Dr. Mahalingam College of Engineering and Technology

(An Autonomous Institution)

Pollachi - 642003

Curriculum and Syllabus for

M.E. STRUCTURAL ENGINEERING

Revision 0

REGULATIONS 2014

DR MAHALINGAM

MCET

COLLEGE OF ENGINEERING AND TECHNOLOGY

Enlightening Technical Minds

Programme : M.E. – Structural Engineering
Curriculum and Syllabus – Revision 0
Approved by Academic Council

Action	Responsibility	Signature of Authorized Signatory
Designed and Developed by	BoS Structural Engineering	
Compiled by	Office of COE	
Approved by	Principal	

Department of Civil Engineering

Curriculum for M.E. Structural Engineering

Regulations 2014 - Revision 0

Semester I

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
140ST0101	Higher Engineering Mathematics	3	1	0	4	100
140ST0102	Experimental Methods and Model Analysis	3	0	0	3	100
140ST0103	Dynamics of Structures	3	1	0	4	100
140ST0104	Design of RCC Structures	3	1	0	4	100
140ST0105	Theory of Elasticity and Plasticity	3	1	0	4	100
xxx	Elective – I	3	0	0	3	100
PRACTICAL						
140ST0107	Structural Engineering Laboratory	0	0	3	2	100
TOTAL		**18**	**4**	**3**	**24**	**700**

SEMESTER II

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
140ST0201	Finite Element Techniques	3	1	0	4	100
140ST0202	Earthquake Resistant Design	3	0	0	3	100
140ST0203	Design of Steel Structures	3	1	0	4	100
140ST0204	Design of foundations	3	1	0	4	100
xxx	Elective II	3	0	0	3	100
xxx	Elective III	3	0	0	3	100
PRACTICAL						
140ST0207	Computer Aided Structural Design Laboratory	0	0	3	2	100
TOTAL		**18**	**3**	**3**	**23**	**700**

22/7/15

SEMESTER III

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
xxx	Elective IV	3	0	0	3	100
xxx	Elective V	3	0	0	3	100
xxx	Elective VI	3	0	0	3	100
PRACTICAL						
11ST307	Project Work Phase I	0	0	12	6	200
TOTAL		**9**	**0**	**12**	**15**	**500**

SEMESTER IV

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
140ST0407	Project Work Phase II	0	0	24	12	400
TOTAL		**0**	**0**	**24**	**12**	**400**

Total Credits: 74

LIST OF ELECTIVES

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
ELECTIVES						
140ST9111	Structural Optimization	3	0	0	3	100
140ST9112	Theory of Plates and shells	3	0	0	3	100
140ST9113	Concrete Technology	3	0	0	3	100
140ST9114	Design of Bridges	3	0	0	3	100
140ST9115	Stability Analysis Of Structures	3	0	0	3	100
140ST9116	Nonlinear Structural Analysis	3	0	0	3	100
140ST9117	Construction Techniques and Management	3	0	0	3	100
140ST9118	Design of Tall Structures	3	0	0	3	100
140ST9119	Design of Industrial Structures	3	0	0	3	100
140ST9120	Special Concretes	3	0	0	3	100
140ST9121	Pre-stressed Concrete Structures	3	0	0	3	100
140ST9122	Prefabricated Structures	3	0	0	3	100
140ST9123	Energy Efficient Buildings	3	0	0	3	100
40ST9124	Soil Structures Intraction	3	0	0	3	100
140ST9125	Off Shore Structures	3	0	0	3	100
140ST9126	Mechanics of Composite Materials	3	0	0	3	100

140ST0101 **HIGHER ENGINEERING MATHEMATICS** **3 1 0 4**

AIM:

To enhance the mathematical knowledge of the students and to develop the skill in determining solutions of engineering problems.

OBJECTIVES:

Students should be able:

- To solve the systems of linear and non-linear equations.
- To study and solve boundary value problems.
- To effectively use mathematical methods to solve partial differential equations.
- To understand probability theory.

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-Ritz method, 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's Theorem-Random variables-Probability density function-cumulative distribution function-Mean and variance of Binomial distribution-Poison distribution-Normal distribution .

L: 45, T: 15, Total: 60

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. Erwin Kreyszig, Advanced Engineering Mathematics, 8th edition, Wiley India, 2007.
3. Curtis F. Gerald Applied Numerical Analysis, 7th Edition, PearsonEducation Ltd, New Delhi, 2007.
4. Steven Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, 2nd Edition, Tata Mcgraw Hill Education Private Limited, New Delhi, 2010.

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22/7/15

140ST0102 EXPERIMENTAL METHODS AND MODEL ANALYSIS 3 0 0 3

AIM:

The aim of the course is to provide students with fundamental knowledge of various destructive, nondestructive testing techniques to measure the static and dynamic response of structures.

OBJECTIVES:

Students should be able:

- to know about various load, strain measurement devices and their principle of operation
- to introduce various devices that are used for vibrating systems
- to familiarize with wind and sound wave pressure measurements
- to impart knowledge about distress measurements and various NDT techniques

UNIT I FORCE AND STRAIN MEASUREMENTS 9

Methods of Measurement -Calibration-Load calibration of testing machines-I.S. Code provisions - Strain measurement- strain gauges- Principle, Types, Performance, Uses- Strain Rosettes-Wheatstone Bridge-Hydraulic jacks and pressure gauges-Electronic load cells- Proving rings.

UNIT II VIBRATION MEASUREMENTS 9

Characteristics of Structural Vibrations – Linear Variable Differential Transformer (LVDT) – Transducers for velocity and acceleration measurements.Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Chart Plotters – Digital data Acquisition systems.

UNIT III DISTRESS MEASUREMENTS AND CONTROL 9

Diagnosis of distress in structures – crack observation and measurements – corrosion of reinforcement in concrete – Half cell, construction and use – damage assessment – controlled blasting for demolition – Techniques for residual stress measurements.

UNIT IV NON DESTRUCTIVE TESTING METHODS 9

Load testing on structures-In situ load testing-Ultimate load testing. Rebound hammer-Principle and Applications-Limitations. Ultrasonic testing- Principles and Applications. Impact Echo testing - Principle and Applications. Brittle coating- Principle and Applications. Stress coat- All Temp- Comparison of brittle coatings- Evaluation of the coating.

UNIT V MODEL ANALYSIS OF STRUCTURES 9

Introduction – Objectives of structural model studies, Some basic definitions, Types of similitude , Classification of model studies, Model materials, Size effects; Principles of similitude – Dimensional analysis, Buckingham π Theorem, Variables in structural behaviour; Requirements of similitude; Direct approach.

L: 45, T: 0, Total: 45

TEXT BOOKS:

1. Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, New Delhi, 1996
2. Ganesan T.P., Model Analysis of Structures, Universities Press, Hyderabad, 2000.

REFERENCES:

1. Srinath.L.S.et al, Experimental Stress Analysis, Tata McGraw Hill company Ltd., New Delhi, 1984
2. Dalley .J.W and Riley.W.F, Experimental Stress Analysis, Mc Graw Hill Book Co, New York, 1991
3. Sirohi.R.S., Radha Krishna.H.C., Mechanical Measurements, New Age International (P) Ltd, 1997
4. Bray.D.E., and Stanley.R.K., Non-Destructive Evaluation, McGraw Hill Pub. Co, New York, 1989.

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22/7/15

140ST0103 **DYNAMICS OF STRUCTURES** **3 1 0 4**

AIM:

The aim of the course is to expose students to the principles and methods of dynamic analysis of structures.

OBJECTIVES:

Students should be able:

- to understand theory of vibration –free, undamped, damped and forced vibrations.
- to solve problems of single degree of freedom (SDOF) systems
- to solve dynamic problems in multi-degree of freedom (MDOF) systems
- to apply concepts on practical structures and analyze structures subjected to dynamic loading

UNIT I THEORY OF VIBRATIONS **9+3**

Introduction - Elements ofvibratory system - Degrees of Freedom – continuous mass - Lumped mass idealization - oscillatory motion - Simple Harmonic motion – free vibrations of single degree of freedom system - undamped and damped vibrations- critical damping - Logarithmic decrement - Forced vibration of SDOF systems - Harmonic excitation.

UNIT II INTRODUCTION TO STRUCTURAL DYNAMICS **9+3**

Objectives of dynamic analysis -Types of dynamic loadings – Methods of discretization - Formulation of equations of motion by different methods - Direct equilibrium using Newton's law of motion / D',Alembert's principle-Energy methods- single Degree of Freedom systems : Formulation. and solution of the equation of motion – Free vibration response - Response to Harmonic, Periodic, Impulsive and general dynamic loadings - Duhamel integral.

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 -Undamped free vibrations – Solutions of Eigen value problem for natural frequencies and mode shapes - Analysis of Dynamic response – stodola method - Modal Analysis -Analysis of second and higher modes - Holzer method - Normal co-ordinates - uncoupled equations of motion-Orthogonal properties of normal modes.

UNIT IV DISTRIBUTED MASS 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.

UNIT V INTRODUCTION TO EARTHQUAKE ANALYSIS **9+3**

Introduction - Excitation by rigid base translation – Lumped mass approach- SDOF and MDOF systems - I S. Code methods of analysis for obtaining response of multi storeyed buildings, static and response spectrum method.

L: 45, T: 15, Total: 60

TEXT BOOKS:

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.

REFERENCES:

1. Patrick Paultre, Dynamics Of Structures, Wiley India Pvt Ltd, New Delhi, 2011.
2. Hurty W.C. Jr., and M. F. Rubinstein, Dynamics of Structures, PHI, New Delhi, 2007.
3. Craig R.R., Structural Dynamics-An Introduction to Computer Methods, John Wiley & Sons, New York, 2010.
4. Damodarasamy S.R and Kavitha S, Basics of Structural Dynamics and Aseismic Design, PHI publishers, 2009.
5. Clough, R.W.; and Penzien, J., Dynamics of structures. 3rd Edition, Computer and Structures, Inc., Berkeley, USA, 2003.

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140ST0104 **DESIGN OF RCC STRUCTURES** **3 1 0 4**

AIM:

The aim of the course is to provide knowledge to students to design reinforced concrete structural elements and structures.

OBJECTIVES:

The objectives of this subject are to enable students:

- to make the students be familiar with the limit state design of RCC beams and columns
- to design hypostatic RC beams and frames
- to develop an idea of designing special R.C. elements
- to familiarize with design and detailing of flat slabs and grid floors
- to expose them to 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 - Design for limit state of serviceability-Calculation of deflection and crackwidth crackwidth as per IS-456-2000.

UNIT II DESIGN OF CONTINUOUS BEAMS AND FRAMES 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 method for wind and earthquake forces-design of members and 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.

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

Hillerberg's strip method of design of slab-Design of flat slab- Equivalent frame method of design-Approximate analysis and Design of grid floors

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.

L: 45, T: 15, Total: 60

TEXT BOOKS:

1. Unnikrishna Pillai and Devdas Menon, 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.

REFERENCES:

1. Park R. and Paulay T., Reinforced Concrete Structures, Wiley India Pvt Ltd, New Delhi, 2009
2. Purushothaman P., Reinforced concrete Structural Elements: Behavior, Analysis and Design, Tata Mc Graw Hill, New Delhi, 2009.
3. Nilson A.H., Design of Concrete Structures, Tata McGraw-Hill, New Delhi, 2003.

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22/7/15

140ST0105 **THEORY OF ELASTICITY AND PLASTICITY** **3 1 0 4**

AIM:

The aim of the course is to provide knowledge on behaviour of materials and structures on application of forces by theory of elasticity and plasticity.

OBJECTIVES:

Students should be able:

- to develop systematic - knowledge of stress strain concept
- to understand and solve two dimensional problems in Cartesian and polar coordinates
- to develop the knowledge about torsion for shapes like ellipse triangular and rectangular
- to understand 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: 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-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) Prandtl Reuss equations - Plastic work - Plastic potential.

L: 45, T: 15, Total: 60

TEXT BOOKS:

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

REFERENCES:

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

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22/7/15

140ST0107 STRUCTURAL ENGINEERING LABORATORY 0 0 3 2

AIM:

The aim of the course is to make the students practice in testing concrete and steel under the action of different forces and determine the various characteristics experimentally.

OBJECTIVES:

The objectives of this laboratory are to enable students:

- To learn the properties of steel, concrete.
- To practically verify the behaviour of different structural elements subjected to loads.

LIST OF EXPERIMENTS:

1. Study of the constitutive behaviour of structural materials (concrete and steel)
2. 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.
3. Strength assessment of concrete -NDT Techniques- Ultrasonic pulse velocity method, Rebound Hammer test, Impact-Echo method.
4. Introduction to electrical strain gauges and Strain recording instruments - Measurement of strain in steel cantilever beam using strain gauges.
5. Introduction to vibration measuring systems - Studying the response of structural members using accelerometers and load cells.
6. Testing of a RC concrete beam in a testing frame.
7. Analysis and verification of displacement in plane truss for various loads.
8. Analysis and verification of deflection in beam for various loads and support conditions.
9. Large deflection behaviour of a steel strip.
10. Dynamic behaviour of a Beam (Modal, Harmonic and Transient)

Total: 45

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, 2012

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SEMESTER II

140ST0201 **FINITE ELEMENT TECHNIQUES** **3 1 0 4**

AIM:

The aim of the course is to provide knowledge on energy principles, finite element concept, and application of finite element method in structural engineering.

OBJECTIVES:

Students should be able:

- To understand various methods of formulation
- To formulate one, two and three dimensional element properties
- To impart knowledge of application of method to structural analysis.
- To apply finite element method to dynamic problems

UNIT I INTRODUCTION **9**

Basic principles- Stress-Strain-displacement relations; Linear constitutive relations. Plane stress and plane strain – choices of element shapes - one, two and three dimensional elements. Choice of Displacement Function, Nodal Degrees of Freedom, Pascal's Triangle, Isoparametric Elements, shape functions, Formulation of Stiffness Matrix-Variational and Weighed Residual Methods – Ritz and Galerkin Formulations – Minimum Potential Energy – Generation of system stiffness Matrix and Load vector. Convergence and compatibility requirements,–Review of Gaussian Elimination and Cholesky methods.

UNIT II ANALYSIS OF FRAMED STRUCTURES **9+6**

Development of element stiffness matrix and nodal load vector for bar, beam and plane frame elements. Transformation matrices – application to relevant trusses, beams and plane frames. 2D elements – stiffness matrices for triangular, quadrilateral and axisymmetric elements- Plane Stress, Plane Strain and axisymmetric Problems. analysis using finite element computer codes

UNIT III THREE DIMENSIONAL STRESS ANALYSIS **9+3**

8 noded isoparametric solid element, analysis of plate bending, displacement functions, various types of plate bending elements, types of isoparametric elements, analysis of shells; bilinear degenerated shell element strain-displacement matrix, stress-displacement matrix, element stiffness matrix, 8 noded shell element, analysis using finite element computer codes.

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

Triangular and Rectangular plate elements, shell elements - Axisymmetric shell elements. Development of stiffness matrix and consistent load vector - Application to folded plates and bridge decks.

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.

L: 45, T: 15, Total: 60

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.
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.

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140ST0202 EARTHQUAKE RESISTANT DESIGN 3 0 0 3

AIM:

The aim of the course is to provide knowledge on the effect of earthquakes, earthquake resistant design of Structures.

OBJECTIVES:

Students should be able:

- To understand earthquakes and its effects.
- To learn the earthquake resistant design concept.
- To design earthquake resistant masonry and R.C. structures.
- To understand base isolation control concept, seismic settlement etc.

UNIT I EARTHQUAKES AND ITS EFFECTS ON STRUCTURES 9

Engineering seismology: Earthquake phenomenon cause of earthquakes-Faults- plate seismic tectonics-waves- Terms associated with earthquakes-Magnitude/Intensity of an earthquake-scales- Energy released-Earthquake measuring instruments-seismoscope, seismograph, accelerograph- Characteristics of strong ground motions- Seismic zones of India. Evaluation of Earthquake Forces as per codal provisions,

UNIT II EARTHQUAKE RESISTANT DESIGN CONCEPT 9

introduction-Functional planning-continuous load path-overall form-simplicity and symmetry-Twisting of buildings-Ductility-definition-ductility relationships, flexible buildings-framing systems-choice of materials-unconfined concrete-confined concrete, masonry-reinforcing steel. Introduction to earthquake resistant design: seismic design requirements-regular and irregular configurations -basic assumptions-design earthquake loads-basic load combinations-permissible stresses-seismic methods of analysis-equivalent lateral force method- response spectrum method-Time history method.

UNIT III EARTHQUAKE RESISTANT DESIGN OF MASONRY STRUCTURES 9

Structural Systems - Types of Buildings, Causes of damage, Planning Considerations, Philosophy and Principle of Earthquake Resistant Design, Guidelines for Earthquake Resistant Design, Earthquake Resistant Earthen Buildings, Earthquake Resistant Masonry Buildings - Design consideration – Guidelines.

UNIT IV EARTHQUAKE RESISTANT DESIGN OF RC STRUCTURES 9

Earthquake Resistant Design of R.C.C. Buildings - Lateral load analysis - Design and detailing – Rigid Frames – Shear wall – Coupled Shear wall. Ductility considerations as per IS13920.

UNIT V SPECIAL TOPICS 9

Mathematical modeling of multistoried RC Buildings – Capacity based design. Vibration Control - Tuned Mass Dampers – Principles and application, Basic Concept of Seismic Base Isolation – various Systems-Soil liquefaction– Effect of Liquefaction. Seismic Design requirements for Foundation – Seismic Bearing capacity - Seismic Settlement. Case Studies.

L: 45, T: 0, Total: 45

REFERENCES:

1. Pankaj Agarwal 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., Aseismic Design of Reinforced Concrete and Masonry buildings, John Wiley and Sons, 1991.
4. Bruce A Bolt, Earthquakes, W H Freeman and Company, New York, 2004
5. Bungale S.Taranath, Structural Analysis and Design of Tall Buildings, McGraw Hill Book Company, New York, 1999.

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140ST0203 **DESIGN OF STEEL STRUCTURES** **3 1 0 4**

AIM:

The aim of the course is to enhance the knowledge of students in designing various steel structures.

OBJECTIVES:

Students should be able:

- To understand general principle in the design of steel structures
- To design various types of connections
- To design steel transmission line towers
- To 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 - Crane 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.

UNIT III ANALYSIS AND DESIGN OF 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 -design for flexure – 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**

Plastic design of tension and compression members - Theory of plastic bending - Plastic hinge – redistribution of moments - failure mechanisms - plastic analysis and design of fixed beams, continuous beams and portal frames by mechanism method.

L: 45, T: 15, Total: 60

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.
3. Arya and Ajmani, Design of Steel Structures, Nemchand Brothers, Roorkee, 1994.
4. Alexander Newman, Metal Building Systems – Design and Specifications, Mc Graw 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.

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140ST0204 **DESIGN OF FOUNDATIONS** **3 1 0 4**

AIM:
Aim of this course is to impart knowledge on design aspects of foundations.

OBJECTIVES:
Students should be able:

- To understand principle of design of foundations.
- To design pile foundations and pile caps
- To design sheet pile structures
- To design machine foundations and special foundations.

UNIT I INTRODUCTION **9+3**

Design of soil investigation report for design of foundation structure – types – Selection of foundation - Basic requirement of foundation – Computation of loads - Bearing Capacity of soil – Plate load test - General principle of design of shallow and deep foundation.

UNIT II PILE FOUNDATIONS **9+3**

Introduction – Load carrying capacity of different types of piles and pile groups according to IS 2911 - Settlement of piles - Negative skin friction - Lateral load resistance of individual piles and pile groups – Design of Piles and Pile cap.

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 IV SPECIAL FOUNDATIONS **9+3**

Foundation in Expansive Soils- Introduction - 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-Design of Anchors.

L: 45, T: 15, Total: 60

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.
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.

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140ST0207 COMPUTER AIDED STRUCTURAL DESIGN LABORATORY 0 0 3 2

AIM:
The aim of the course is to make the students practice in designing various reinforced concrete and steel structures.

OBJECTIVES:
The objectives of this laboratory are to enable students

- To design different concrete structures.
- To design different steel structures.
- To use softwares like ETABS, STAAD Pro etc to design the structures.

LIST OF EXPERIMENTS:

ANALYSIS OF STRUCTURES USING SOFTWARES

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

DESIGN OF REINFORCED CONCRETE STRUCTURES

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

STEEL STRUCTURES

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

Total: 45

REFERENCE:
Computer Aided Structural Design Laboratory Manual of Civil Engineering department, MCET, Pollachi, 2012

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