite Element Method in Engineering, 5th Edition, Butterworth-heinemann, Oxford, 2010.
6. Zienkiewicz O.C. and Taylor R.L., Finite Element Method for Solid and Structural Mechanics, 6th Edition, Butterworth-heinemann, Oxford, 2005.
7. Daryl Logan, First Course in the Finite Element Method, 4th Edition, Nelson Engineering, 2007.

BOS CHAIRMAN

Course Code:141ST0202	Course Title:EARTHQUAKE RESISTANT DESIGN
Core/Elective:Core	L : T : P : C : M – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours: 45

COURSE OUTCOMES

At the end of the course students will be able to,

CO.1. Explain the causes of earthquake and its effect on structures.
CO.2. Explain the earthquake resistant design concept.
CO.3. Design earthquake resistant masonry structures.
CO.4. Design earthquake resistant RC. and steel structures.
CO.5. Explainbase isolation control concept and explain design requirements for soil structure interaction effects.

UNIT I EARTHQUAKE AND ITS EFFECTS ON STRUCTURES 9

Engineering seismology: cause of earthquakes-Faults- plate tectonics –seismic waves-Magnitude and Intensity of an earthquake- Earthquake measuring instruments-Characteristics of strong ground motions- Seismic zones of India, Past earthquakes in India & World.

UNIT II EARTHQUAKE RESISTANT DESIGN CONCEPT 9

Design philosophy of earthquake resistant design of structures- Functional planning and Layout- ERD Consideration- IS1863 codal Provision- Analysis of multi storey buildings for earthquake loads- Equivalent Static load method- response spectrum method-Time history method, P-Delta effects.

UNIT III EARTHQUAKE RESISTANT DESIGN OF MASONRY STRUCTURES 9

Planning Considerations, Principle of Earthquake Resistant Design, Translational and torsional shear due to eccentricity- IS code provision for torsion, design of bands, piers and walls.

UNIT IV EARTHQUAKE RESISTANT DESIGN OF RC & STEEL STRUCTURES 9

Earthquake Resistant Design of R.C.C. Buildings - Design and detailing – Rigid Frames – Shear walls – Coupled Shear walls, Ductility detailing as per IS13920, Earthquake resistant design of steel structures, Design philosophy of various types of lateral force resisting systems- IS code provision.

UNIT V VIBRATION CONTROL TECHNIQUES 9

Mathematical modeling of multistoried RC Buildings – Capacity based design. Push over analysis - Vibration Control – Tuned Mass Dampers –Seismic Base Isolation – Design consideration for Soil liquefaction. Seismic foundation Design requirements for soil structure interaction effects, seismic qualification of equipments – vertical floor flexibility effects in seismic design.

REFERENCES:

1. PankajAgarwal and Manish Shrikhande, Earthquake Resistant Design of Structures, Prentice Hall of India, New Delhi, 2006.
2. Duggal S.K., Earthquake Resistant Design of Structures, Oxford University Press, USA, 2007.
3. Paulay,T and Priestly, M.N.J., A seismic Design of Reinforced Concrete and Masonry buildings, John Wiley and Sons, 19911.
4. Bruce A Bolt, Earthquakes, W H Freeman and Company, New York, 2004

BOS CHAIRMAN

5. BungaleS.Taranath, Structural Analysis and Design of Tall Buildings, McGraw Hill Book Company, New York, 1999.
6. C. A. Brebbia,"Earthquake Resistant Engineering Structures VIII",WIT Press, 2011
7. Mohiuddin Ali Khan "Earthquake-Resistant Structures: Design, Build and Retrofit", Elsevier Science & Technology, 2012
8. S K Duggal, "Earthquake Resistant Design of Structures", Oxford University Press, 2007.

BOS CHAIRMAN

Course Code:141ST0203	Course Title:DESIGN OF STEEL STRUCTURES
Core/Elective: Core	**L : T : P : C : M** – 3 : 1 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:** 60

COURSE OUTCOMES

At the end of the course students will be able to,

CO.1. Explain general principle in the design of steel structures
CO.2. Analyze and Design the Industrial buildings
CO.3. Design the special structures such as bunkers, silos, chimneys, water tanks and transmission line towers
CO.4. Design the Light gauge sections.
CO.5. Design steel structures by using plastic design method.

UNIT I STRUCTURAL CONNECTIONS **9 + 3**

Design of high strength function grip bolts - Design of beam-column bolted connections-problems -Welded connections - eccentric connections - Beam end connections - Web connections – Moment resistant connections - Behaviour of welded connections – problems.

UNIT II INDUSTRIAL BUILDING **9+3**

Industrial building frames - General - Framing - Bracing - Gantry girders and columns - Analysis of Trussed bents - Design example - Design of rigid joints knee for gable frames. Structure of Multistoreyed Buildings - Bracing of Multistorey frames - Loads - Lateral load of Frames - Design. Analysis and design of different types of Live pan, Pratt and north light roof trusses – Space trusses – Analysis and design of industrial buildings – Sway and non sway frames

UNIT III SPECIAL STRUCTURES **9+3**

Design of steel bunkers and silos - Janssen's theory - Aiy's theory - design parameters-design criteria. Design and detailing of guyed steel chimneys. Analysis and Design of Steel Water Tanks. Transmission line towers - Introduction, types of towers - tower configuration, load analysis and design of members.

UNIT IV LIGHT GAUGE SECTIONS **9+3**

Design of cold formed sections - concepts - effective width - stiffened sections - multiple stiffened sections - Behaviour of Compression Elements - Effective width for load and deflection determination – Behaviour of Unstiffened and Stiffened Elements – design for flexure – Lateral buckling of beams – Shear Lag - design of two span continuous beams - design of light gauge columns –Torsional –Flexural buckling – Tension Members - beam column - connections.

UNIT V PLASTIC ANALYSIS AND DESIGN **9+3**

Introduction - Theory of plastic bending - Plastic hinge – Shape factor, Moment redistribution, failure mechanisms, Analysis of portal frames, Effect of axial force - Effect of shear force on plastic moment, Connections - Requirement – Moment resisting connections. Design of Straight Corner Connections – Haunched Connections – Plastic design of tension and compression members - Design of continuous beams.

REFERENCES:

1. Dayaratnam P., Design of Steel Structures, A.H. Wheeler & Co., Ltd, Allahabad, 2008.
2. Punmia B.C., Jain A.K. and Arunkumar Jain, Design of Steel Structures, Vol. I & II, Arhant Publications, Bombay, 2004.

BOS CHAIRMAN

3. Arya and Ajmani, Design of Steel Structures, Nemchand Brothers, Roorkee, 1994.
4. Alexander Newman, Metal Building Systems – Design and Specifications, McGraw Hill, New Delhi, 2004.
5. IS 800-2007 Indian Standard General Construction in Steel – code of practice (3rd Revision), BIS.
6. Subramanian N., Design of steel structures, Oxford University Press, New Delhi, 2008.
7. Linton E. Grinter, Design of Modern Steel Structures, Eurasia Publishing House, New Delhi, 1996.
8. John E. Lothers, Design in Structural Steel, Prentice Hall of India, New Delhi, 1990.
9. Lynn S. Beedle, Plastic Design of Steel Frames, John Wiley and Sons, New York, 1990.

BOS CHAIRMAN

Course Code:141ST0204	Course Title:DESIGN OF FOUNDATIONS
Core/Elective:Core	L : T : P : C : M – 3 : 1 : 0 : 4 : 100
Type: Lecture	Total Contact Hours:60

COURSE OUTCOMES

At the end of the course students will be able to,

CO.1. Explain the principle of design of foundations.
CO.2. Design pile foundations and pile caps.
CO.3. Design sheet pile structures.
CO.4. Design machine foundations.
CO.5. Design special foundations.

UNIT I INTRODUCTION **9 + 3**

Soil investigation report for foundation design – Types of foundation – Selection of foundation – Requirements of foundation - Computation of loads - Bearing Capacity of soil – Plate load test - General principle of design of shallow and deep foundation – Design of strip, isolated, combined and strap footings – Raft foundation.

UNIT II PILE FOUNDATIONS **9 + 3**

Introduction, Types of pile foundation– Load carrying capacity of different types of piles and pile groups according to IS 29111 - Settlement of piles - Negative skin friction - Lateral load resistance of individual piles and pile groups – Structural design of straight piles – Different shapes of pile caps – Structural design of pile cap – Reinforcement detailing, Types of well foundation – Grip length – Construction of wells – Failures and remedies – Design of well foundation.

UNIT III SHEET PILES **9 + 3**

Sheet pile structures-cantilever sheet pile walls in granular soils and cohesive soils-Anchored Bulk head - Free earth support method - Fixed earth support method - lateral earth pressure on Braced sheet piles – design examples.

UNIT IV MACHINE FOUNDATIONS **9 + 3**

Introduction - Types of machine foundation – Basic principles of design of machine foundation - Dynamic properties of soil - Vibration analysis of machine foundation - Natural frequency - Design of foundation for Reciprocating machines and Impact machines - Reinforcement and construction details – Vibration isolation.

UNIT V SPECIAL FOUNDATIONS **9 + 3**

Foundation in Expansive Soils - Identification of expansive soils - Indian expansive soils – Swell potential and swelling pressure - Methods of foundation in expansive soils - Under reamed pile foundation - Foundations for concrete towers and chimneys.

REFERENCES:

1. Swamy Saran, Analysis and Design of Substructures, Oxford and IBH Publishing Co., 2006.
2. Varghese P.C., Foundation Engineering, Prentice-Hall of India Private Ltd, New Delhi, 2006.
3. Thomlinson M.J. and Boorman R., Foundation Design and Construction, ELBS Longman, 1995.
4. Murthy V.N.S, Advanced Foundation Engineering, CBS publisher, 2007.

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5. Kurien.N.P, Design of foundation systems-Principles and Practices, Narona Publishing House-New Delhi, 1994.
6. Bowles.J.E, Foundation Analysis & Design, Mcgraw Hill-New Delhi, 1988.

BOS CHAIRMAN

Course Code:141ST0207	Course Title: COMPUTER AIDED STRUCTURAL DESIGN LABORATORY
Core/Elective: Core	**L : T : P : C : M** – 0 : 0 : 3 : 2 : 100
Type: Practical	**Total Contact Hours:** 45

COURSE OUTCOMES

At the end of the course students will be able to,

CO.1. Use softwares like ETABS, STAAD Pro and ANSYS

CO.2. Apply the theory of elasticity and finite element analysis concepts for analyzing the plate problems

CO.3. Analyze and design different concrete structures.

CO.4. Analyze and design different steel structures.

CO.5. Analyze and design the Industrial building

LIST OF EXPERIMENTS:

ANALYSIS OF STRUCTURES USING SOFTWARE

1. Analysis of pin jointed plane trusses
2. Analysis of rigid jointed plane frames
3. Plane stress analysis of using CST and four nodedisoparametric elements
4. Plate bending analysis using isoparametric plate and shell element

DESIGN OF REINFORCED CONCRETE STRUCTURES USING SOFTWARE

5. Design and Detailing of Slabs and Beams
6. Design and Detailing of short and slender Columns including biaxial bending
7. Design and Detailing of reinforced concrete retaining wall (cantilever type)
8. Design and Detailing of different types of foundations

DESIGN OF STEEL STRUCTURES USING SOFTWARE

9. Design of steel structural elements (Beams and Columns)
10. Design of purlins and elements of truss.
11. Design of Industrial building with gantry girder.
12. Design of steel Towers

REFERENCES:

1. Computer Aided Structural Design Laboratory Manual of Civil Engineering department, MCET, Pollachi, 2012.

BOS CHAIRMAN

Course Code:141ST9111	Course Title:STRUCTURAL OPTIMIZATION
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

COURSE OUTCOMES

At the end of the course students will be able to,

CO.1. Explainthe concept of Optimization techniques.
CO.2. Explain theory of linear programming.
CO.3. Explain theory of nonlinear programming.
CO.4. Solve problems of conversion of a final value problem into an initial value problem and dynamic programming in optimization
CO.5. Apply concepts on practical structures subjected to dynamic loading as well.

UNIT I INTRODUCTION TO OPTIMIZATION 9

Introduction-Engineering applications of optimization-statement of an optimization problem-classification of optimization problems-optimization techniques

UNIT II LINEAR PROGRAMMING 9

Standard form of a linear programming problem-Geometry of linear programming problems-simplex method-basic solution-computation-maximization and minimization.Duality in linear programming, General primal-Dual relations-Dual simplex method-revised simplex method.

UNIT III NON-LINEAR PROGRAMMING 9

One Dimensional minimization methods-Dichotomous search - Fibonacci Method - Golden section method. Unconstrained optimization Techniques-classification-direct search, pattern search, cauchy's steepest descent method and davidon Fletcher powell method. Constrained function of a single variable-several variables.

UNIT IV DYNAMIC PROGRAMMING 9

Multistage decision processes-representation and types-concept of sub-optimization problems and the principle of optimality-conversion of a final value problem into an initial value problem-linear programming as a case of dynamic programming.

UNIT V STRUCTURAL APPLICATIONS 9

Methods for optimal design of structural elements, continuous beams and single storied frames using plastic theory - Minimum weight design for truss members - Fully stressed design - Optimization principles to design of R.C. structures such as multistorey buildings, water tanks and bridges.

REFERENCES:

1. Rao,S.S. Engineering Optimization: Theory and Practice, 3rd Edition, New Age International, New Delhi, 2010.
2. Belegundu A.D., Chandrupatla T.R., Optimization Concepts and Applications in Engineering, 2nd Edition, Cambridge University Press, Delhi, 2011.
3. Christensen P.W., Klarbring A., An Introduction to Structural Optimization, Springer, 2008.
4. Spunt L., Optimization in Structural Design, Prentice-Hall, New Jersey, 1971.
5. Iyengar.N.G.R and Gupta.S.K.,Structural Design Optimisation, Affiliated East West Press Ltd, New Delhi, 2008.

BOS CHAIRMAN

Course Code:141ST9112	Course Title:THEORY OF PLATES AND SHELLS
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:**45

COURSE OUTCOMES

At the end of the course students will be able to,

CO.1. Explain and derive differential equation for bending of thin plate.
CO.2. Obtain deflection of rectangular Plates.
CO.3. Obtain deflection of circular thin plates.
CO.4. Explain behaviour of anisotropic plates, thick plates and grids.
CO.5. Describe membrane and bending theory for cylindrical shells.

UNIT I INTRODUCTION TO PLATE THEORIES 9

Introduction to Plate Theories: Thin and Thick Plates, small and large deflection, small deflection theory of thin plate-assumptions, moment- curvature relations, stress resultants, differential equation of laterally loaded thin plates in Cartesian coordinates.

UNIT II RECTANGUALR PLATES 9

Navier solution and Levy's method for rectangular plates with various edge conditions, plates on elastic foundation.

UNIT III CIRCULAR PLATES 9

Differential equation of thin circular plates- solution for simply supported or clamped edges.

UNIT IV ANISOTROPHIC PLATES AND THICK PLATES 9

Bending of anisotrophic plates - Derivation of governing differentialequation – Determination of Rigidities in various cases like R.C. slabs, corrugated sheet – applicationto the theory of grid works

UNIT V SHELLS 9

Classification of shells on geometry,thin shell theory,equation of shellsurfaces, Stress resultants, Stress-displacement relations,membrane theory of cylindrical shells–bending theory of cylindrical shells.

REFERENCES:

1. Ansel C.Ugural,"Stresses in plate and shells", McGraw Hill International Edition, 1999.
2. Chandrashekahara, K. Theory of Plates, University Press (India) Ltd., Hyderabad, 2001.
3. Reddy J N, "Theory and Analysis of Elastic Plates and Shells", McGraw Hill Book Company, 2006.
4. Timoshenko.S.P, and Krieger S.W. "Theory of Plates and Shells", McGraw Hill Book Company, New York, 2003.

BOS CHAIRMAN

Course Code:141ST9113	Course Title: CONCRETE TECHNOLOGY
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

COURSE OUTCOMES

At the end of this course students will be able to,

CO.1. Explain with the new types of concretes and admixtures
CO.2. Conduct the tests on concrete and interpret the results.
CO.3. Demonstrate various types of mix design
CO.4. Explain the various types of special concretes
CO.5. Explain precaution measures in concreting under special circumstances

UNIT I CONSTITUENTS OF CONCRETE 9

Aggregates classification, IS Specifications, Properties, Grading, Methods of combining aggregates, specified gradings, testing of aggregates. Cement, Grade of cement, Chemical composition, Chemical & physical process of Hydration , Structure of hydrated cement, properties of cement and their effect on concrete special cements, Specification and quality of mixing water and curing water - Chemical admixtures, Mineral admixtures.

UNIT II TESTS ON CONCRETE 9

Properties of fresh concrete-Workability, factors affecting workability, significance, segregation, causes &effects- Hardened concrete, factors affecting performance of hardened concrete, water/cement ratio-Abram's law, power's law, Gelspace ratio, maturity concept, strength, Elastic properties, creep and shrinkage –Durability of concrete-Permeability-chemical attack-sulphate attack-Quality of water-marine conditions-Thermal properties of concrete-fire resistance-methods of making durable concrete.

UNIT III MIX DESIGN 9

Principles of concrete mix design, Methods of concrete mix design, IS Method, ACI Method, DOE Method – Statistical quality control – Sampling and acceptance criteria.

UNIT IV SPECIAL CONCRETES 9

Lightweight and Heavy Weight Concrete-High Strength Concrete-High Performance Concrete-Fly ash concrete, Fibre reinforced concrete, Sulphur impregnated concrete, Polymers in Concrete- Ferrocement Concrete Vacuum Concrete – Shotcrete-Ready Mixed Concrete-SIFCON, High performance concrete. High performance fiber reinforced concrete, Self-Compacting-Concrete, Geo Polymer Concrete, Waste material based concrete – Ready mixed concrete.

UNIT V CONCRETING UNDER SPECIAL CIRCUMSTANCES 9

Process of manufacturing of concrete, methods of transportation, placing and curing.Extreme weather concreting, special concreting methods.Vacuum dewatering – Underwater Concrete-Underground Construction-Under water Construction-Hot weather and Cold weather concreting.

REFERENCES:

1. Shetty M.S., Concrete Technology, S. Chand and Company Ltd, New Delhi, 2003.
2. Gambir M.L., Concrete Technology, Tata McGraw Hill Publishing Co, Ltd, NewDelhi, 2004.
3. Krishnaraju.N, Design of Concrete mixes, CBS publishers, New Delhi, 2002.
4. Santhakumar A.R., Concrete Technology, Oxford University Press, New Delhi, 2006.

BOS CHAIRMAN

Course Code:141ST9114	Course Title: DESIGN OF BRIDGES
Core/Elective:Elective	L : T : P : C : M – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours:45

COURSE OUTCOMES

At the end of the course students will be able to,

CO.1. Explain general principle in the design of steel and concretes bridges.
CO.2. Design short span bridges.
CO.3. Design long span bridges
CO.4. Design prestressed bridges.
CO.5. Design of plate girder bridges and substructures.

UNIT I INTRODUCTION **6**

Classification, investigations and planning, choice of type, I.R.C.specifications for road bridges, standard live loads, other forces acting on bridges, general design considerations.

UNIT II SHORT SPAN BRIDGES **9**

Types of bridges and loading standards - Choice of type - Load distribution theories, I.R.C. specifications for road bridges – Design of RCC solid slab bridges -analysis and design of slab culverts, Tee beam and slab bridges..

UNIT III LONG SPAN GIRDER BRIDGES **12**

Design principles of continuous girder bridges, box girder bridges, balanced cantilever bridges and arch bridges.

UNIT IV DESIGN OF PRESTRESSED BRIDGES **9**

Flexural and torsional parameters – Courbon's theory – Distribution co-efficient by exact analysis– Design of girder section – maximum and minimum prestressing forces – Eccentricity – Live load and dead load shear forces – Cable Zone in girder – check for stresses at various sections – check for diagonal tension – Diaphragms – End block – short term and long term deflections.

UNIT V DESIGN OF PLATE GIRDER BRIDGES, BEARINGS AND SUBSTRUCTURES **9**

Design of riveted and welded plate girder bridges for highway and railway loading – wind effects– main section, splicing, curtailment, stiffeners – Different types of bearings – Design of bearings– Design of masonry and concrete piers and abutments – Types of bridge foundations – Design of foundations.

REFERENCES:

1. Jagadeesh.T.R. and Jayaram.M.A. Design of Bridge Structures, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2009.
2. Ponnuswamy, S., Bridge Engineering, 2nd Edition, Tata McGraw Hill Education pvt Ltd., New Delhi, 2007.
3. Johnson Victor, D. Essentials of Bridge Engineering, 6th Edition, Oxford and IBH Publishing Co. New Delhi, 2007.
4. Raina V.K., Concrete Bridge Practice Analysis, Design and Economics, 3rd Edition, Shroff Pub & Dist. Pvt. Ltd, New Delhi, 2007.
5. Bakht. B. and Jaegar, L.G., Bridge Analysis Simplified, McGraw Hill, 1985.
6. Krishnaraju. N., Prestressed Concrete Bridges, CBS publishers, New Delhi, 2009.

BOS CHAIRMAN

Course Code:141ST9115	Course Title:STABILITY ANALYSIS OF STRUCTURES
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:**45

COURSE OUTCOMES

At the end of this course students will be able to,

CO.1. Understand the basic nature of elastic and inelastic stability in structures.
CO.2. Solve problems of buckling of columns, beam columns and frames.
CO.3. Solve the problems in buckling of plates.
CO.4. Illustrate the difference between buckling of columns and plates and the effect of imperfections on them.
CO.5. Understand the concept of flexural – torsional buckling in beams.

UNIT I BUCKLING OF COLUMNS **12**

States of equilibrium - Classification of buckling problems - concept of equilibrium, energy, and vibration approaches to stability analysis –Sensitivity to imperfections.Eigen value problem.Governing equation for columns - Analysis for different applicable (free, simply supported and fixed) boundary conditions using Equilibrium, and Energy methods. Approximate methods - Rayleigh Ritz, Galerkin's approach - Numerical Techniques - Finite element and difference methods - Effect of shear on buckling.

UNIT II BUCKLING OF BEAM-COLUMNS AND FRAMES **9**

Theory of beam columns - Stability analysis of beam columns with single and several concentratedloads, distributed load and end moments. Analysis of rigid jointed frames with and without sway -Use of stability function to determine the critical load - Moment distribution - Slope deflection and stiffness methods.

UNIT III TORSIONAL AND LATERAL BUCKLING **9**

Torsional buckling - Torsional and flexural buckling - Local buckling - Buckling of Open Sections.Numerical solutions.Lateral buckling of beams, pure bending of simply supported beam and cantilever beams.

UNIT IV BUCKLING OF PLATES **9**

Governing differential equation - Buckling of thin plates, various edge conditions -Analysis byequilibrium and energy approach - Approximate and Numerical techniques – Finite difference method

UNIT V INELASTIC BUCKLING **6**

Double modulus theory - Tangent modulus theory - Shanley's model - Eccentrically loaded inelastic column. Inelastic buckling of plates - Post buckling behaviour of plates

REFERENCES:

1. Timoshenko, S.P., Gere G.M., Theory of Elastic Stability, 2nd Edition, Dover publications, 2009.
2. Chajes, A., Principles of Structures Stability Theory, Prentice Hall, 1974.
3. Iyenger.N.G.R., Elastic Stability of Structural Elements, Macmillan India Ltd, New Delhi, 2007.
4. Gambhir M.L., Stability Analysis and Design of Structures, Springer Publishing Company, New York, 2009.
5. Simitser.G.J and Hodges D.H "Fundamentals of Structural Stability", Elsevier Ltd., 2006.

BOS CHAIRMAN

Course Code:141ST9116	Course Title:NONLINEAR STRUCTURAL ANALYSIS
Core/Elective:Elective	L : T : P : C : M – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours:45

COURSE OUTCOMES

At the end of the course students will be able to,

CO.1. Explain various elastic and inelastic analysis and their concepts in general
CO.2. Formulate and make them to analysis the flexural members and plates
CO.3. Impart knowledge of application of vibration theory and analysis of flexural members.
CO.4. Analyse the elastic and Inelastic behaviour of plates.
CO.5. Formulate and make them to know about non linear vibration and instability

UNIT I ELASTIC ANALYSIS OF FLEXURAL MEMBERS 9

Introduction to nonlinear mechanics; statically determinate and statically indeterminate flexible bars of uniform and variable thickness.

UNIT II INELASTIC ANALYSIS OF FLEXURAL MEMBERS 9

Inelastic analysis of uniform and variable thickness members subjected to small deformations; inelastic analysis of flexible bars of uniform and variable stiffness members with and without axial restraints.

UNIT III VIBRATION THEORY AND ANALYSIS OF FLEXURAL MEMBERS 9

Vibration theory and analysis of flexible members; hysteretic models and analysis of uniform and variable stiffness members under cyclic loading.

UNIT IV ELASTIC AND INELASTIC ANALYSIS OF PLATES 9

Elastic and inelastic analysis of uniform and variable thickness plates.

UNIT V NONLINEAR VIBRATION AND INSTABILITY 9

Nonlinear vibration and Instabilities of elastically supported beams.

REFERENCES:

1. Sathyamoorthy, M., Nonlinear Analysis of Structures, CRC Press, Boca Raton, Florida, 1997.
2. Fertis, D. G. Nonlinear Mechanics, CRC Press, Boca Raton, Florida, 1998.
3. Reddy.J.N, Non linear Finite Element Analysis, Oxford University Press, 2nd Edition 2008.

BOS CHAIRMAN

Course Code:141ST9117	Course Title:CONSTRUCTION TECHNIQUES AND MANAGEMENT
Core/Elective:Elective	L : T : P : C : M – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours:45

COURSE OUTCOMES

At the end of this course students will be able to,

CO.1. To make the students be familiar with the advanced methods of constructions

CO.2. To know about the sub and super structure constructions

CO.3. To develop an idea about the construction of special structures

CO.4. Explain principles of various NDT equipments and use them for testing.

CO.5. To plan and manage the construction projects.

UNITI SUB STRUCTURE CONSTRUCTION 10

Box jacking - pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques - piling techniques - driving well and caisson - sinking cofferdam - cable anchoring and grouting - driving diaphragm walls, sheet piles - laying operations for built up offshore system - shoring for deep cutting - large reservoir construction - well points - dewatering and stand by plant equipment for underground open excavation.

UNIT II SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS 10

Vacuum dewatering of concrete flooring – concrete paving technology – techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – launching techniques – suspended form work – erection techniques of tall structures, large span structures – launching techniques for heavy decks – insitu prestressing in high rise structures, aerial transporting handling erecting lightweight components on tall structures.

UNIT III CONSTRUCTION OF SPECIAL STRUCTURES 10

Erection of lattice towers and rigging of transmission line structures – construction sequence in cooling towers, silos, chimney, sky scrapers, bow string bridges, cable stayed bridges – launching and pushing of box decks – Advanced construction techniques for offshore structures – construction sequence and methods in domes and prestress domes – support structure for heavy equipment and conveyor and machinery in heavy industries – erection of articulated structures, braced domes and space decks.

UNIT IV CONSTRUCTION EQUIPMENTS 10

Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Front end Waders, Earth Movers. Forklifts and related equipment - Portable Material Bins – Conveyors - Hauling Equipment.Crushers – Feeders - Screening Equipment - Handling Equipment - Batching and Mixing Equipment - Hauling, Pouring and Pumping Equipment – Transporters. Equipment for Dredging, Trenching, Tunneling, Drilling, Blasting - Equipment for Compaction - Erection Equipment - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Foundation and Pile Driving Equipment –Equipment for Demolition.

UNIT V CONSTRUCTION EQUIPMENT MANAGEMENT 5

Identification – Planning - Equipment Management in Projects - Maintenance Management – Replacement - Cost Control of Equipment - Depreciation Analysis – Safety Management.

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REFERENCES:

1. Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 1995.
2. Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992.
3. Jerry Irvine, Advanced Construction Techniques, CA Rocketr, 1984
4. Peter.H.Emmons, "Concrete repair and maintenance illustrated", Galgotia Publications Pvt. Ltd., 2001.
5. Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University Press, New Delhi, 2008.

BOS CHAIRMAN

Course Code:141ST9118	Course Title:DESIGN OF TALL STRUCTURES
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:**45

COURSE OUTCOMES

At the end of this course students will be able to,

CO.1. Explain general principle in the design and loading on tall structures
CO.2. Formulate the knowledge in the behavior of various structural systems
CO.3. Impart them to analysis and design of tall buildings
CO.4. Design various structural elements
CO.5. Make the problems in stability of tall buildings

UNIT I DESIGN PRINCIPLES AND LOADING 9

Design philosophy, Loading, sequential loading, materials – high performance, concrete – Fibre reinforced Concrete – Light weight concrete – design mixes. Gravity loading Wind loading Earthquake loading.

UNIT II BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS 9

Factors affecting growth, Height and Structural form. High rise behaviour, Rigid frames, braced frames, Infilled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, futrigger - braced and hybrid mega systems.

UNIT III ANALYSIS AND DESIGN 9

Modelling for approximate analysis, Accurate analysis and reduction techniques, Analysis of buildings as total structural system considering overall integrity and major subsystem interaction, Analysis for member forces, drift and twist, computerised general three dimensional analysis.

UNIT IV STRUCTURAL ELEMENTS 9

Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow, Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance.

UNIT V STABILITY OF TALL BUILDINGS 9

Overall buckling analysis of frames, wall-frames, Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and P-Delta analysis, Translational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation.

REFERENCES:

1. Bryan Stafford Smith and Alexcoull, Tall Building Structures - Analysis and Design, John Wiley and Sons, Inc., 19911.
2. Taranath B.S., Structural Analysis and Design of Tall Buildings, McGraw Hill, 1988.
3. Gupta.Y.P.,(Editor), Proceedings of National Seminar on High Rise Structures - Design and Construction Practices for Middle Level Cities, New Age International Limited, New Delhi,1995.
4. Smith. B.S. and Coull. A., Tall building structures, John Wiley & Sons 19911.
5. Lynn S.Beedle, 'Advances in Tall Buildings', CBS Publishers and Distributors, New Delhi, 1996.

BOS CHAIRMAN

Course Code:141ST9119	Course Title:DESIGN OF INDUSTRIAL STRUCTURES
Core/Elective:Elective	L : T : P : C : M – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours: 45

COURSE OUTCOMES

At the end of this course students will be able to,

CO.1. Explain general planning and functional requirements of Industrial buildings
CO.2. Design gantry girder and corbels used in Industries
CO.3. Design principles involved in the power plant structures and their foundations
CO.4. Know the concept of design of power transmission towers
CO.5. Know the concept of design of auxiliary structures

UNIT I PLANNING AND FUNCTIONAL REQUIREMENTS 9

Classification of Industries and Industrial structures - planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration - Guidelines of Factories Act.

UNIT II INDUSTRIAL BUILDINGS 9

Roofs for Industrial Buildings - Steel and RCC - Gantry Girders - Design of Corbels and Nibs – Design of Staircase - Machine foundations

UNIT III POWER PLANT STRUCTURES 9

Types of power plants – Containment structures - Cooling Towers - Bunkers and Silos - Pipe supporting structures

UNIT IV POWER TRANSMISSION STRUCTURES 9

Analysis and design of transmission line towers - Saj and Tension calculations, Transmission Line Towers - Substation Structures - Tower Foundations - Testing Towers - Design of self supporting chimney, Design of Chimney bases.

UNIT V AUXILLIARY STRUCTURES 9

Chimneys and cooling Towers – Bunkers and Silos – Pipe supporting structures, Design of Turbo generator foundation

REFERENCES:

1. Dayaratnam. P., Deign of Steel Structures, A.H. Wheeler & Co., Ltd., Allahabad, 2008
2. Santhakumar A.R.an d Murthy S.S., Transmission Line Structures, Tata McGraw Hill, 1992.
3. Dr. Rajagopalan. K., Storage Structures, Oxford IBH Publishing Company Ltd. 1989.
4. Jurgen Axel Adam, KatharriaHausmann, Frank Juttner, Klauss Daniel, Industrial Buildings: A Design Manual, Birkhauser Publishers, 2004.
5. Procs. of Advanced course on Industrial Structures, Structural Engineering Research Centre, Chennai, 1982.

BOS CHAIRMAN

Course Code:141ST9120	Course Title:SPECIAL CONCRETES
Core/Elective:Elective	L : T : P : C : M – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours:45

COURSE OUTCOMES

At the end of the course students will be able to,

CO.1. Explain the modern concrete and their mix proportioning
CO.2. Explain about light weight and high density concrete
CO.3. Formulate an idea about the application of Ferro cement
CO.4. Formulate an idea about the application offiber reinforced concrete
CO.5. Explain the concepts of high performance concretes

UNIT I MODERN CONCRETE AND MIX PROPORTIONING 9

Role of constituents, Development in cements and cement replacement materials, - pozzolona, fly ash, silica fume, rice husk ash, recycled aggregates, chemical admixtures - Mix proportioning - Principles and methods.

UNIT II LIGHT WEIGHT CONCRETE AND HIGH DENSITY CONCRETE 9

Introduction - classification, properties, strength and durability - mix proportioning and problems. Radiation shielding ability of concrete - materials for high density concrete - mix proportioning - properties in fresh and hardened state, placement methods

UNIT III FERRO CEMENT 9

Ferrocement materials - mechanical properties, cracking of ferrocement - strength and behaviour in tension, compression and flexure - Design of ferrocement in tension, ferrocement constructions, durability, and applications

UNIT IV FIBRE REINFORCED CONCRETE 9

Fibre materials, mix proportioning, distribution and orientation, interfacial bond, properties in fresh state, strength and behavior in tension, compression and flexure of steel fibre reinforced concrete, mechanical properties, crack arrest and toughening mechanism, applications

UNIT V HIGH PERFORMANCE CONCRETE 9

Constituents, mix proportioning, properties in fresh and hardened states, applications and limitations. Ready Mixed Concrete, Self Compacting Concrete, Reactive powder concrete, bacterial concrete

REFERENCES:

1. Venkataraman M.K., Higher Mathematics for Engineering and Science, National publishing company, 2000.
2. Grewal B.S, Higher Engineering Mathematics, 40th Edition, Khanna publishers, Delhi, 2007.
3. Ramana B. V., Higher Engineering Mathematics, Tata Mc-Graw Hill Publishing Company limited, New Delhi, 2007.
4. Erwin Kreyszig, Advanced Engineering Mathematics, 8th edition, Wiley India, 2007.
5. Curtis F. Gerald Applied Numerical Analysis, 7th Edition, Pearson Education Ltd, New Delhi, 2007.
6. Steven Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, 2nd Edition, Tata Mcgraw Hill Education Private Limited, New Delhi, 2010.

BOS CHAIRMAN

Course Code:141ST9121	Course Title: PRESTRESSED CONCRETE STRUCTURES
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

COURSE OUTCOMES

At the end of this course students will be able to,

CO.1. Explain the basic principle of prestressing

CO.2. Design the flexural member and understand the difference in behavior of reinforced and prestressed concrete

CO.3. Design simply supported and continuous beams including short and long term deflection limits.

CO.4. Design the tension and compression members

CO.5. Design the composite members. Be able to understand the role of concrete shrinkage in the design of composite members.

UNIT I PRINCIPLES OF PRESTRESSING 9

Principles of Prestressing - types and systems of prestressing, Need for High Strength materials. Analysis methods - Losses, deflection (short-long term), camber, cable layouts.

UNIT II DESIGN OF FLEXURAL MEMBERS 9

Behavior of flexural members, Difference in behaviors of reinforced and prestressed concrete beams and the moment resisting mechanisms in each.Determination of ultimate flexural strength – Codal provisions –Design of flexural members, Design for shear, bond and torsion, Design of end blocks.

UNIT III DESIGN OF CONTINUOUS BEAMS 9

Analysis and design of continuous beams - Methods of achieving continuity – concept of lineartransformations, concordant cable profile and gap cables.

UNIT IV DESIGN OF TENSION AND COMPRESSION MEMBERS 9

Design of tension members - application in the design of prestressed pipes and prestressed concrete cylindrical water tanks - Design of compression members with and without flexure - Application in the design of piles, flag masts and transmission line poles.

UNIT V DESIGN OF COMPOSITE MEMBERS 9

Composite beams - analysis and design, Role of concrete shrinkage in design.Propped and un-propped construction.Ultimate strength calculations. Partial prestressing – Necessity and itsadvantages.

REFERENCES:

1. Krishna Raju, Prestressed Concrete, Tata McGraw Hill Publishing Co, New Delhi, 2000.
2. Sinha.N.C.andRoy.S.K, Fundamentals of Prestressed Concrete, S. Chand and Co, New Delhi 1998.
3. Antoine E. Naaman, Prestressed Concrete Analysis and Design Third Edition 2012
4. Rajagopalan.N, Prestressed Concrete, Narosa Publications, New Delhi, 2008

BOS CHAIRMAN

Course Code:141ST9122	Course Title:PREFABRICATED STRUCTURES
Core/Elective:Elective	L : T : P : C : M – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours: 45

COURSE OUTCOMES

At the end of this course students will be able to,

CO.1. Know about the general principles of fabrication
CO.2. Explain the formulation of prefabricated elements
CO.3. Study about the production technology
CO.4. Study about the hoisting technology
CO.5. Impart knowledge about the application of prefabricated structures

UNIT I GENERAL PRINCIPLES OF FABRICATION 9

General Civil Engineering requirements - specific requirements for planning and layout of prefabrication plant - Comparison with monolithic construction – Types of prefabrication – site and plant prefabrication -Economy of prefabrication – Modular coordination – Standardization – Planning for Components of prefabricated structures – Disuniting of Prefabricates, production, transportation, erection, stages of loading and code provisions, safety factors, material properties, Deflection control, Lateral load resistance, Location and types of shear walls.

UNIT II PREFABRICATED ELEMENTS 9

Roof and floor panels, ribbed floor panels – wall panels – footings – Joints for different structural connections – Effective sealing of joints for water proofing – Provisions for non-structural fastenings –Expansion joints in pre-cast construction

UNIT III PRODUCTION TECHNOLOGY 9

Choice of production setup – Manufacturing methods – Stationary and mobile production – Planning of production setup – Storage of precast elements – Dimensional tolerances – Acceleration of concrete hardening.

UNIT IV HOISTING TECHNOLOGY 9

Equipments for hoisting and erection – Techniques for erection of different types of members like Beams, Slabs, Wall panels and Columns – Vacuum lifting pads

UNIT V APPLICATIONS 9+3

Designing and detailing of precast unit for factory structures – Purlins, Principal rafters, roof trusses, lattice girders, gable frames – Single span single storeyed frames – Single storeyed buildings – slabs, beams and columns.

REFERENCES:

1. Mokk. L., Prefabricated Concrete for Industrial and Public Structures, Publishing House of the Hungarian Academy of Sciences, Budapest, 2007.
2. Koncz. T., Manual of Precast Concrete Construction, Vol. I, II, III & IV, Berlin, 1971
3. Lewicki. B., Building with Large Prefabricates, Elsevier Publishing Company, Amsterdam, London, New York, 1998
4. Structural Design Manual, Precast Concrete Connection Details, Society for the Studies in the use of Precast Concrete, Netherland BetorVerlag, 2009.

BOS CHAIRMAN

Course Code:141ST9123	Course Title:ENERGY EFFICIENT BUILDINGS
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:**45

COURSE OUTCOMES

At the end of the course students will be able to,

CO.1. Explainabout the different energy available to use in the buildings
CO.2. Develop an idea about the energy efficient building systems
CO.3. Explain the energy efficient building implementation
CO.4. Make them to know about the energy efficient assessment in building
CO.5. Make them to know about economics of energy efficient building

UNIT I ENERGY **9**

Conventional versus energy efficient building delivery systems – energy efficient building project execution - the integrated design process – energy efficient building documentation requirements - design versus ecological design - historical perspective - contemporary ecological design - future ecological design – energy efficient design to regenerative design.

UNIT II ENERGY EFFICIENT BUILDING SYSTEMS **9**

Sustainable sites and landscaping – enhancing ecosystems - building envelop – selection of green materials - products and practices - passive design strategy – internal load reduction – indoor environment quality – building water and waste management – relevance to LEED / IGBC EFFICIENT

UNIT III ENERGY EFFICIENT BUILDING IMPLEMENTATION **9**

Site protection planning - health and safety planning - construction and demolition waste management - reducing the footprint of construction operations - maximizing the value of building commissioning in HVAC System, lighting and non mechanical Systems - costs and benefits relevance to LEED / IGBC standards

UNIT IV ENERGY EFFICIENT BUILDING ASSESSMENT **9**

USGBC LEED building assessment standard - LEED certification process – green globes building assessment protocol- international building assessment systems - LEED-NC Platinum / gold / silver building case studies – trends in building rating systems – IGBC standards – ECBC compliances

UNIT V ECONOMICS OF ENERGY EFFICIENT BUILDINGS **9**

Business case for high-performance energy efficient buildings - the economics of energy efficient building - benefits - managing initial costs - cost barrier in project management - long-term environment benefits

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REFERENCES:

1. Means, R.S., Green building: project planning & cost estimating: a practical guide for constructing sustainable buildings: cost data. Kingston, Mass., 2006.
2. Means, R.S., Green building: project planning & cost estimating: a practical guide to materials, systems and standards; green, 2nd Edition. Kingston, Mass., 2006.
3. Alex Wilson and Mark Peipkorn., Green Building Products: the GreenSpec guide to residential building materials, 2nd Edition, Gabriola Island, BC: 2004
4. Jane Anderson, David E. Shiers, and Mike Sinclair. The green guide to specification: an environmental profiling system for building materials and components, 3rd Edition, Oxford; Malden, MA: Blackwell Science, 2002.

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5. Charles J. Kibert, Sustainable Construction: Green Building Design and Delivery, 2nd Edition, Wiley, 2007.
6. ECBC 2007 Manual, Bureau of Energy Efficiency, Prentice Hall New Delhi 2003

BOS CHAIRMAN

Course Code:141ST9124	Course Title:SOIL STRUCTURE INTERACTION
Core/Elective:Elective	L : T : P : C : M – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours:45

COURSE OUTCOMES

At the end of the course students will be able to,

CO.1. Explain the behaviour of soil-foundation interaction.
CO.2. Explain the provision of beam on elastic foundations.
CO.3. Know the behaviour of plate on elastic medium.
CO.4. Impart knowledge of elastic analysis of pile foundation.
CO.5. Familiar with the concept of laterally loaded pile.

UNIT I SOIL-FOUNDATION INTERACTION 9

Introduction to soil-foundation interaction problems – Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, Soil response models, Winkler, Elastic continuum, two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour.

UNIT II BEAM ON ELASTIC FOUNDATION- SOIL MODELS 9

Infinite beam, two parameters, Isotropic elastic half-space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness

UNIT III PLATE ON ELASTIC MEDIUM 9

Infinite plate, Winkler, Two parameters, Isotropic elastic medium, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, Numerical analysis of finite plates, Simple solutions.

UNIT IV ELASTIC ANALYSIS OF PILE 9

Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.

UNIT V LATERALLY LOADED PILE 9

Load deflection prediction for laterally loaded piles, Sub grade reaction and elastic analysis, Interaction analysis, Pile raft system, Solutions through influence charts.

REFERENCES:

1. Selvadurai. A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier, 1999.
2. Poulos. H.G., and Davis, E.H., Pile Foundation Analysis and Design, JohnWiley, 2001
3. Scott, R.F., Foundation Analysis, Prentice Hall, 2002
4. Structure-Soil Interaction - State of Art Report, Institution of Structural Engineers, 1996
5. ACI 336, Suggested Analysis and Design Procedures for combined footings and Mats, American Concrete Institute, Delhi, 1988

BOS CHAIRMAN

Course Code:141ST9125	Course Title:OFF SHORE STRUCTURES
Core/Elective:Elective	L : T : P : C : M – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours:45

COURSE OUTCOMES

At the end of the course students will be able to,

CO.1. Explain about the wave theories
CO.2. Formulate the forces on offshore structures
CO.3. Formulate the offshore soil & structures modelling
CO.4. Verify the problems in analysis of offshore structures
CO.5. Explain the design the offshore structures

UNIT I WAVE THEORIES **9**

Wave generation process, small and finite amplitude wave theories.

UNIT II FORCES OF OFFSHORE STRUCTURES **9**

Wind forces, wave forces on vertical, inclined cylinders, structures - current forces and use of Morison equation.

UNIT III OFFSHORE SOIL AND STRUCTURE MODELLING **9**

Different types of offshore structures, foundation modeling, and structural modeling.

UNIT IV ANALYSIS OF OFFSHORE STRUCTURES **9**

Static method of analysis, foundation analysis and dynamics of offshore structures

UNIT V DESIGN OF OFFSHORE STRUCTURES **9**

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. Dawson.T.H., Offshore Structural Engineering, Prentice Hall Inc Englewood Cliffs, N.J. 1983
3. Brebia, C.A and Walker, S., Dynamic Analysis of Offshore Structures, New Butterworths, U.K. 1979.
4. API, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms, American Petroleum Institute Publication, RP2A, Dallas, TX,2000.
5. Reddy, D.V. and Arockiasamy, M., Offshore Structures, Vol.1 and Vol.2, Krieger Publishing Company, Florida, 19911.

BOS CHAIRMAN

Course Code:141ST9126	Course Title:MECHANICS OF COMPOSITE MATERIALS
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:**45

COURSE OUTCOMES

At the end of the course students will be able to,

CO.1. Explain the concept of composite materials
CO.2. Explain about mechanical properties and analysis of composite laminae
CO.3. Verify the behaviour of glass – fibre - laminates
CO.4. Formulate the an idea of structural design with properties
CO.5. Explain the design of GRP Box beams

UNIT I INTRODUCTION **9**

Requirements of structural materials, influence of nature of materials in structural form' Nature of structural materials- Homogeneous materials, composite materials

UNIT II MACROMECHANICAL PROPERTIES AND ANALYSIS OF COMPOSITE LAMINAE **9**

Introduction – Assumptions and Idealizations, stress strain relationship for composite Laminae- Isotropic, orthotropic laminae- strength Characteristics-Basic concepts- hypothesis for isotropic and orthotropic laminae- Macro mechanical Analysis of composite laminae: introduction, Assumptions and Limitations, stiffness characteristics of glass reinforced laminae- Stress- Strain relationships in continuous' discontinuous fiber laminae, strength characteristics of glass reinforced laminae - strengths in continuous discontinuous fibrelaminae.

UNIT III BEHAVIOUR OF GLASS FIBRE-REINFORCED LAMINATES **9**

Introduction, stiffness characteristics of laminated composites-Behaviour of laminated beams and plates, strength characteristics of Laminated composites- strength analysis and failure criteria, Effect of inter laminar structures' Glass Reinforced composites: Introduction, continuously reinforced laminates- uni-directionally and multi directionally continuously reinforced laminates, Discontinuously reinforced laminates - Stiffness and Strength properties.

UNIT IV GRP PROPERTIES RELEVANT TO STRUCTURAL DESIGN **9**

Introduction, short-term strength and stiffness-Tensile' compressive, Flexural and Shearing Long term strength and Stiffness properties, Temperature effects, Effect of Fire-Structural joints-Adhesive, mechanical, Combinational, Transformed sections

UNITV DESIGN OF GRP BOX BEAMS **9**

Introduction, loading, span and cross-sectional shape selection of material, Beam manufacture, beam stresses, Experimental Behaviour, Effect on Beam performance- Modulus of Elasticity, Compressive strength, I value, prevention of compression buckling failure Behaviour under long term loading. Design of Stressed skinned roof structure: Introduction, loading and material properties, preliminary design, and computer analysis.

REFERENCES:

1. Holmes. M. and Just. D.J., GRP in Structural Engineering, Narosa Publications, New Delhi, 2008
2. MadhujithMukhopadhyay Mechanics of composite materials and Structures Universities Press 2001

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3. Robart M. Jones, Mechanical of Composite Materials McGraw Hill Publishing Co., 2002.
4. Bhagwan D Agarvalm, and Lawrence J Brutman, Analysis and Performance of Fiber Composites John Willy and Sons. 2004.

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