SCHEME AND SYLLABUS OF

M.Tech Programme in Civil Engineering (2013 Scheme)

with specialisation in STRUCTURAL ENGINEERING

University of Kerala
Thiruvananthapuram
### M.Tech Programme

**CIVIL ENGINEERING – STRUCTURAL ENGINEERING**

**CURRICULUM AND SCHEME OF EXAMINATIONS**

**Scheme**

#### SEMESTER I

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Name of Subject</th>
<th>Credits</th>
<th>Hrs / week</th>
<th>End Sem Exam hours</th>
<th>Marks</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSM1001</td>
<td>Advanced Numerical Methods</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>40 60 100</td>
<td>Of the 40 marks of internal assessment 25 marks for test and 15 marks for assignment. End sem exam is conducted by the University</td>
</tr>
<tr>
<td>CSC1001</td>
<td>Structural Dynamics</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>40 60 100</td>
<td>do</td>
</tr>
<tr>
<td>CSC1002</td>
<td>Advanced Theory &amp; Design of RC Structures</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>40 60 100</td>
<td>do</td>
</tr>
<tr>
<td>CSC1003</td>
<td>Advanced Metal Structures</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>40 60 100</td>
<td>do</td>
</tr>
<tr>
<td>CSC1004</td>
<td>Experimental Methods and Instrumentation</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>40 60 100</td>
<td>do</td>
</tr>
<tr>
<td>CSC1005</td>
<td>Theory of Elasticity</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>40 60 100</td>
<td>do</td>
</tr>
<tr>
<td>CSC1101</td>
<td>Structural Engineering and Computational Lab</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>100 - 100</td>
<td>No End Sem Examinations</td>
</tr>
<tr>
<td>CSC1102</td>
<td>Seminar</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>100 - 100</td>
<td>do</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>21</td>
<td>22</td>
<td></td>
<td></td>
<td>7 Hours of Departmental Assistance work</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Name of Subject</th>
<th>Credits</th>
<th>Hrs / week</th>
<th>End Sem Exam hours</th>
<th>Marks</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Theory of Elasticity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Structural Engineering and Computational Lab</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Seminar</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### SEMESTER II

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Name of Subject</th>
<th>Credits</th>
<th>Hrs / week</th>
<th>End Sem Exam hours</th>
<th>Marks</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC2001</td>
<td>Theory and Design of Plates and Shells</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>CSC 2002</td>
<td>Analysis and Design of Earth Quake Resistant Structures</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>*</td>
<td>Stream Elective I</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>*</td>
<td>Stream Elective II</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>*</td>
<td>Department Elective</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>CCC 2001</td>
<td>Research Methodology</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>CSC2101</td>
<td>Structural Dynamics Laboratory</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>CSC2102</td>
<td>Thesis – Preliminary – Part I</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>CSC2103</td>
<td>Seminar</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>22</td>
<td>23</td>
<td>---</td>
<td></td>
<td>6 Hours of Departmental Assistance work</td>
</tr>
</tbody>
</table>

List of Stream Electives

**Stream Elective I**
- CSE 2001 Advanced Pre-Stressed Concrete Design
- CSE 2002 Forensic Engineering
- CSE 2003 Structural Optimisation

**Stream Elective II**
- CSE 2004 Finite Element Method
- CSE 2005 Composite Structures
- CSE 2006 Analysis and Design of Substructures
### SEMESTER III

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Name of Subject</th>
<th>Credits</th>
<th>Hrs / week</th>
<th>End Sem Exam hours</th>
<th>Continuous Assessment</th>
<th>End Semester Exam</th>
<th>Total</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td>End Sem Exam is conducted by the Individual Institutions</td>
</tr>
<tr>
<td></td>
<td>Stream Elective III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td>do</td>
</tr>
<tr>
<td></td>
<td>Stream Elective IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-Dept. (Interdisciplinary) Elective</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td>do</td>
</tr>
<tr>
<td></td>
<td>CSC3101 Thesis – Preliminary – Part -II</td>
<td>5</td>
<td>15</td>
<td>-</td>
<td>200</td>
<td></td>
<td>200</td>
<td>No End Sem Examinations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**List of Stream Electives**

**Stream Elective III**
1. CSE 3001 High Rise Structures
2. CSE 3002 Engineering Applications of Artificial Intelligence and Expert Systems
3. CSE 3003 Random Vibration

**Stream Elective IV**
1. CSE 3004 Stability of Structures
2. CSE 3005 Structural Reliability
3. CSE 3006 Fracture Mechanics
## SEMESTER IV

<table>
<thead>
<tr>
<th>Code No</th>
<th>Subject Name</th>
<th>Credits</th>
<th>Hrs/week</th>
<th>Continuous Assessment</th>
<th>University Exam</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Guide</td>
<td>Evaluation Committee</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>12</td>
<td>21</td>
<td>150</td>
<td>150</td>
<td>200</td>
</tr>
</tbody>
</table>

**Note:** 6 to 8 hours per week is for department assistance
List of Department Electives

1. CSD 2001 Design of Bridges
2. CHD 2001 Project Planning in Water Resources
3. CRD 2001 Geoinformatics in Civil Engineering
   (Students of Geoinformatics specialization are not allowed to choose CRD 2001 subject as the contents are dealt with in detail in the core papers)
4. CGD2001-Geoenvironment and landfill
6. CTD 2002 Regional Transportation Planning
7. CED 2001 Ecological Engineering
8. CED 2002 Air Pollution Control and Monitoring
9. CED 2003 Environmental Impact Assessment and Risk Analysis

List of Interdisciplinary Electives

1. CSI 3001 Finite Element Analysis
2. CSI 3002 Mechanics Of Composites
3. CHI 3001 Fuzzy Sets And Systems In Engineering
4. CRI 3001 Geoinformatics For Infrastructure Development
5. CGI 3001 Geotechnical Engineering For Infrastructure Projects
6. CTI 3001 Fundamentals Of Reliability Engineering
7. CEI 3001 Philosophy Of Technology
8. CEI 3002 Environmental Management
9. CEI 3003 Environment And Pollution
CSM 1001 Advanced Numerical Methods

Structure of the Course

Lecture: 3 hrs/ Week  Credits: 3
Internal Continuous Assessment:  40 Marks
End Semester Examination :  60 Marks

Course Objectives

- To give awareness to different numerical solutions.
- To impart ability to apply mathematics for finding solutions to real-time problems.

Learning Outcomes

- Understand various computational methods available to solve practical problems
- Enhance the capacity to select appropriate techniques for tackling problems in engineering and science.

Module I


Module II


Module III


Note: Stress must be given to structural problems

Assignment must be computer oriented

References


Structure of the Question paper

For the end semester examination there will be three questions from each module out of which two questions are to be answered by the students.
CSC 1001  Structural Dynamics

Structure of the Course
Lecture : 3 hrs/ Week  Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

• To understand the behaviour of structures under dynamic loads
• To familiarise with the dynamic analysis of structures subjected to time varying loads

Learning Outcomes

• Will be equipped with the analytical tools required to determine the dynamic response of structures
• will serve as a pre-requisite to study the subject “Analysis and design of earthquake resistant structures”

Module I

Module II

Module III
Distributed mass (continuous) systems – differential equation of motion – Axial vibration of rods – Flexural vibration of single span beams such as simply supported beam, cantilever beam and fixed beam– Evaluation of frequencies and mode shapes – Beam flexure including shear deformation and rotary inertia – Forced vibration of single span beams – Lagrange’s equation.

References

Structure of the question paper
For the end semester examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students.
Structure of the Course
Lecture : 3 hrs/ Week                Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination         : 60 Marks

Course Objectives

This course is designed to
• Provide the ability in analysis and design of basic reinforced concrete components
• Study of advanced topics including theory and design of reinforced concrete structures

Learning Outcomes

• Understand the theory and design of the main elements in reinforced concrete structures
• Understand the behaviour of reinforced concrete structures
• Carry out calculations on safety verification of reinforced concrete members
• Understand the design of special reinforced concrete members and components

Module I

Module II
Design of special RC members- Analysis of shear walls- distribution of lateral loads in uncoupled shear walls, Shear wall frame interactions. Design of concrete corbels, deep beams, ribbed slabs, pile caps.

Module III

References
5. IS 456 –2000, Indian Standard for Plain and Reinforced Concrete- Code of Practice, New Delhi
6. American Concrete Institute, Building Code Requirements for Structural Concrete (ACI 318-02) and Commentary (ACI 318R-02)

Structure of the Question paper
For the End Semester Examination the question paper will consist of 60% Design problems and 40 % Theory. There will be three questions from each module out of which two questions are to be answered by the students.
CSC 1003  Advanced Metal Structures

Structure of the Course
- Lecture : 3 hrs/ Week   Credits : 3
- Internal Continuous Assessment : 40 Marks
- End Semester Examination : 60 Marks

Course Objectives
- To familiarise the student with the advances in metal structures and designs procedures.

Learning Outcomes
- Application of plastic design philosophy
- Knowledge of the basis of codal provisions and design implications
- Introduction to steel-concrete composite structures and aluminium structures

Module I
Methods of Analysis- Elastic analysis (first order, second order), buckling analysis (linear, inelastic). Sources of non-linearity. First order plastic analysis, second order inelastic analysis. Plastic method of analysis - moment redistribution - static, kinematic and uniqueness theorems - Effect of axial and shear force on plastic moment capacity. Analysis of single and two bay portal frames, gable frames. Plastic design with LRFD concepts - Requirements for plastic design, advantages of plastic design - Plastic design of continuous beams and portal frames.

Module II

Industrial buildings: Layout - Sway and non-sway frames, bracings and bents - Rigid frame joints - Knees for rectangular frames and pitched roofs. Fabrication and Erection (Designs not expected)

Module III
Cold Formed Steel Members: Local and post buckling of thin elements - Behaviour under axial, bending and shear forces. (Designs not expected).

Steel – Concrete Composite structures – shear connectors – types of shear connectors – degrees of shear connections – partial and full shear connections – composite sections under positive and negative bending.

Aluminium Structures: Introduction – Stress-strain relationship – Permissible stresses – Design of Tension members, Compression members and Beams.

References
3. Wie-Wen Yu, Cold-Formed Steel Structures, McGraw Hill Book Company.
4. Lothers, Advanced Design in Steel, Prentice Hall, USA.
5. N. Subramanian, Design of Steel Structures, Oxford University Press.
Structure of the Question paper
For the End Semester Examination the question paper will consist of 60% Analysis/Design problems and 40 % Theory. There will be three questions from each module out of which two questions are to be answered by the students.
CSC 1004  Experimental Methods And Instrumentation

Structure of the Course

Lecture : 3 hrs/ Week                Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination         : 60 Marks

Course objectives

- Design experiments related to stress analysis problems
- Learn methodology for conducting laboratory and field experiments
- Analyse and interpret experimental observations and results

Learning outcomes

- Capability to provide suitable instrumentation for conducting experiments
- Acquire capacity to organize laboratory experiments for project and thesis works
- Building capacity to conduct destructive and nondestructive experiments as a practicing engineer

Module I

The measurement system: Purpose Structure and Elements - Characteristics of measurement system - Accuracy, Precision, Repeatability; Calibration – Standards and evaluation; Dynamic Characteristics – zero order, first order and second order instruments.
Measurement of Strain: Electrical resistance strain gauges - Gauge materials - gauge construction – gauge factor; Vibrating wire strain gauges ; strain gauge bridges – Potentiometric and Wheatstone bridge - sensitivity
Force transducers: Load cells different types – design of force transducers; Force balance pressure gauges – construction - sensitivity.
Measurement of displacement: Potentiometers – different types; Linear variable differential transformer – principle and working.

Module II

Photo elasticity- use of polarised light - Maxwell’s law - polariscopes and their use; Photoelastic model materials ; Two dimensional photo elasticity - analysis and reduction of data.
Moire fringe method- techniques and its use.

Module III

Non Destructive Testing Methods: Ultrasonic Methods; Hardness methods - Rebound Hammer ; Core sampling technique; Pullout experiment; Detection of embedded reinforcement .
Indicating & recording elements – Chart recorders – Cathode ray oscilloscope; Computer based data acquisition systems – structure and components.
Statistical Analysis - Errors in measurement - best estimate of true value Normal Distribution - Confidence level.
References

Structure of the Question paper
For the End Semester Examination the question paper will consist of 60% problems and 40 % theory. There will be three questions from each module out of which two questions are to be answered by the students.
CSC 1005   Theory of Elasticity

Structure of the Course

Lecture : 3 hrs/ Week          Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

• To understand the behaviour of linear elastic solids under loads
• Provide a firm foundation for more advanced courses, for research and practise in civil engineering fields
• To provide the student with various solution strategies while applying them to practical cases

Learning Outcomes

• Understand concepts, principles and governing equations in dealing with elastic solids
• Understand the methods for solving elastic boundary value problems
• To obtain skill and capability in civil engineering in analysing and solving problems

Module I

Analysis of stress and strain in 3D:
Strain tensor – Strain displacement relations for small deformations – Compatibility conditions – Strain transformations – Principal strains – Strain invariants.
Saint Venant’s principle. Uniqueness of Solution

Module II

Two dimensional problems in Rectangular coordinates:
Plane stress and plane strain problems – Airy’s stress function - Solution by polynomials – Bending of cantilever loaded at free end., Bending of simply supported beam with udl.
Two dimensional problems in polar coordinates:
General equations- Equilibrium equations, Strain displacement relations and Stress strain relations. Biharmonic equations and Airy’s stress functions.
Problems of axisymmetric stress distributions - Thick cylinders - Stress concentration due to circular hole in plates (Kirsch’s problem).

Module III

Torsion of prismatic bars:
Saint Venant’s Semi inverse and Prandtl’s stress function approach – Torsion of Straight bars – Elliptic and Equilateral triangular cross section. Torsion of thin walled open and closed tubes, Membrane Analogy
Plasticity: Basic concepts and yield criteria; Equations of plasticity, Theories of strength, Yield criteria, elasto-plastic analysis of torsion and bending problems.
References

Structure of the Question paper
For the End Semester Examination the question paper will consist of 60% problems and 40 % Theory. There will be three questions from each module out of which two questions are to be answered by the students.
CSC 1101 Structural Engineering and Computational Lab

Structure of the Course
Lab : 2 hrs/ Week                Credits : 1
Internal Continuous Assessment : 100 Marks

Course Objectives

- Practical training for conducting experiments related to structural engineering.
- Ability to solve stress analysis problems.
- Ability to write algorithms for problem solving.

Learning Outcomes

- Acquire capacity to organise experiments for project and thesis works.
- Capability to use finite element packages for stress analysis.
- Building capacity to write programs for problem solving.

Details of experiments:
1. Review of testing methods of cement, coarse aggregate and fine aggregate as per Indian Standards.
2. Design of concrete mixes as per Indian Standard
3. Study of behaviour of RCC beams
4. Study of behaviour of RCC columns.
5. Accelerated curing experiments for concrete.
7. Free vibration analysis of steel cantilever beams.
8. Non-destructive testing of concrete
   a) Rebound hammer
   b) Core cutting
   c) Ultrasonic pulse velocity
   d) Pullout test
   e) Detection of embedded reinforcements
9. Photo elastic studies using plane polariscope
10. Analysis of plates using software package.
11. Analysis of shells using software package.
13. Writing programs in any high level language for solving computational problems
CSC 1102 Seminar

Structure of the Course

Duration: 2 hrs/ Week Credits: 2
Continuous Assessment: 100 Marks

The student has to present a seminar in one of the current topics in the stream of specialisation. The student will undertake a detailed study based on current published papers, journals, books on the chosen subject, present the seminar and submit seminar report at the end of the semester.

Distribution of marks
Seminar Report Evaluation – 40 marks
Seminar Presentation – 60 marks
Structure of the Course

Lecture: 3 hrs/ Week  
Credits: 3  
Internal Continuous Assessment: 40 Marks  
End Semester Examination: 60 Marks

Course Objectives:

Thin walled structures in the form of plates and shells are encountered in many branches of technology. Such a widespread use of plate and shell structures arises from their intrinsic properties. So it is necessary to study the behaviour of the plates and shells with different geometry under various types of loads.

Learning Outcomes:

Understand the behaviour of plates and shells under different types of loads and come up with proper design methods.

Module I

Introduction-Assumptions in the theory of thin plates-Bending of long rectangular plates to a cylindrical surface. Pure bending of plates-Slope and curvature - Relations between bending moments and curvature - Particular cases of pure bending. Symmetrical bending of circular plates-Differential equation-Uniformly loaded circular plates with simply supported and fixed boundary conditions-Annular plate with uniform moments and shear forces along the boundaries

Module II


Module III

Deformation of shells without bending-definations and notation- Shells in the form of a surface of revolution, displacements-Membrane theory of cylindrical shells plates. General theory of cylindrical shells-A circular cylindrical shell loaded symmetrically with respect to its axis- stresses in cylindrical shell under dead and snow loads, symmetrical deformation. General case of deformation of a cylindrical shell- cylindrical shells with supported edges- Shells having the form of surface of revolution and loaded symmetrically with respect to their axis. Detailed analysis and design of cylindrical shells- hyperbolic shells- Hyperbolic paraboloid shells-Detailing of reinforcement in shells, edge beams and transfer beams.

References

Structure of the Question paper
For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students. Use of relevant IS codes may be permitted in the examination hall.
CSC 2002 Analysis and Design of Earthquake Resistant Structures

Structure of the Course

Lecture : 3 hrs/ Week Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

• To impart awareness about the effect of earthquakes on structures.
• To study IS code provisions for the analysis, design and detailing of earthquake resistant structures

Learning Outcomes

• Understand various aspects of earthquake engineering
• Capable of design and detailing of earthquake resistant structures
• Awareness about disaster management due to earthquakes.

Module I

Elements of earthquake engineering- characteristics of ground motion – earthquake intensity and magnitude- recording instruments -seismic zoning- earthquake effects on different types of structures- Effect of architectural features and structural irregularities- review of damages during past earthquakes

Module II

Principles and guidelines for earthquake resistant design of structures- Design lateral forces- Static analysis – Dynamic analysis- Shear walls

Module III

IS Code provision for design and detailing for earthquake resistance- reinforcement detailing for members and joints- design examples. Repair and rehabilitation of damaged structures- case studies- methods for disaster mitigation- Vulnerability assessment and seismic evaluation of structures – vulnerability reduction

Reference

Structure of the Question paper
For the End Semester Examination the question paper will consist of 60% Design or Analysis problems and 40% Theory. There will be three questions from each module out of which two questions are to be answered by the students.
Structure of the Course

Practical: 2 hrs/Week    Credits: 1
Internal Continuous Assessment: 100 Marks
No End Semester Examination

Course Objectives

• Ability to identify the response of structures subjected to dynamic loading
• Provide a firm foundation for research and practice in civil engineering
• Ability to solve dynamic problems numerically

Learning Outcomes

• Understand concepts and principles involved in structural dynamics
• To train the students to perform experimental work for project and thesis

Details of Experiments

1. Dynamics of a three storied building frame subjected to harmonic base motion
2. Dynamics of a single storied building frame with planar asymmetry subjected to harmonic base motion
3. Dynamics of a three storied building frame with planar asymmetry subjected to periodic (non-harmonic) base motion
4. Vibration isolation of a secondary system
5. Dynamics of a vibration absorber
6. Dynamics of a four storied building frame with and without an open ground floor
7. Dynamics of a single span and two span beams
8. Earthquake induced waves in rectangular water tanks (Demonstration only)
9. Dynamics of free standing rigid bodies under base motion (Demonstration only)
10. Seismic wave amplification, liquefaction and soil structure interaction. (Demonstration only)

Note: Results obtained from experiments may be numerically verified wherever possible.
CSC 2102 Thesis Preliminary Part - I

Structure of the Course

Hours/week: 2  Credits: 2

Internal Assessment: 100 Marks

For the Thesis-Preliminary part I the student is expected to start the preliminary background studies towards the Thesis by conducting a literature survey in the relevant field. He/she should broadly identify the area of the Thesis work, familiarize with the design and analysis tools required for the Thesis work and plan the experimental platform, if any, required for Thesis work. The student will submit a detailed report of these activities at the end of the semester.

**Distribution of marks**

Internal assessment of work by the guide: 50 marks

Internal evaluation by the committee: 50 marks
CSC 2103 Seminar

Structure of the Course
Duration: 2 hrs/ Week  Credits : 2
Continuous Assessment : 100 Marks

The student is expected to present a seminar in one of the current topics in the stream of specialisation. The student will undertake a detailed study based on current published papers, journals, books on the chosen subject, present the seminar and submit seminar report at the end of the semester.

Distribution of marks
Seminar Report Evaluation- 40 marks
Seminar Presentation – 60 marks
CSE 2001  Advanced Prestressed Concrete Design

Structure of the Course
Lecture: 3 hrs/ Week   Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Objectives

• To impart to students the knowledge of methods of prestressing, analysis and design of various prestressed concrete elements under relevant codal provisions

Learning Outcomes

• Understand and use suitably the different concepts of prestressing.
• Comprehend the design of various prestressed concrete members used in practice

Module I
Basic concepts and brief history of prestressing, advantages and limitations of prestressing, types of prestressing, prestressing systems and devices, concrete and steel used in prestressed concrete, losses in prestress, analysis of members under flexure, shear and torsion.

Module II
Design of axially loaded members, flexural members – Type I and Type II sections, limiting zone, design of end block, design for shear and torsion, calculation of deflection and crack width, detailing of reinforcement, design of one way and two way slabs, analysis and design of continuous beams.

Module III

References
3. Rajagopalan, N, Prestressed Concrete, Alpha Science, 2002
4. Ramaswamy G.S., Modern prestressed concrete design, Arnold Heinimen, New Delhi, 1990
6. IS 1343: 1980 Indian Standard Code of Practice for Prestressed Concrete
7. IS 456: 2000 Indian Standard Code of Practice for Plain and Reinforced Concrete

Structure of the Question paper
For the End Semester Examination the question paper will consist of 60% Design problems and 40% Theory. There will be three questions from each module, out of which two questions are to be answered by the students.
CSE 2002         Forensic Engineering

Structure of the Course
Lecture : 3 hrs/ Week                Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Module I

Module II
Diagnosis and assessment of deterioration, visual inspection, non destructive tests, ultrasonic pulse velocity method, rebound hammer method, pull out tests, Bremer test, Windsor probe test, crack detection techniques, etc.

Module III

References
2. Dovkaminetzky, Design and Construction Failures, Galgotia Publication., NewDelhi
3. Jacob Field and Kenneth L Carper, Structural Failures, Wiley Europe

Structure of the Question paper
For the end semester examination there will be three questions from each module out of which two questions are to be answered by the students.
CSE 2003  Structural Optimization

Structure of the Course
Lecture : 3 hrs/ Week                Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination         : 60 Marks

Course Objectives
• The ability to identify the importance of optimization in the engineering field
• Should be able to use optimization techniques for real life time applications
• Ability to apply optimization concepts for solving multi task applications

Learning Outcomes
• Understand various optimization methods
• Understand capabilities of optimization programmes
• Understand, Analyse various techniques and apply them for real time applications

Module I
Problem formulation with examples- Single Variable Unconstrained Optimization Techniques – Optimality Criteria - Interpolation methods - Gradient Based methods

Module II
Multi Variable Unconstrained Optimization Techniques – Optimality Criteria.
Unidirectional Search - Direct Search methods - Simplex method - Gradient based methods - Constrained Optimization Techniques – Classical methods - Linear programming problem

Module III
Indirect methods- Direct methods Specialized Optimization techniques- Dynamic programming, Geometric programming, Genetic Algorithms.

References
2. Deb, K., Optimisation for Engineering Design – Algorithms and examples, Prentice Hall.

Structure of the Question paper
For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students.
Structure of the Course

Lecture : 3 hrs/ Week              Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination       : 60 Marks

Course Objectives

• To provide an understanding of fundamental knowledge and technique of FEM
• To develop tools to analyse engineering problems using FEM and typical commercial FEA package.

Learning Outcomes

• Will be able to analyse and build FEA model for various engineering problems.
• Can be extended to the dynamic analysis of structures

Module I

Module II
Element properties- Displacement functions- convergence requirements- equilibrium and compatibility in the solution- Development of equilibrium equation- Types of finite elements- Development of shape functions for truss, beam and frame elements- CST, LST- Lagrange and Serendipity elements - Plane stress and plane strain problems- Gauss quadrature technique- Development of stiffness matrix for truss and beam elements.

Module III
Development of consistent nodal load vector- patch test- static condensation- Concept of isoparametric formulation- Line element- Plane bilinear element- Subparametric and superparametric elements- Assembly procedure and storage techniques of stiffness matrix, Application of boundary conditions- Solution techniques of equilibrium equation- Introduction to plate and shell elements- Types of 3D elements- Discussion of finite element packages.

References
Structure of the question paper
For the end semester examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students.
Structure of the Course

Lecture: 3 hrs/ Week      Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Objectives:
Composite materials are finding immense application in the field of aerospace, automobile and Civil engineering presently due to its outstanding material capability. It is required for the present structural engineers to know the fundamentals of composite material for designing composite structures in various fields.

Learning Outcomes:

• An ability to identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.
• A basic understanding of linear elasticity with emphasis on the difference between isotropic and anisotropic material behavior.
• An ability to predict the failure strength of a laminated composite plate.
• An ability to use the ideas developed in the analysis of composites towards using composites in aerospace design.

Module I


Module II


Module III

Bending, Buckling and Vibrations of Laminated Beams and Plates - Governing equations and boundary conditions, Solution techniques, deflection of composite beams and plates under transverse loads for different boundary conditions, buckling of laminated beams and plates under in-plane loads, vibration of laminated beams and plates under different boundary conditions.

References
3. Calcote, L. R., Analysis of Laminated Composite structures, Van Nostrand, 1969


**Structure of the Question paper**
For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students.
Structure of the Course

Lecture : 3 hrs/ Week                Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination         : 60 Marks

Course Objectives

• Ability to identify the soil-structure interaction
• Ability to select suitable foundation for different types of structures
• Should be able to analyse and design substructures

Learning Outcomes

• Basic understanding of type and selection of foundations
• To analyse and design foundations

Module I

Introduction to soil-structure interaction - Soil-structure interaction problems. Contact pressure
distribution beneath rigid and flexible footings on sand and clay - Contact pressure distribution
beneath raft. Selection of foundations. Structural design of spread footing, combined Footing and raft
foundation.

Module II

Pile foundation: Introduction - Estimation of pile capacity by static and dynamic formulae-
Settlement of single pile - Laterally loaded piles - Brom’s method - Ultimate lateral resistance of piles -
Pile groups - Consideration regarding spacing - Efficiency of pile groups – Pile Cap-Structural Design
of Pile and pile cap

Module III

Retaining Walls -Types - Stability analysis of cantilever retaining walls against overturning and
sliding-Bearing capacity considerations- Structural design of retaining walls
Introduction to well foundations – Elements of well foundations – Types – Sinking stresses in wells –
Design of well cap, Well steining, well curb, cutting edge and bottom plug

References

   Ltd., 2012

Structure of the Question paper

For the End Semester Examination the question paper will consist of three questions from each module
out of which two questions have to be answered by the students.
Structure of the Course

Hours/week: 15  Credits: 5

Continuous Assessment: 200 Marks

The Thesis Preliminary Part -II is an extension of Thesis Preliminary Part I. Thesis Preliminary Part II comprises of preliminary thesis work, two seminars and submission of thesis –preliminary report. The first seminar would highlight the topic, objectives and methodology and the second seminar will be a presentation of the work they have completed till the third semester and the scope of the work which is to be accomplished in the fourth semester, mentioning the expected results.

Distribution of marks

Internal assessment of work by the guide: 100 marks

Internal evaluation by the committee: 100 marks
CSE 3001                        High Rise Structures

Structure of the Course
Lecture : 3 hrs/ Week                Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination         : 60 Marks

Course Objectives

• The ability to identify the structural systems for various combinations of gravity and horizontal loading considering their functional use and heights.
• Should be able to analyse the behaviour and drift capacities of various high rise structural forms

Learning Outcomes

• Understand behaviour of common high rise structures under gravity and lateral loading
• Understand the drift capabilities of different structural forms

Module I

Module II
Structural form, Floor systems, Rigid frame Structures- rigid frame behaviour –approximate determination of member forces by gravity loading- two cycle moment distribution, approximate determination of member forces by lateral loading- Portal method, Cantilever method, approximate analysis of drift, Braced frames- Types of bracings-behaviour of bracings-behaviour of braced bents-method of member force analysis-method of drift analysis, Infilled frames- behaviour of infilled frames-stresses in infill-forces in frame- design of infill- design of frame- horizontal deflection.

Module III
Shear wall Structures-behaviour of shear wall structures-proportionate wall systems, non proportionate wall systems- horizontal deflection, Coupled shear walls-behaviour of coupled wall structures-method of analysis, Wall frame structures- behaviour of wall frames, Tubular structures-framed tube structures-bundled tube structures-braced tube structures, Core structures, Outtrigger-Braced Structures, Foundations for tall structures-pile foundation-mat foundation, Modelling for analysis for high rise structures – approximate analysis, accurate analysis and reduction techniques, Discussion of various Finite Element Packages for the analysis of High Rise Structures

References
5. ATC40- Seismic evaluation and retrofitting of concrete buildings, Seismic safety commission, California 1996.

Structure of the Question paper
For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students.
CSE 3002  Engineering Applications of Artificial Intelligence and Expert Systems

Structure of the Course
Lecture: 3 hrs/ Week                Credits : 3
Internal Continuous Assessment :  40 Marks
End Semester Examination :       60 Marks

Course Objectives
• Introduces the different algorithms that can be applied in Artificial Intelligence.
• Impart an idea about how these algorithms can be used to solve the Civil Engineering problems

Learning Outcomes
• Students become aware of expert systems for knowledge representation, neural networks for knowledge organization and search techniques for knowledge manipulation.

Module I

Module II

Module III

References
4. Winston, Artificial Intelligence, Addison-Wesley, 1992

Structure of the Question paper
For the end semester examination there will be three questions from each module out of which two questions are to be answered by the students.
CSE 3003    Random Vibration

Structure of the Course

Lecture : 3 hrs/ Week                Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination         : 60 Marks

Course objectives

• Study of statistical concepts in vibration analysis
• Learn behaviour of structures subjected to random vibration

Learning outcomes

• Capability to solve random vibration problems
• Acquire basic knowledge in nonlinear random vibration analysis

Module I
Probability Theory – Random variables, Probability distribution and density functions –
Expected value mean, variance, conditional probability, characteristic functions, Chebyshev inequality, functions of random variable

Module II
Random process - concepts of stationary and ergodicity – nonstationary process – auto and
cross correlation and covariance functions – Mean square limit, differentiability and integrability –
Spectral decomposition, power spectral and cross spectral density functions – Wiener Khintchine
relation - Properties of Guassian, Poisson and Markov process. Broad band and narrow band random
process – white noise

Module III
Random vibration - response of linear SDOF and MDOF systems to stationary and
nonstationary random excitation. Response of continuous systems – normal mode method-Nonlinear
random vibration - Markov vector – equivalent linearisation and perturbation methods - Level
crossing, peak and envelope statistics – First excursion and fatigue failures - Applications

References

Structure of the Question paper
For the End Semester Examination the question paper will consist of 60% problems and 40 % theory.
There will be three questions from each module out of which two questions are to be answered by the students.
CSE 3004    Stability of Structures

Structure of the Course
Lecture : 3 hrs/ Week                   Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• Provides students a strong background in buckling phenomenon, buckling in columns, beam columns, frames, plates and shells
• Gives an idea of situations where the different structures are susceptible to buckling

Learning Outcomes
• Students become aware of the actual situations where stability becomes a governing factor

Module I
Large Deformation Theory for Columns. The Behaviour of Imperfect Columns. Eccentrically Loaded Column. Inelastic Buckling of Columns- Double Modulus Theory- Tangent Modulus Theory

Module II
Buckling of Built up Columns, Non-prismatic members- Effect of shear on critical Loads
Torsional Buckling. Torsional and Torsional – Flexural Buckling of Columns, Lateral Buckling of Beams. Continuous beams with axial load.

Module III
Stability of a frame by Matrix Analysis
Buckling of Plates – Differential Equation of Plate Buckling – Critical Load of a plate uniformly compressed in one direction. Tension field behavior in Plate Girder Webs Postbuckling behavior of axially compressed plates. Instability of shells

References
Structure of the Question paper
For the end semester examination there will be three questions from each module out of which two questions are to be answered by the students.
CSE 3005  Structural Reliability

Structure of the Course
Lecture: 3 hrs/ Week                Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination         : 60 Marks

Course Objectives

• Should be able to identify the uncertainty in structural systems
• Ability to extend reliability analysis concepts from structural elements to structural systems

Learning Outcomes

• Understand reliability concept and reliability indices
• Analyse structural systems using reliability method

Module I
General introduction to structural safety and reliability, Concept of uncertainty in reliability based analysis and design, Random variables- Concept and definition, Probability axioms and probability functions, Conditional probability, Common probability density and distribution functions and its descriptors, Correlation between random variables.

Module II
Joint probability distributions, Functions of random variables- Expectation and moments of functions of random variables, Concept of failure of a structure, Reduced variable space and basic definition of reliability index, First order second moment index, Hasofer-Lind reliability index, Rackwitz - Fiessler reliability index. Second order reliability method.

Module III
System reliability, Simulation techniques in reliability estimation, Importance sampling / Variation reduction techniques, Time variant reliability- (introduction alone)

References

Structure of the Question paper
There will be three questions from each module out of which two questions are to be answered by the students.
CSE 3006 Fracture Mechanics

Structure of the Course
Lecture : 3 hrs/ Week                Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• Introduce Fracture Mechanics and its applications to Structural Engineering students
Learning Outcomes
• Understand fracture mechanics which has wide applications in Structural Engineering.

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

Module II

Module III

References

Structure of the Question paper
For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students.
Structure of the Course

Hours/week: 21   Credits: 12

Continuous Assessment: 300 Marks

End Semester Examination: 300 Marks

The student has to continue the Thesis work done in second and third semesters. There would be an interim presentation at the first half of the semester to evaluate the progress of the work and at the end of the semester there would be a Pre-Submission seminar before the Evaluation committee for assessing the quality and quantum of work. This would be the qualifying exercise for the students for getting approval from the Department Committee for the submission of Thesis. At least once technical paper is to be prepared for possible publication in Journals/Conferences. The final evaluation of the Thesis would be conducted by the board of examiners constituted by the University including the guide and the external examiner.

Distribution of marks

Internal evaluation of the Thesis work by the guide: 150 marks

Internal evaluation of the Thesis by the Evaluation Committee: 150 marks

Final evaluation of the Thesis Work by the Internal and External Examiners:

[Evaluation of Thesis: 200 marks + Viva Voce: 100 marks (5% of the marks is earmarked for publication in Journal/Conference)] – 300 marks
Structure of the course

Lecture: 3hrs/Week  
Credits: 3  
Internal continuous assessment: 40 marks  
End semester Examination: 60 marks

Course Objectives

• To understand the theory and design methods of various forms of bridges.

Learning Outcomes

• Students should be able to select a particular form of bridge to suit the requirements and analyse, design the same.

Module I

Classification and components of bridge. Review of road and railway bridge specifications and IRC provisions.  
Foundation and substructure: Types of foundations, Piers and abutments- Forces on piers and abutments, Design of piers and abutments, bed blocks.  
Bearings: Concrete, steel and neoprene bearings, Design of elastomeric pad bearings.

Module II

Bridge decks-Grid analysis- Courbons method-Orthotropic plate theory.  
R. C. Bridges: Design of R. C bridge decks-slab bridges- Design of T beam bridges and balanced cantilever bridges. Introduction to – continuous girder bridges, box girder bridges, rigid frame bridges and arch bridges.

Module III

Pre-stressed Concrete Bridges: Design of single span bridges- Introduction to various forms- Slab bridges-girder bridges-box girder bridges-Steel bridges: Design of plate girder and Pratt truss bridges, Introduction to suspension bridges and cable stayed bridges.

References

2. Vazirani V. N., Design of Concrete Bridges, Khanna publishers, 2004  

Structure of the Question paper

For the end Semester Examination the question paper will consist of 60% design problems and 40% theory. There will be three questions from each module out of which two questions are to be answered by the students.
CSI 3001 Finite Element Analysis

Structure of the Course

Lecture: 3 hrs/Week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination: 60 Marks

Course Objectives

- To provide an understanding of fundamental knowledge and technique of FEM
- To develop tools to analyse engineering problems using FEM and typical commercial FEA package.

Learning Outcomes

- Will be able to analyse and build FEA model for various engineering problems.
- Can be extended to the dynamic analysis of structures

Module I


Module II

Element properties- Displacement functions- convergence requirements- equilibrium and compatibility in the solution- Development of equilibrium equation- Types of finite elements- Development of shape functions for truss, beam and frame elements- CST, LST- Lagrange and Serendipity elements- Plane stress and plane strain problems- Gauss quadrature technique- Development of stiffness matrix for truss and beam elements.

Module III

Development of consistent nodal load vector- patch test- static condensation- Concept of isoparametric formulation- Line element- Plane bilinear element- Subparametric and superparametric elements- Assembly procedure and storage techniques of stiffness matrix, Application of boundary conditions- Solution techniques of equilibrium equation- Introduction to plate and shell elements- Types of 3D elements- Discussion of finite element packages.

References

Structure of the question paper
For the end semester examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students.
CSI 3002  Mechanics of Composites

Structure of the Course
Lecture : 3 hrs/ Week       Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives:
Composite materials are finding immense application in the field of aerospace, automobile and Civil engineering presently due to its outstanding material capability. It is required for the present structural engineers to know the fundamentals of composite material for designing composite structures in various fields.

Learning Outcomes:

- An ability to identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.
- A basic understanding of linear elasticity with emphasis on the difference between isotropic and anisotropic material behavior.
- An ability to predict the failure strength of a laminated composite plate.
- An ability to use the ideas developed in the analysis of composites towards using composites in aerospace design.

Module I
Introduction. Composite Fundamentals: Definition of composites, Objectives, constituents and Classification of composites based on size (macro, micro, nano);structure (multilayered and multiphase); fibre architecture- linear, 2D, 3D, nd , matrix material (PMC,MMC,CMC, CC). General Characteristics of reinforcement- classification, terminology used in fibre science, General fibres-Glass, carbon, aramid, polyethylene, boron. Polymer matrix composites- Thermoplastics and thermostetting resins; mechanical properties, glass transition. Carbon fibre/epoxy, carbon fibre/PEEK, glass fibre/polyester, phenolic, epoxy, polyimide, cyanate ester composites. Concept of A stage, B stage and C stage. Structural applications of Composite Materials, Manufacturing Processes.

Module II

Module III
References
3. Calcote, L. R., Analysis of Laminated Composite structures, Van Nostrand, 1969

Structure of the Question paper
For the End Semester Examination the question paper will consist of three questions from each module out of which two questions are to be answered by the students.