## SEMESTER – I

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CA – Continuous Assessment, ESE – End Semester Examination
# M.E. DEGREE IN STRUCTURAL ENGINEERING (FULL TIME)

## CURRICULUM

(For the candidates admitted from academic year 2012-13 onwards)

### SEMESTER – II

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CA – Continuous Assessment, ESE – End Semester Examination
## M.E. DEGREE IN STRUCTURAL ENGINEERING (FULL TIME)

(For the candidates admitted from academic year 2012-13 onwards)

### SEMESTER – III

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CA – Continuous Assessment, ESE – End Semester Examination
KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE- 638 052  
(Autonomous Institution affiliated to Anna University of Technology, Coimbatore)

M.E. DEGREE IN STRUCTURAL ENGINEERING (FULL TIME)

CURRICULUM
(For the candidates admitted from academic year 2012-13 onwards)

SEMESTER – IV

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CA – Continuous Assessment, ESE – End Semester Examination
### LIST OF ELECTIVES

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Objective:
On completion of the course the students are expected
- To understand the basic concepts and properties of probability and random variables.
- To understand partial and multiple correlation, regression.
- To understand analysis of time series and simulation.

MODULE - I
Probability: Axiomatic approach to probability, addition and multiplication laws of probability, conditional probability, Baye’s theorem.
Random variable: Discrete and continuous random variables – Probability function – Mathematical expectation – Cumulative distribution function – Properties – Moments - Moment generating function
Joint probability distributions, marginal and conditional density functions.

MODULE - II
Correlation and Regression: Simple linear correlation and regression, Multiple correlation – partial correlation – Regression: Multiple regression analysis

MODULE - III
Design of Experiments: Basic definitions – Analysis of variance – One way classification – Completely Randomised design – Two way classification – Randomised Block design – Latin Square design.

REFERENCE BOOKS
Objective:
- To understand the concept of 2 Dimensional and 3 Dimensional stress-strain analysis and its applications to simple problems.

MODULE - I
Analysis of stress and strain, stress strain relationship- Generalized Hooke's law- Plane stress and plane strain-Airy’s stress function, Stress polynomials-Two dimensional problems in Cartesian co-ordinates.

MODULE - II

MODULE - III

Lecture: 45, Tutorial: 15, TOTAL: 60

REFERENCE BOOKS
Objective:
- To study the advanced method of analysis such as Flexibility method and Stiffness method with the application of computer software tools. Direct stiffness method are also covered.

MODULE - I 15

MODULE - II 15

MODULE - III 15

REFERENCE BOOKS
11SE104 STRUCTURAL DYNAMICS

Objective:
- To expose the students about the principles and methods of dynamic analysis of structures and to prepare them for designing the structures for wind, earthquake and other dynamic loads. They will be able to estimate the aptitude, frequency and vibration by various techniques

MODULE – I
15
Principles of Vibration Analysis: Equations of motion by equilibrium and energy methods, free and forced vibration of single degree of freedom systems, Effect of damping, Transmissibility.
Two Degree of Freedom Systems: Equations of motion of two degree of freedom systems, normal modes of vibration, applications.

MODULE – II
15

MODULE - III
15

Lecture: 45, Tutorial: 15, TOTAL : 60

REFERENCE BOOKS
Objective:
- To study the analyze and design of different types of foundation and retaining structures.

MODULE - I
Criteria for foundation choice, Bearing capacity, total and differential settlement tolerance for various types of structures. Interpretation of soil profile for design parameters like modulus of compressibility, Modulus of sub grade reaction, Poisson’s ratio, etc. Soil Structure Interaction (SSI) analysis of combined, continuous and raft foundation - Beam on elastic foundation – Raft foundations for Building and tower structures – Different types of rafts.

MODULE - II
Pile foundations – types, method of installation, Codal practices for permissible load under vertical and lateral loads, structural design of pile caps; Diaphragm wall design and construction.

MODULE - III

TOTAL: 45

REFERENCE BOOKS
11CM103 ADVANCED CONCRETE TECHNOLOGY
(Common to M.E. Construction Engineering & Management and Structural Engineering)

Objective:
- To review the basics of concrete ingredient
- To study the properties of fresh and hardened concrete properties
- To understand the durability of concrete

MODULE - I
Concrete Ingredients: Composition of OPC - Manufacture - Modified Portland Cements - Hydration process of Portland Cements - Structure of Hydrated Cement Pastes - Mineral admixtures - Slags - Pozzolans and Fillers - Chemical admixtures - Solutes - Retarders - Air entraining agents - Water proofing compounds - Plasticizers and super plasticizers - Shape and mechanical properties - Absorption and Physical durability - Chemical stability - Packing characteristics

MODULE - II
Fresh and Hardened Concrete: Workability - Mix proportioning - Mixes incorporating Fly ash, Silica fume, GGBS - Mixes for High Performance Concrete - Mix design methods - variations in concrete strength - Interfacial transition zone - Fracture strength - Mechanical properties - High Strength Concrete - Shrinkage - Creep - Other properties - NDT systems

MODULE - III
Durability of Concrete: Basic consideration - Stability of constituents - Chemical attack - Corrosion of reinforcing Steel.
Special Concretes: Fibre Reinforced Concrete - Self Compacting Concrete - Polymer Concrete - Geopolymer Concrete - Super Plasticized Concrete - Light Weight Concrete - Roller Compacted Concrete - Reactive Powder Concrete - RMC - Basalt Fibre Concrete - Wisper concrete - Recycled Aggregate Concrete - High Density Concrete - HVFA Concrete - Vacuum Concrete - Foam Concrete - Bacterial Concrete

TOTAL : 45

REFERENCE BOOKS
Objective:
- To impart the practical knowledge to the students about the testing and studying the properties of structural – concrete elements

LIST OF EXPERIMENTS

1. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour.
2. Testing of simply supported steel beam for strength and deflection behaviour.
3. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading.
4. Dynamic testing of cantilever steel beam
   a. To determine the damping coefficients from free vibrations.
   b. To evaluate the mode shapes.
5. Static cyclic testing of single bay two storied steel frames to evaluate
   a. Drift of the frame.
   b. Stiffness of the frame.
   c. Energy dissipation capacity of the frame.
6. Determination of in-situ strength and quality of concrete using i) rebound hammer and ii) Ultrasonic Pulse Velocity Tester

REQUIRED LABORATORY EQUIPMENTS

1. Strong Floor
2. Loading Frame
3. Hydraulic Jack
4. Load Cell
5. Proving Ring
6. Demec Gauge
7. Electrical Strain Gauge with indicator
8. Rebound Hammer
9. Ultrasonic Pulse Velocity Tester
10. Dial Gauges
11. Clinometer
12. Vibration Exciter
13. Vibration Meter
14. FFT Analyser
15. Vibrating Table (mode shape)

REFERENCE BOOK
11SE201  FINITE ELEMENT ANALYSIS  

Objective:
- To study about stress analysis, meshing, nonlinear and thermal analysis.

MODULE - I  

MODULE - II  

MODULE - III  

Lecture: 45, Tutorial: 15, TOTAL: 60

REFERENCE BOOKS
11SE202  STABILITY OF STRUCTURES  3  1  0  4

Objective:
- At the end of this course, students will be in a position to understand the phenomenon of buckling and its effects on structural components.
- To study the concept of buckling and analysis of structural elements.

MODULE - I

MODULE - II
Buckling of Beam-Columns, Frames and Plates: Theory of beam column – Stability analysis of beam column with single and several concentrated loads, distributed load and end couples – Stability of frames – Stability functions – Analysis of rigid jointed frames with and without sway – Moment distribution – Governing differential equation – Buckling of thin plates, various edge conditions – Analysis by equilibrium and energy approach – Buckling of rectangular plates of various end conditions – Finite difference method – Post buckling behaviour of plates.

MODULE - III

Lecture: 45, Tutorial: 15, TOTAL: 60

REFERENCE BOOKS
11SE203  DESIGN OF CONCRETE STRUCTURES
(IS 456:2000 & IS 3370 Part II&IV,13920:1993 codes are permitted)

Objective:
- To make the students be familiar with the limit state design of RCC beams and columns
- At the end of the course the students shall be in a position to design hypostatic RC beams and frames and other structures such as deep beams and grid floors

MODULE - I  
Design of Special RC Elements: Review of limit state design of beams, slabs and columns according to IS Codes. Calculation of deflection and crack width according to IS Design of slender columns - Design of RC walls - ordinary and shear walls. Strut and tie method of analysis and design for corbels and deep beams, Design of corbels, Deep-beams

MODULE - II  
Flat slabs and Flat Plates: Design of flat slabs and flat plates according to IS methods - Design of shear reinforcement - Design of spandrel beams - Yield line theory and Hillerborgs strip method of design of slabs. Design of grid floors.

MODULE - III  

TOTAL: 45

REFERENCE BOOKS
11SE204  EARTHQUAKE ANALYSIS AND DESIGN OF STRUCTURES
(IS 1893, IS 13920 SP34, SP32 & IS 4326 codes are permitted)

Objective:
- To study the effect of earthquakes, analysis and design of earthquake resistant structures.

MODULE - I

MODULE - II
Earthquake Resistant design of Masonry structures: Effect of earthquake on different types of structures, lessons learnt from past earthquakes. 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.

MODULE - III

TOTAL: 45

REFERENCE BOOKS
Objective:

- At the end of the laboratory classes the students would be known how to plan, analysis and design the buildings and the preparation of detailed drawings.
- Planning, Analysis and Design of industrial structures, Multi storeyed buildings, Bridges, Towers, Storage structures, Material handling equipment and special structures. Geotechnical aspects in foundation design. Special emphasis on earthquake resistant design. Design, detailing and preparation of drawings of the above.
11SE301  DESIGN OF STEEL AND STEEL CONCRETE COMPOSITE STRUCTURES  
(IS 801,807,811,875, 1024,3370,6533 part 2 codes are permitted)  

Objective:
- To impart knowledge on steel constructions
- At the end of this course students will be in a position to design bolted and welded connections in industrial structures, light gauge sections and all related connections incorporating the recommendations of IS 800-2007 code.

MODULE - I  
15  
Design of members subjected to lateral loads and axial loads - Principles of analysis and design of Industrial buildings and bents - Crane gantry girders and crane columns – Analysis and design of steel towers - Design of industrial stacks - Self supporting and guyed stacks lined and unlined. Types of connections, Design of framed beam connections, Seated beam connection, Un-stiffened, Stiffened seat connections, Continuous beam - to - beam connections and continuous beam-to-column connection both welded and bolted.

MODULE - II  
15  
Cold formed Steel sections - Types of cross sections - Local buckling and post buckling - Design of compression and tension members - Beams - Deflection of beams – Combined stresses and connections. Introduction to composite design - shear connectors - types of shear connectors - degrees of shear connections - partial and full shear connections - composite sections under positive bending - negative bending - propped conditions - un-propped conditions - deflection of composite beams.

MODULE - III  
15  

TOTAL: 45

REFERENCE BOOKS
Objective:
- To impart the knowledge to the students about field situations/conditions and train them how to handle these situations.
- The student will make at least two technical presentations on current topics related to the specialization. The same will be assessed by a committee appointed by the department. The students are expected to submit a report at the end of the semester covering the various aspects of his/her presentation together with the observation in industry visits.
11SE011  DESIGN OF INDUSTRIAL STRUCTURES

3 0 0 3

Objective:
- At the end of this course the students shall be able to plan and design the Engineering, Chemical and Textile Industries.
- They will be able to design the structures such as Silos, Bunkers and Chimneys.

MODULE - I  15

MODULE - II  15

MODULE - III  15

TOTAL: 45

REFERENCE BOOKS
5. Handbook on “Fundamental Requirements of Industrial Buildings (Lighting and Ventilation)”, BIS.
11CM202 MAINTENANCE AND REHABILITATION OF STRUCTURES
(Common to M.E.Construction Engineering & Management and Structural Engineering)  
3 0 0 3

Objective:
- To bring about an exposure to serviceability and durability criteria.
- To study the development of maintenance and repair strategy.
- To study the development of repair materials.

MODULE - I
Introduction: Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking. Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

MODULE - II
Maintenance and Repair strategies: Facts of maintenance, importance of Maintenance, Preventive measures on various aspects of Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.

MODULE - III

TOTAL: 45

REFERENCE BOOKS
Objective:
- At the end of this course the student shall have a knowledge of methods of pre-stressing and the problems involved in design of various pre-stressed concrete elements under codal provisions.

MODULE - I
15

MODULE - II
15
Limit state of flexure and shear resistance of cracked and uncracked sections-Design of shear and flexure reinforcement-Transmission of pre-stressing force by bond in pre-tensioned members- Check for transmission length- Design of anchorage zone for post-tensioned beams by I.S.Code methods and Guyon’s method.

MODULE - III
15
Types of composite construction involving precast, pre-stressed units -Analysis for stress-Design for flexure and shear. Design of tank wall incorporating the recommendations of I.S: 3370 part III and IV codes- Types of prestressed concrete pipes-Design of pipes- Methods of achieving continuity in prestressed concrete continuous beams.

TOTAL: 45

REFERENCE BOOKS
Objective:
- To study the loads, forces on bridges and design of several types of bridges.

MODULE - I
Introduction, short and long span Bridges: 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.

Load distribution theories, analysis and design of slab culverts, tee beam and slab bridges. Design principles of continuous bridges, box girder bridges, balanced cantilever bridges.

MODULE - II

MODULE - III

REFERENCE BOOKS
11SE014  THEORY OF PLATES, SHELLS AND SPACE FRAMES
(IS 1730-1989, IS 5488-1987, IS 2210-1988, IS 6332-1984 codes are permitted.)

Objective:
  • To study the behavior of plates, shells and space frames.

MODULE - I  15
Introduction to Plates: Simple bending of Plates - Assumptions in thin plate theory - Different relationships – Different boundary conditions for plates – Plates subjected to lateral loads – Navier’s method for simply supported plates – Levy’s method for general plates – Example problems with different types of loading.

MODULE - II  15
Introduction to Shells: Classification of shells – Membrane and bending theory for singly curved and doubly curved shells – Various approximations – Analysis of folded plates.

MODULE - III  15
Introduction to Space frame: Space frames – Configuration – Types of nodes – General principles of design Philosophy – Behaviour.

TOTAL: 45

REFERENCE BOOKS
Objective:
- To study the behaviour, analysis and design of tall structures.

MODULE - I
15

MODULE - II
15
Analysis and design of Structural Elements: 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. 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.

MODULE - III
15
Stability of Tall buildings: 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.

TOTAL: 45

REFERENCE BOOKS
Objective:
- To study the behaviour of composite materials and to investigate the failure and fracture characteristics.

MODULE - I  15
Introduction to composites, classifying composite materials, commonly used fiber and matrix constituents, Composite construction, properties of unidirectional Long Fiber composites, Short Fiber composites. Concepts in solid mechanics, Hooke’s law for orthotropic and anisotropic materials, Linear elasticity for Anisotropic materials, rotations of stresses, strains, residual stresses.

MODULE - II  15

MODULE - III  15
Failure and Fracture of composites: Netting analysis, failure criterion, maximum stress, maximum strain, fracture mechanics of composites, Sandwich Construction. Metal and ceramic matrix composites, applications of composites, composite joints, design with composites, Review, environmental issues.

TOTAL: 45

REFERENCE BOOKS
Objective:
- To study the concept of wave theories, forces and design of jacket towers, pipes and cables.

MODULE - I
WAVE THEORIES AND FORCES OF OFFSHORE STRUCTURES: Wave generation process, small and finite amplitude wave theories. Wind forces, wave forces on vertical, inclined cylinders, structures - current forces and use of Morison equation.

MODULE - II
OFFSHORE SOIL AND STRUCTURE MODELLING: Different types of offshore structures, foundation modeling, structural modeling.

MODULE - III
ANALYSIS AND DESIGN OF OFFSHORE STRUCTURES: Static method of analysis, foundation analysis and dynamics of offshore structures. Design of platforms, helipads, Jacket tower and mooring cables and pipe lines.

TOTAL: 45

REFERENCE BOOKS
Objective:
- To study the optimization methodologies applied to structural engineering.

MODULE - I
Basic principles and Classical optimization techniques:
- Definition - Objective function;

MODULE - II
Linear programming:
Non linear programming:

MODULE - III
Geometric and Dynamic Programming:
- Polynomial - degree of difficulty - reducing G.P.P to a set of simultaneous equations - Unconstrained and constrained problems with zero difficulty - Concept of solving problems with one degree of difficulty. Bellman’s principle of optimality - Representation of a multistage decision problem - concept of sub-optimization problems using classical and tabular methods. 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.

TOTAL: 45

REFERENCE BOOKS
11SE019  PREFABRICATED STRUCTURES
(SP 7 Part 4-2005, IS 14142-1994, IS 14143-1994 codes are permitted.)

Objective:
- To Study the design principles, analysis and design of Prefabricated structures.

MODULE - I
Design principles and Reinforced concrete: General Civil Engineering requirements, specific requirements for planning and layout of prefabricates plant. IS Code specifications. Modular coordination, standardization, Demoulding of Prefabricates, production, transportation, erection, stages of loading and codal provisions, safety factors, material properties, Deflection control, Lateral load resistance, Location and types of shear walls. Prefabricated structures - Long wall and cross-wall large panel buildings, one way and two way prefabricated slabs, Framed buildings with partial and curtain walls, -Connections – Beam to column and column to column.

MODULE - II
Floors, Stairs, Roofs and Walls: Types of floor slabs, analysis and design example of cored and panel types and two-way systems, staircase slab design, types of roof slabs and insulation requirements, Description of joints, their behaviour and reinforcement requirements, Deflection control for short term and long term loads, Ultimate strength calculations in shear and flexure. Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls, load transfer from floor to wall panels, vertical loads, Eccentricity and stability of wall panels, Design Curves, types of wall joints, their behaviour and design, Leak prevention, joint sealants, sandwich wall panels, approximate design of shear walls.

MODULE - III
Industrial buildings and Shell roofs: Components of single-storey industrial sheds with crane gantry systems, R.C. Roof trusses, Roof panels, corbels and columns, wind bracing design. Cylindrical, Folded plate and hyper-prefabricated shells, erection and jointing, joint design, hand book based design.

TOTAL: 45

REFERENCE BOOKS
Objective:
- To study the concept of wind effects, analysis and design of structures.

MODULE - I
15
Introduction, Spectral studies, Gust factor, Wind velocity, Method of measurement, variation of speed with height, shape factor, aspect ratio, drag effects.
Wind Tunnel Studies, Types of tunnels, Modeling requirements, Interpretation of results, Aero-elastic models.

MODULE - II
15
Effect of wind on structures: IS codes and special structures, wind on structures, rigid structures, Flexible structures, Static and Dynamic effects, Tall buildings, Chimneys. Application to design, IS875 code method, buildings, chimneys, roofs, shelters

MODULE - III
15
Cyclone effects: Cyclone effect on structures, cladding design, window glass design.

TOTAL: 45

REFERENCE BOOKS
Objective:
- To introduce the basic concept to the students about the testing techniques and methods adopted for different types of loading.

MODULE - I
15
General: Basic concept in measurements, measurement in displacement, strain pressure, force torque etc, type of strain gauges (Mechanical, Electrical resistance, Acoustical etc.) strain gauge circuits-The potentiometer and Wheatstone bridge. Use of lead wires switches etc. Use of electrical resistance strain gauge in transducer applications.

MODULE - II
15
Testing and analysis Method: indicating and recording- static and dynamic data recording-Data (Digital and Analogue) acquisition and processing systems. Strain analysis methods-Rosette analysis. Static and Dynamic testing techniques. Equipment for loading - Moire’s techniques.

MODULE - III
15

TOTAL: 45

REFERENCE BOOKS
Objective:
• To study the environmental effects on structures, corrosion, tests and prevention of corrosion.

MODULE - I

MODULE - II
Identification and appraisal of Corrosion: Corrosion process and mechanism – approach to investigation-visual observation and documentation, in situ testing of concrete-rebound hammer test, cover meter survey-(UPV) Ultrasonic pulse velocity test –core sampling and testing, in situ testing of steel rebar –carbonation test and pH value, chloride content-half cell potential survey-resistivity mapping –measurement of corrosion rate.

MODULE - III
Protective measures: Coating to reinforcement-metallic coatings-epoxy coatings-cement based coatings – coating to prestressing steel, galvanized reinforcement, stainless steel, non-ferrous reinforcement and coating to concrete surface, improving the concrete, corrosion resistant steel. Definition of inhibitor-anodic and cathodic inhibitors-rice husk ash, fly ash, electrochemical removal of chloride from concrete, non-metallic materials, carbon FRP, Glass FRP.

TOTAL: 45

REFERENCE BOOKS