# PONDICHERRY ENGINEERING COLLEGE, PUDUCHERRY – 605 014

## CURRICULUM AND SYLLABI FOR AUTONOMOUS STREAM

### M.TECH. (STRUCTURAL ENGINEERING) COURSES

*(FOR STUDENTS ADMITTED FROM ACADEMIC YEAR 2015-16 ONWARDS)*

## CURRICULUM

### I SEMESTER

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject Code</th>
<th>Subject Category</th>
<th>Periods</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA152</td>
<td>Applied Mathematics</td>
<td>TY</td>
<td>3 1 0</td>
<td>40 60 100</td>
<td>4</td>
</tr>
<tr>
<td>CE160</td>
<td>Theory of Elasticity And Plasticity</td>
<td>TY</td>
<td>3 1 0</td>
<td>40 60 100</td>
<td>4</td>
</tr>
<tr>
<td>CE161</td>
<td>Advanced Concrete Design</td>
<td>TY</td>
<td>3 1 0</td>
<td>40 60 100</td>
<td>4</td>
</tr>
<tr>
<td>CE162</td>
<td>Seismic Design of Structures</td>
<td>TCM</td>
<td>3 - 2</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>-</td>
<td>Elective – I</td>
<td>TY</td>
<td>- - -</td>
<td>40 60 100</td>
<td>4</td>
</tr>
<tr>
<td>-</td>
<td>Elective – II</td>
<td>TY</td>
<td>- - -</td>
<td>40 60 100</td>
<td>4</td>
</tr>
<tr>
<td>CE163</td>
<td>Structural Engineering Laboratory</td>
<td>LB</td>
<td>0 0 3</td>
<td>60 40 100</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>26</strong></td>
</tr>
</tbody>
</table>

### II SEMESTER

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject Code</th>
<th>Subject Category</th>
<th>Periods</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE164</td>
<td>Finite Element Methods</td>
<td>TCM</td>
<td>3 0 2</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>CE165</td>
<td>Design of Steel Structures</td>
<td>TY</td>
<td>3 1 0</td>
<td>40 60 100</td>
<td>4</td>
</tr>
<tr>
<td>-</td>
<td>Elective III</td>
<td>TY</td>
<td>- - -</td>
<td>40 60 100</td>
<td>4</td>
</tr>
<tr>
<td>-</td>
<td>Elective IV</td>
<td>TY</td>
<td>- - -</td>
<td>40 60 100</td>
<td>4</td>
</tr>
<tr>
<td>-</td>
<td>Elective V</td>
<td>TY</td>
<td>- - -</td>
<td>40 60 100</td>
<td>4</td>
</tr>
<tr>
<td>-</td>
<td>Elective VI</td>
<td>TY</td>
<td>- - -</td>
<td>40 60 100</td>
<td>4</td>
</tr>
<tr>
<td>CE166</td>
<td>CAD in Structural Engineering</td>
<td>LB</td>
<td>0 0 3</td>
<td>60 40 100</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>26</strong></td>
</tr>
</tbody>
</table>
### III SEMESTER

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Name of the Subjects</th>
<th>Category</th>
<th>Periods</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE157</td>
<td>Research Methodology</td>
<td>PR</td>
<td>0 0 3</td>
<td>100 - 100</td>
<td>1</td>
</tr>
<tr>
<td>CE167</td>
<td>Project Phase - I</td>
<td>PR</td>
<td>0 0 24</td>
<td>150 150 300</td>
<td>9</td>
</tr>
<tr>
<td>-</td>
<td>Professional Development Course®</td>
<td>PR</td>
<td>- - -</td>
<td>100 - 100</td>
<td>-</td>
</tr>
</tbody>
</table>

Total Credits 10

Note: ⊗ Students may start satisfying this requirement (refer para: 6.10) even during the first year. However, the assessment will be made in the fourth semester only.

### IV SEMESTER

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Name of the Subjects</th>
<th>Category</th>
<th>Periods</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE168</td>
<td>Project Phase - II</td>
<td>PR</td>
<td>0 0 36</td>
<td>200 200 400</td>
<td>14</td>
</tr>
<tr>
<td>-</td>
<td>Professional Development Course</td>
<td>PR</td>
<td>- - -</td>
<td>100 - 100</td>
<td>2</td>
</tr>
</tbody>
</table>

Total Credits 16

# CA – Continuous Assessment, SE – Semester Examination, TM – Total Marks

* TY – Theory, TCM – Theory with a Mini Project, LB – Laboratory, PR – Practice
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE69</td>
<td>Stability of Structures</td>
<td>TY</td>
</tr>
<tr>
<td>CEE70</td>
<td>Design of Shell Structures</td>
<td>TY</td>
</tr>
<tr>
<td>CEE71</td>
<td>Design of Bridges</td>
<td>TY</td>
</tr>
<tr>
<td>CEE72</td>
<td>Theory of Plates</td>
<td>TY</td>
</tr>
<tr>
<td>CEE73</td>
<td>Prestressed Concrete Structures</td>
<td>TY</td>
</tr>
<tr>
<td>CEE74</td>
<td>Structural Health Monitoring</td>
<td>TY</td>
</tr>
<tr>
<td>CEE75</td>
<td>Design and Construction of Prefabricated Structures</td>
<td>TY</td>
</tr>
<tr>
<td>CEE76</td>
<td>Design of Steel Concrete Composite Structures</td>
<td>TY</td>
</tr>
<tr>
<td>CEE77</td>
<td>Advanced Concrete Technology</td>
<td>TY</td>
</tr>
<tr>
<td>CEE78</td>
<td>Structural Dynamics</td>
<td>TY</td>
</tr>
<tr>
<td>CEE79</td>
<td>Design of Machine Foundations</td>
<td>TY</td>
</tr>
<tr>
<td>CEE80</td>
<td>Structural Design of Infrastructure Facilities</td>
<td>TY</td>
</tr>
<tr>
<td>CEE81</td>
<td>Optimum Design of Structures</td>
<td>TY</td>
</tr>
<tr>
<td>CEE82</td>
<td>Offshore Structures</td>
<td>TY</td>
</tr>
<tr>
<td>CEE83</td>
<td>Experimental Techniques and Instrumentation</td>
<td>TY</td>
</tr>
<tr>
<td>CEE84</td>
<td>Design of Industrial Structures</td>
<td>TY</td>
</tr>
<tr>
<td>CEE85</td>
<td>Design of Sub Structures</td>
<td>TY</td>
</tr>
<tr>
<td>CEE86</td>
<td>Safety Practices in Construction</td>
<td>TY</td>
</tr>
<tr>
<td>CEE87</td>
<td>Disaster Resistant Structures</td>
<td>TY</td>
</tr>
<tr>
<td>CEE88</td>
<td>Matrix Methods of Structural Analysis</td>
<td>TY</td>
</tr>
</tbody>
</table>
SYLLABUS (Core Subjects)
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA152</td>
<td>Applied Mathematics</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

**Prerequisite**

- To acquaint with the calculus of variations.
- Special functions
- Tensor Analysis

**Objectives**

- Understands functional and variational problems
- Enable to find series solutions of Bessels and Legendre equations
- Application of Bessel function and Tensor analysis

**Outcome**

- Understands functional and variational problems
- Enable to find series solutions of Bessels and Legendre equations
- Application of Bessel function and Tensor analysis

**UNIT – I**

Calculus of Variations


**UNIT – II**

Bessel Functions

Series solution of Bessel equations (Frobenius method) – Bessel functions – Recurrence formula – Generating function – Bessel integral – Jacobi series – Practical applications of Bessel function.

**UNIT – III**

Legendre Polynomials


**UNIT – IV**

Tensor Analysis


**UNIT – V**

Differentiation of Tensors

Symmetric and skew – Symmetric tensors – Metric, conjugate or reciprocal, Associative tensors – Christoffel symbols – Derivatives of the fundamental tensors – Transform of Christoffel symbols – Covariant derivative of vectors – Curl of a covariant and divergence of a contravariant vectors – Covariant differentiation of covariant and contravariant tensors.

**Reference Books:**

Department: Civil Engineering  
Programme: M.Tech. Structural Engineering

Semester: One  
Category: TY

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE160</td>
<td>Theory of Elasticity and Plasticity</td>
<td>3 L 1 T 0 P 4 C 40 CA 60 SE 100 TM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Prerequisite

Objectives

- Impart knowledge on the general features of elastic systems.
- To understand the concept of 3D stress, strain analysis and its applications to simple problems.

Outcome

- Students will have the ability to understand the transformation of stress and strain in a 3-Dimensional field and solve the plane stress and plane strain problems.

UNIT – I  
Introduction  
Hours: 9

Basic concepts of deformation of bodies - Notations of stress and strain in 3D field - Transformation of stress and strain in a 3D field - Equilibrium equations in 2D and 3D Cartesian coordinates.

UNIT – II  
Elasticity Solution  
Hours: 9

Plane stress and plane strain problems - 2D problems in Cartesian coordinates as applied to beam bending using Airy’s stress function - Problems in 2D - Polar coordinate - Equations of equilibrium and compatibility.

UNIT – III  
Curved Beams  
Hours: 9

Curved beam bending - Stress concentration in holes - Circular disc subjected to diametral compressive loading - Semi-infinite solid subjected to different types of loads.

UNIT – IV  
Torsion of Non-Circular Sections  
Hours: 9

Torsion of non-circular sections - St. Venant’s theory - Torsion of elliptical sections - Torsion of triangular sections - Prandtl’s membrane analogy - Torsion of rolled profiles - Stress concentration around re-entrant corners - Torsion of thin walled tubes-Stress concentration

UNIT – V  
Plasticity  
Hours: 9

Introduction - Plastic stress strain relations - Different hardening rules - Yield criteria for metals - Graphical representation of yield criteria - Application to thin and thick cylinders under internal pressure.

Total Contact Hours: 45  
Total Tutorials: 15  
Total Practical Class:  
Total Hours: 60

Reference Books:
**Department** : Civil Engineering  
**Programme**: M.Tech. (Structural Engineering)  
**Semester**: One  
**Category**: TY

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>CE161</td>
<td>Advanced Concrete Design</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Prerequisite**

- To understand the design of special RCC structures in civil engineering, by using the basic concepts of design of RCC structural elements as per Indian standards.

**Objective**

- By the end of the course, students shall be able
- To describe the field of reinforced concrete engineering, its challenges and possibilities.
- To develop understanding of RC structural elements under axial, bending and combined forces.

**UNIT – I**  
**Introduction**  
***Hours : 9***

Stress-strain characteristics of concrete under multi - Axial stresses- Confined concrete- Effect of cyclic loading on concrete and reinforcing steel - Ultimate Deformation and ductility of members with flexure - Strength and deformation of members with tension - Control of deflections - Strut and Tie Models - Developments - Design methodology.

**UNIT – II**  
**Design Philosophy**  
***Hours : 9***


**UNIT – III**  
**Serviceability Limit States**  
***Hours : 9***

Serviceability limit states: estimation of deflections and crack widths in RC members.

**UNIT – IV**  
**Special RC Members**  
***Hours : 9***

Behaviour and design of special RC member - deep beams, walls, including shear walls, ribbed slabs, corbels, pile caps.

**UNIT – V**  
**Analysis of RC Members**  
***Hours : 9***

Limit analysis of RC members: moment redistribution in continuous beams.

**Total Contact Hours : 45**  
**Total Tutorials : 15**  
**Total Practical Class**  
**Total Hours : 60**

**Reference Books**

**Department:** Civil Engineering  
**Programme:** M.Tech. Structural Engineering

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE162</td>
<td>Seismic Design of Structures</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

**Prerequisite**
- To introduce the basics of Earthquake Engineering and how they influence the structural design.
- To introduce the engineering seismology, building characteristics, structural irregularities, do’s and don’ts in earthquake engineering design.

**Objectives**
- Students will be able to understand the basics of Earthquake Engineering and how they influence the structural design.

**UNIT – I Engineering seismology**

**UNIT – II Design Concepts**
- Seismic design concepts – EQ load on simple buildings – Load path – Floor and roof diaphragms – Seismic resistant building architecture – Plan configuration – Vertical configuration – Pounding effects – Mass and stiffness irregularities – Torsion in structural system

**UNIT – III Moment Resisting Frames**
- Provision of seismic code (IS1893 & IS 13920) – Building systems – Frames – Shear wall – Braced frames – Layout design of Moment Resisting Frames (MRF) – Ductility of MRF – Infill walls – Non-structural elements

**UNIT – IV Analysis and Design**
- Calculation of EQ load – 3D modelling of building systems and analysis (theory only) Design and detailing of frames, shear wall, and frame walls

**UNIT – V Cyclic Loading Behaviour**
- Cyclic loading behaviour of RC steel and pre-stressed concrete elements - Modern concepts – Base isolation – Adaptive systems – Case studies

**Reference Books:**
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>CE163</td>
<td>Structural Engineering Laboratory</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

**Prerequisite**

- To impart knowledge on behavior of Modulus of elasticity of concrete, Non-destructive testing techniques.
- Procedure involved in testing large scale beams
- Usage of Mechanical and electrical strain gauges in real time testing.

**Objectives**

- Students will have knowledge in behaviour of RC beams and utilisation of strain gauges, NDT equipments.

**Outcome**

Utilization of mechanical and electrical resistance strain gauges, NDT equipments, load cell, Data acquisition systems – Study on the behaviour of under and over reinforced concrete beams – Study on the behaviour of beams under shear – Study on the behaviour of steel beams under flexure.

**Total Contact Hours:** 45  
**Total Tutorials:**  
**Total Practical Class:** 45  
**Total Hours:** 45
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE164</td>
<td>Finite Element Methods</td>
<td>L 3 T 0 P 2</td>
<td>C 4</td>
<td>CA 50 SE 50 TM 100</td>
</tr>
</tbody>
</table>

**Prerequisite**

- To gain basic knowledge in modeling of structures using finite element Methods
- To understand the concepts of developing finite elements and FE packages

**Objectives**

- An ability to generate the shape functions of various elements used in FE packages and understand the assembly and solution techniques.

**Outcome**

**UNIT – I Introduction**

Differential equilibrium equations - strain displacement relation - linear constitutive relation - special cases - Principle of stationary potential energy - application to finite element methods.

**UNIT – II Element Formulation**


**UNIT – III Stress Analysis and 2D - Elements**

Two dimensional isoparametric elements - Four noded quadrilateral elements – triangular elements- Computation of stiffness matrix for isoparametric elements - Numerical integration (Gauss quadrature) - Convergence criteria for isoparametric elements.

Assemblage of elements – Direct stiffness method- Special characteristics of stiffness matrix- Boundary condition & reaction - Gauss elimination and LDT decomposition- Basic steps in finite element analysis.

Analysis of framed Structures- 2D truss element - 2D beam element. Analysis of plate bending: - displacement functions - plate bending Elements – Introduction to finite element analysis softwares

**Practices**

1. Analysis of a beam using 1-D beam elements
2. Analysis of a Truss using 1-D Truss elements
3. Analysis of beams using 2D elements
4. Analysis of a plate with and without hole
5. Analysis of a retaining walls using plane strain elements
6. Thick cylinders subjected to pressures
7. Analysis of rectangular plates
8. Analysis of irregular plates
9. Analysis of a rectangular water tank
10. Analysis of a circular water tank

**Total Contact Hours : 45**

**Total Tutorials :**

**Total Practical Class : 30**

**Total Hours : 75**

**Reference Books:**

### Design of Steel Structures

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE165</td>
<td>Design of Steel Structures</td>
<td>3 1 0 4</td>
<td>40 60 100 60</td>
<td></td>
</tr>
</tbody>
</table>

#### Prerequisite
- To analyse the few important steel structures
- To understand the codal provisions for design of various steel structures.

#### Outcome
- At the end of the course the students would develop confidence and adequate capability in simple practical design.

### UNIT – I
Design of Structural Elements
- Design of members subjected to lateral loads and axial loads, Sway and non-sway frames, Design of Purlins, Louver rails, Gable column and Gable wind girder, Design of Moment Resisting Base Plates.

### UNIT – II
Design of Connections

### UNIT – III
Analysis and Design of Towers & Chimneys

### UNIT – IV
Plastic Analysis of Structures

### UNIT – V
Design of Light Gauge Steel Structures

Total Contact Hours : 45  Total Tutorials : 15  Total Practical Class :  Total Hours : 60

### Reference Books:
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE166</td>
<td>CAD in Structural Engineering</td>
<td>0 0 3 2</td>
<td>60 40 100</td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**
- To impart knowledge on use of Structural Engineering software for analysis of structures

**Objectives**
- An ability to generate the shape functions of various elements used in FE packages and understand the assembly and solution techniques.

**Outcome**
- Use of softwares STADD Pro, SAP 2000N, ETABS and ANSYS.
  1. Introduction to pre, post processors and analysers
  2. Analysis of space truss
  3. Analysis of space frame
  4. Analysis of different floor/roof plans for calculation of centre of stiffness and centre of mass.
  5. Analysis of symmetrical buildings using response spectrum method
  6. Analysis of unsymmetrical buildings using ELCENTRO seismic record.
  7. Analysis of rectangular plate with hole at centre.
  8. Analysis of rectangular beams using solid elements
  9. Analysis of frames with infills/shear walls.
  10. Introduction to pushover analysis and progressive collapse analysis.

**Total Contact Hours :** 45  **Total Tutorials :** 45  **Total Practical Class :** 45  **Total Hours :** 45
<table>
<thead>
<tr>
<th>Subject code</th>
<th>Subject</th>
<th>Hours/week</th>
<th>Credit</th>
<th>Maximum marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE157</td>
<td>Research Methodology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prerequisite</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Objectives**
- To educate students to methods of selection of research problems
- To expose students to different research methods

**Outcomes**
- Students will be capable to identify and narrow down to the area of research on the basis of the requirements of industrial and global requirements
- Students will exhibit the domain skill to choose suitable research methods to execute research effectively
- Students will possess knowledge to further their academic program, namely, Ph.D program.


**Characteristics of research:** Various functions that describe characteristics of research such as systematic, valid, verifiable, empirical and critical approach.

**Types of research:** Pure and applied research. Descriptive and explanatory research. Qualitative and quantitative approaches.

**Research procedure:** Formulating the Research Problem, Literature Review, Developing the objectives, Preparing the research design including sample. Design, Sample size.

**Considerations in selecting research problem:** Relevance, interest, available data, choice of data, Analysis of data, Generalization and interpretation of analysis.

**Outcome of research:** Significance of report writing – Layouts of the research report – Types of reports – Oral presentation – Mechanics of writing research report – Precautions for writing research reports – Plagiarism and copy right violation – Patent writing and filing.

**Total contact hours:** -  
**Total tutorials:** -  
**Total practical classes:** 15  
**Total hours:** 15

**Reference books:**
1. Dawson, Catherine, Practical Research Methods, UBS Publishers and Distributors, New Delhi, 2002
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE167</td>
<td>Project Phase - I</td>
<td>L 0</td>
<td>T 0</td>
<td>P 24</td>
</tr>
</tbody>
</table>

**Description:** The project work will start in semester III and the duration would be six months. Project phase –I includes introduction including objectives, limitations of study, Literature Survey, background to the research, Problem statement and methodology of work, Theoretical contents associated with topic of research, Field Applications, case studies, Data collection from field/organizations or details of experimental work/analytical work. The evaluation of the dissertation will be as per the regulations.
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>CE168</td>
<td>Project Phase - II</td>
<td>0</td>
<td>0</td>
<td>36</td>
</tr>
</tbody>
</table>

**Description**

It is the continuation of the Project phase-I. It includes a detailed experimental work/analytical work, results and discussion, conclusions and future research work. The project is to be submitted at the end of fourth semester. The evaluation of the dissertation will be as per the regulations. The findings/outcome of the dissertation work shall be published in standard journals/symposia etc. Publication may be completed before the viva-voce examination.
SYLLABUS (Elective Subjects)
Department: Civil Engineering  
Programme: M.Tech. Structural Engineering  

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE69</td>
<td>Stability of Structures</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>4</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>4</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prerequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>To learn different formulation principles such as Energy principle, Rayleigh-Ritz method, Galerkin Method etc</td>
</tr>
<tr>
<td>To deal with stability problems in structural forms and systems.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>By the end of this course, students can be able to</td>
</tr>
<tr>
<td>Analyze stability of structural systems with various boundary conditions and loads.</td>
</tr>
<tr>
<td>Use approximate methods to compute critical elastic buckling loads.</td>
</tr>
<tr>
<td>Better understanding of stability problems in structural forms and systems.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT – I</th>
<th>Buckling of columns</th>
<th>Hours: 12</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>UNIT – II</th>
<th>Energy principle</th>
<th>Hours: 12</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>UNIT – III</th>
<th>Beams and Beam columns</th>
<th>Hours: 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction – lateral buckling of beams – Beam column with concentrated and distributed loads – effect of axial load on bending stiffness</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT – IV</th>
<th>Buckling of frames</th>
<th>Hours: 12</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>UNIT – V</th>
<th>Buckling of plates</th>
<th>Hours: 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Differential equation of plate buckling – Critical load on plates for various boundary conditions – Energy method – Finite difference method – Shear deformation of plates.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Contact Hours: 60</th>
<th>Total Tutorials:</th>
<th>Total Practical Class:</th>
<th>Total Hours: 60</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reference Books

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE70</td>
<td>Design of Shell Structures</td>
<td>L 3</td>
<td>T 1</td>
<td>P 0</td>
</tr>
</tbody>
</table>

**Prerequisite**

- To present the foundations of the classical theory of shells.
- To understand the limitations and differences of shell theories within context of the theory of elasticity.

**Objectives**

- By the end of the course, students can
  - Apply the theory of shells in engineering designs.
  - Enrich research capability in shells.

**UNIT – I**

- **Introduction**
  Classification of shells - types of shells - Structural action - shells of revolution & shells of translation - examples - membrane theory - limitation of membrane theory
  
  **Hours : 9**

**UNIT – II**

- **Flexural Theory**
  Flexure theory - Design of cylindrical shell by D.K.J. Method - other theories of analysis - use of ASCE manual for the design of cylindrical shells - prestressing of shells
  
  **Hours : 9**

**UNIT – III**

- **Cylindrical Shells and Folded Plates**
  
  **Hours : 9**

**UNIT – IV**

- **Doubly Curved Shells**
  Bending theory of doubly curved shells - Hyperbolic parabolic shells subjected to external loads and gravity loads - shells of revolution.
  
  **Hours : 9**

**UNIT – V**

- **Buckling of RC Roof Shells and Pyramids**
  Slenderness of beams – Circular shells – Buckling strength of supporting members – Softwares for analysis – Design of pyramid roofs.
  
  **Hours : 9**

**Total Contact Hours : 45**

**Total Tutorials : 15**

**Total Practical Class :**

**Total Hours : 60**

**Reference Books:**

Department: Civil Engineering  
Programme: M.Tech. Structural Engineering

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE71</td>
<td>Design of Bridges</td>
<td>3 1 0 4</td>
<td>40 60 100</td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**

- To study the loads, forces on bridges and design of several types of bridges.

**Objectives**

- At the end of the course, the student is able to select the type of bridge, design and its construction.

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

**UNIT – II**  
Loads on Bridges  
Indian Road Congress (IRC) bridge codes - dimensions - dead and live loads - impact effect - wind and seismic forces - longitudinal and centrifugal forces - hydraulic forces - earth pressure - temperature effect and secondary stresses.

**UNIT – III**  
Slab and T-Beam Bridges  

**UNIT – IV**  
Long Span Bridges  

**UNIT – V**  
Bearings and Substructure  

**Total Contact Hours:** 45  
**Total Tutorials:** 15  
**Total Practical Class:**  
**Total Hours:** 60

**Reference Books:**

**Department**: Civil Engineering  
**Programme**: M.Tech. Structural Engineering  

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE72</td>
<td>Theory of Plates</td>
<td>L 3  T 1  P 0  C 4</td>
<td>CA 40  SE 60  TM 100</td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**

- To study the behaviour and analysis of thin plates and the behaviour of Anisotropic and thick plates.

**Objectives**

- The students will gain knowledge in approximate methods of plate analysis.
- The students will gain knowledge in orthotropic and moderately thick plates.

**Outcome**

- The students will gain knowledge in approximate methods of plate analysis.
- The students will gain knowledge in orthotropic and moderately thick plates.

**UNIT – I**  
**Introduction to Plate Theory**  
**Hours**: 9  
Thin Plates with small deflection - Laterally loaded thin plates, governing differential equation, various boundary conditions.

**UNIT – II**  
**Rectangular Plates**  
**Hours**: 9  
Rectangular plates - Simply supported rectangular plates, Navier solution and Levy’s method, Rectangular plates with various edge conditions, plates on elastic foundation.

**UNIT – III**  
**Circular Plates**  
**Hours**: 9  
Symmetrical bending of circular plates - uniformly loaded circular plates, circular plates with circular hole at the centre, circular plates concentrically loaded at the centre.

**UNIT – IV**  
**Approximate Methods**  
**Hours**: 9  
Energy methods, Finite difference and Finite element methods.

**UNIT – V**  
**Anisotropic Plates and Thick Plates**  
**Hours**: 9  
Orthotropic plates and grids, moderately thick plates.

**Total Contact Hours**: 45  
**Total Tutorials**: 15  
**Total Practical Class**:  
**Total Hours**: 60

**Reference Books**:

Department: Civil Engineering  
Programme: M.Tech. Structural Engineering  

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
<th>CA</th>
<th>SE</th>
<th>TM</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE73</td>
<td>Prestressed Concrete Structures</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**

- To make the students understand the basic concept of pre stressed concrete structures.
- To analyse a few important pre stressed concrete elements
- To understand the various codal provisions for the design of prestressed concrete structures.

**Objectives**

- Gain knowledge of the behaviour of structure under prestressing, advantage of prestress, systems, losses and deflection due to prestressing of concrete members.

**Outcome**

- Limit state of collapse against flexure, shear, and torsion - limit state of serviceability - Limit State design of partially prestressed concrete beams - Crack widths in Prestressed concrete members.

**UNIT – I**  
Analysis of Prestressed Concrete Members  
**Hours : 9**

**UNIT – II**  
Statically Indeterminate Structures  
**Hours : 9**

**UNIT – III**  
Composite Sections  
**Hours : 9**

**UNIT – IV**  
Prestressed Concrete Bridges  
**Hours : 9**

**UNIT – V**  
Miscellaneous Structures  
**Hours : 9**

**Total Contact Hours : 45**  
**Total Tutorials : 15**  
**Total Practical Class**  
**Total Hours : 60**

**Reference Books:**

Subject Code: CEE74
Subject: Structural Health Monitoring

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
<th>CA</th>
<th>SE</th>
<th>TM</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
</tbody>
</table>

**Prerequisite:**
- To gain basic knowledge of concepts and techniques in structural health monitoring

**Objective:**
- Student will be able to apply the health monitoring concepts to civil engineering structures

**UNIT – I: Structural Modelling and Finite Element Models**


**UNIT – II: Signals, Systems, Sensors and Data Acquisition Systems**


Sensors for Health Monitoring Systems: Acoustic emission sensors, ultrasonic sensors, piezoceramic sensors and actuators, fibre optic sensors and laser shearography techniques, imaging techniques.

**UNIT – III: Monitoring Systems**


Integrated Health Monitoring Systems: Intelligent Health Monitoring Techniques, Neural network classification techniques, extraction of features from measurements, training and simulation techniques, connectionist algorithms for anomaly detection, multiple damage detection, and case studies.

**UNIT – IV: Information Technology for Health Monitoring**

Information Technology for Health Monitoring: Information gathering, signal analysis, information storage, archival, retrieval, security; wireless communication, telemetry, real time remote monitoring, network protocols, data analysis and interpretation.

**UNIT – V: Project Based Health Monitoring Techniques**

Project Based Health Monitoring Techniques: Health monitoring techniques based on case studies, practical aspects of testing large bridges for structural assessment, optimal placement of sensors, structural integrity of aging multistory buildings, condition monitoring of other types of structures.

**Total Contact Hours:** 60
**Total Tutorials:**
**Total Practical Class:**
**Total Hours:** 60

**Reference Books:**
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE75</td>
<td>Design and Construction of Prefabricated Structures</td>
<td>L 3 T 1 P 0</td>
<td>C 4</td>
<td>CA 40 SE 60 TM 100</td>
</tr>
</tbody>
</table>

**Prerequisite**
- To familiarize the design of basic elements in precast construction.
- To familiarize the students with various prefabrication construction techniques adopted in practice.

**Objectives**
- Student should able to design precast elements and be able to execute the construction sequence in a project with precast elements.

**Outcome**

### UNIT – I Materials in Precast Structures
- Materials, admixtures, pigments
- Modular co-ordination, standardization and tolerances-system of prefabrication.
- Pre-cast concrete manufacturing techniques, Moulds—construction design, maintenance and repair.

### UNIT – II Precast Construction Techniques
- Pre-casting techniques - Planning, analysis and design considerations
- Handling techniques - Transportation Storage and erection of structures.
- Curing techniques including accelerated curing such as steam curing, hot air blowing, etc

### UNIT – III Precast Concrete Floors and Beams
- Simplified frame analysis
- Precast concrete flooring options, flooring arrangements, structural design of individual units, design of composite floors, Composite and non-composite reinforced beams

### UNIT – IV Precast Concrete Columns and Connections
- Precast concrete columns and their design. Basic mechanism of joints and connections, compression joints, shear joints, tension joints. Connections-pin jointed and moment resisting connections.

### UNIT – V Application of Prefabricated Structures
- Pre-cast and pre-fabricating technology for low cost and mass housing schemes. Small pre-cast products like door frames, shutters, Ferro-cement in housing - Water tank service core unit.

**Total Contact Hours : 45**
**Total Tutorials : 15**
**Total Practical Class :**
**Total Hours : 60**

**Reference Books:**
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE76</td>
<td>Design of Steel Concrete Composite Structures</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Prerequisite**

- To introduce the concept of advanced steel design and composite construction and their applications in engineering.
- To discuss shear connector types, degree of shear connector, interaction and their strength.

**Objectives**

- Students will be able to understand concept of design of steel concrete composite structures and their applications in engineering.

**Outcome**

**UNIT – I**


**UNIT – II**


**UNIT – III**

Introduction – Composite slabs – profiled sheeting – sheeting parallel to span – sheeting perpendicular to span – analysis and design of composite floor system.

**UNIT – IV**

Types of Composite columns – design of encased columns – design of in-filled columns – axial, uni-axial and bi-axially loaded columns.

**UNIT – V**

Case studies on steel concrete composite construction in buildings. Seismic behaviour of composite structures – Steel concrete steel sandwich construction.

**Total Contact Hours : 45**

**Total Tutorials : 15**

**Total Practical Class :**

**Total Hours : 60**

**Reference Books:**

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE77</td>
<td>Advanced Concrete Technology</td>
<td>4 0 0 4 40 60 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**
- Should be able to understand the Engineering properties of materials, Cement, Aggregates, Admixtures
- Understand the hydration mechanism of Cement & properties of fresh and Hardened concrete

**Objectives**
- To understand causes of deterioration and related tests on concrete.
- To be aware of the application of advanced techniques in the field of advanced concrete.

**Outcome**
- To understand causes of deterioration and related tests on concrete.
- To be aware of the application of advanced techniques in the field of advanced concrete.

**UNIT – I**  
**Introduction**  
Hours: 12


**UNIT – II**  
**Durability**  
Hours: 12


**UNIT – III**  
**Concrete Deterioration**  
Hours: 12

Classification of causes of concrete deterioration – Permeability of concrete – Chloride penetration – Acid attack - Sulphate attack – Alkali-aggregate reaction – Concrete in sea water – AC impedance test - Corrosion of embedded steel in concrete – Case histories.

**UNIT – IV**  
**Non-Destructive Testing**  
Hours: 12


**UNIT – V**  
**Special Concrete and Concreting Methods**  
Hours: 12

Concreting under special circumstances – Special materials in construction – Concreting machinery and equipments – Future trends in concrete technology.

Total Contact Hours: 60  
Total Tutorials:  
Total Practical Class:  
Total Hours: 60

**Reference Books:**
3. A.R. Santhakumar, Concrete Technology” Oxford University Press, 2006
# Subject: Structural Dynamics

**Department:** Civil Engineering  
**Programme:** M.Tech. Structural Engineering  
**Semester:** First  
**Category:** TY

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE78</td>
<td>Structural Dynamics</td>
<td>3 1 0 4 40 60 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite:**
- To introduce the students the principles and methods of dynamic analysis of structures and to prepare them for designing the structures for wind, earthquake and other dynamic loads.

**Objectives:**
- After undergoing this course, students will have
  - Knowledge in concepts of dynamic systems
  - Ability to identify, formulate and solve dynamic response of SDOF
  - Ability to identify, formulate and solve dynamic response of MDOF

**Outcome:**
- Equations of motion by equilibrium and energy methods, free and forced vibration of single degree of freedom systems, effect of damping, transmissibility.
- Equations of motion of two degree of freedom systems, normal modes of vibration, applications.
- Multidegree of freedom systems, orthogonality of normal modes, approximate methods. Mode superposition technique, numerical integration procedure.
- Idealisation and formulation of mathematical models for wind, earthquake, blast and impact loading, aerodynamics, gust phenomenon, principles of analysis.

**UNIT – I**
**Principles of Vibration Analysis**  
**Hours:** 9

**UNIT – II**
**Two Degree of Freedom Systems**  
**Hours:** 9

**UNIT – III**
**Dynamic Analysis of MDOF**  
**Hours:** 9

**UNIT – IV**
**Dynamic Analysis of Continuous Systems**  
**Hours:** 9

**UNIT – V**
**Practical Applications**  
**Hours:** 9

**Total Contact Hours:** 45  
**Total Tutorials:** 15  
**Total Practical Class:** 60

**Reference Books:**
Department: Civil Engineering  
Programme: M.Tech. Structural Engineering

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE79</td>
<td>Design of Machine Foundations</td>
<td>3 L, 1 T, 0 P</td>
<td>4 C</td>
<td>40 CA, 60 SE, 100 TM</td>
</tr>
</tbody>
</table>

**Prerequisite**

**Objectives**
- To provide the student the basic concept of soil dynamics
- Introduce the students the concept of analysis and design foundations subjected to dynamic loads.
- To introduce the techniques to resolve problems associated with machine foundations.

**Outcome**
- To understand the basics of dynamics – dynamic behaviour of soils – effects of dynamic forces and the various design methods.

**UNIT – I**  
**Theory of Vibration**  
Introduction, nature of dynamic loads free vibrations of spring mass systems, forced vibrations viscous damping, principles of vibration measuring equipments.

**UNIT – II**  
**Dynamic Soil Properties and Behaviour**  
Dynamic properties of soils: Elastic properties of soils, coefficient of elastic uniform and non-uniform compression and shear, effect of vibration on the dissipative properties of soils, determination of dynamic properties of soils, Codal provisions.

**UNIT – III**  
**Foundations of Reciprocating Machines**  

**UNIT – IV**  
**Foundation for Impact and Rotary Machines**  

**UNIT – V**  
**Vibration Control**  
Vibration isolation, passive and active isolation, use of springs and springs and damping materials, construction aspects of machine foundations.

**Total Contact Hours:** 45  
**Total Tutorials:** 15  
**Total Practical Class:**  
**Total Hours:** 60

**Reference Books:**
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE80</td>
<td>Structural Design of Infrastructure Facilities</td>
<td>L 4 T 0 P 0 C 4 CA 40 SE 60 TM 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**

- To get exposed to the special requirements to be considered in the design of environmental structures and their detailed design incorporating codal requirements.

**Objectives**

- At the end of the course students get exposed to the special requirements to be considered in the design of environmental structures and their detailed design incorporating codal requirements.

**UNIT – I**  
**Design of Pipes**  
Structural Design of Concrete, Prestressed Concrete, Steel and cast iron piping mains.

**UNIT – II**  
**Analysis and Design of Water Tanks**  

**UNIT – III**  
**Special Structures**  
Design of Special purpose structures - Underground reservoirs and swimming pools, intake towers, structural design including foundation of water retaining structures such as settling tanks, clarifloculators, aeration tanks, Imhoff tanks.

**UNIT – IV**  
**Repair and Rehabilitation of Structures**  
Diagonising the cause and damage, identification of different types of structural and non structural cracks - Repair and rehabilitation methods for masonry, concrete and steel structures.

**UNIT – V**  
**Sewerage Works**  
Design of Steel, Lattice Structures used in water and sewerage works, Protection methods of both RC and Steel structures.

Total Contact Hours: 60  
Total Tutorials:  
Total Practical Class:  
Total Hours: 60

**Reference Books:**

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE81</td>
<td>Optimum Design of Structures</td>
<td>4 0 0 4 40 60 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**
- To study optimization techniques and their application to structural design.
- To bring about an understanding of application of optimization techniques structural design problems
- To know about computer application to optimization

**Objectives**
- By the end of the course, students will have the ability
  - To use the optimization tools for the design of structures effectively
  - To use the major conventional and modern optimization methods

**Outcome**

**UNIT – I** Introduction  
Basic concepts of minimum weight, minimum cost design, objective function, constraints, classical methods.

**UNIT – II** Optimization Techniques And Algorithms  
Linear, Integer, quadratic, dynamic and Geometric programming methods for optimal design of structural elements.

**UNIT – III** Computer Search Methods  
Linear programming methods for plastic design of frames, computer search methods for univariate and multivariate Minimization.

**UNIT – IV** Optimization Theorems  
Optimization by structural theorems, Maxwell, Mitchell and Heyman's theorems for trusses and frames, fully stressed design with deflection constraints, optimality criterion methods.

**UNIT – V** Game Theory  
Strategies and their properties - Pure and mixed strategies, Two person zero games, Minimax Maximin, saddle point, value of game - Rule of Dominance - Graphical solution.

**Reference Books:**
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE82</td>
<td>Offshore Structures</td>
<td>L 3 T 1 P 0 C 4 CA 40 SE 60 TM 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**
- To get exposed to special features of offshore structures like geometry, forces encountered, structural modeling for design purpose together with their design.
- To develop the knowledge of wave generalized process and wave theories
- To understand the forces on offshore structure

**Objectives**
- Student will be familiarized with the terminology and fundamental concepts of planning designing offshore structures.

**Outcome**
- Wave generation process, small and finite amplitude wave theories.
- Wind forces, wind forces on vertical, inclined cylinders, structures – current forces and use of Morrison equation.
- Different type of offshore structures, foundation modeling, structural modeling.
- Static methods of analysis, foundation analysis and dynamics of offshore structures.
- Design of platforms, helipads, jacket tower and mooring cables and pipelines - Corrosion and Fatigue Failure.

**UNIT – I**
- **Wave Theories**
  - Hours : 9

**UNIT – II**
- **Forces on Offshore Structures**
  - Hours : 9

**UNIT – III**
- **Offshore Soil and Structure Modelling**
  - Hours : 9

**UNIT – IV**
- **Analysis of Offshore Structures**
  - Hours : 9

**UNIT – V**
- **Design of Offshore Structures**
  - Hours : 9

**Total Contact Hours**: 45  **Total Tutorials**: 15  **Total Practical Class**:  |  **Total Hours**: 60

**Reference Books**:
**Department:** Civil Engineering  
**Programme:** M.Tech. Structural Engineering  

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE83</td>
<td>Experimental Techniques and Instrumentation</td>
<td>4 0 0 4 40 60</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**

**Objectives**
- Provide training in the more advanced contemporary techniques of strain, displacement and motion measurement.
- In-depth consideration is given to the device as well as associated data acquisition.

**Outcome**
- Students get training in the more advanced contemporary techniques of strain, displacement and motion measurement.

**UNIT – I**  
**Force and Strain Measurements**  
Hours: 12

Strain gauges, principle, types, performance and uses - Electrical resistance strain gauges - Gauge sensitivity - gauge factor - Simple strain gauge circuits - application - Photo elasticity, principle and applications Isoclinics - Isochromatics - Hydraulic jacks and pressure gauges load cells - Proving Rings - Calibration of testing Machines.

**UNIT – II**  
**Vibration Measurements**  
Hours: 12

Characteristics of structural vibrations - Linear variable differential transformer (LVDT) - Transducers for velocity and acceleration measurements - Vibration meter - Seismographs - Vibration analyzer Electro Dynamic Exciters - Display and recording of signals Oscilloscope - XY Plotters - Strip Chart recorders - Digital data Acquisition systems - principles and applications.

**UNIT – III**  
**Acoustics and Wind Flow Measurements**  
Hours: 12

Pressure transducer - sound level meter - Wind tunnel and its use in structural analysis - structural modeling - direct and indirect model analysis application to structural problems Testing of Transmission line towers.

**UNIT – IV**  
**Distress Measurements**  
Hours: 12

Diagnosis of distress in structures - crack observation and measurement Cracking due to corrosion of reinforcement in concrete construction and use - Damage assessment - controlled blasting for demolition.

**UNIT – V**  
**Non Destructive Testing Methods**  
Hours: 12

Load testing of structures, Buildings, bridges - Rebound Hammer Ultrasonic Testing, Principles and applications - Moire fringes coatings - holography - use of Lasers for structural testing.

**Total Contact Hours:** 60  
**Total Tutorials:**  
**Total Practical Class:**  
**Total Hours:** 60

**Reference Books:**
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>CEE84</td>
<td>Design of Industrial Structures</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Prerequisite**

**Objectives**
- To understand the planning aspects of industrial structures.
- To understand the design principles of industrial structures.

**Outcome**
- The students would become confident in design of practical industrial design problems.

**UNIT – I**  Planning and Functional Requirements  

**UNIT – II**  Industrial Buildings  

**UNIT – III**  Power Plant Structures  
Types of power plants – Design of Turbo generator foundation – containment structures.

**UNIT – IV**  Power Transmission Structures  

**UNIT – V**  Auxilliary Structures  
Chimneys and cooling Towers – Bunkers and Silos – Pipe supporting structures.

**Total Contact Hours : 45**  
**Total Tutorials : 15**  
**Total Practical Class :**  
**Total Hours : 60**

**Reference Books:**
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE85</td>
<td>Design of Sub Structures</td>
<td>3 1 0 4 40 60 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**

- To introduce the students to the concept of design of substructures.
- To introduce the various construction techniques in design of substructures.

**Objectives**

- To understand the basics of design and construction of underground structures.

**Outcome**

- To understand the basics of design and construction of underground structures.

**UNIT – I**  
**Sub Surface Exploration**  
Hours: 9

Purpose – Programme and Procedures – Interpretation of bore logs, soil data and exploration reports.

**UNIT – II**  
**Shallow Foundation**  
Hours: 9


**UNIT – III**  
**Deep Foundations**  
Hours: 9

Types of Piles and their applications – Load capacity – Settlements – Group action – Design of piles and pile caps – Lateral load capacity of piles.

**UNIT – IV**  
**Foundation For Miscellaneous Structures**  
Hours: 9


**UNIT – V**  
**Machine Foundations**  
Hours: 9

Types – General requirements and design criteria – General analysis of machine foundations – soil system – Stiffness and damping parameters – Tests for design parameters – Guide lines for design of reciprocating engines, impact type machines, rotary type machines, framed foundations.

**Total Contact Hours:** 45  
**Total Tutorials:** 15  
**Total Practical Class:** 45  
**Total Hours:** 60

**Reference Books:**

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
<th>CA</th>
<th>SE</th>
<th>TM</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE86</td>
<td>Safety Practices in Construction</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**

**Objectives**
- To study and understand the various safety concepts and requirements applied to construction projects.
- To study of construction accidents, safety programmes, contractual obligations
- To study safety procedures to be followed for various construction activities

**Outcome**
- On completion of this course the students will be able to know various constructions safety concepts and safety procedures

**UNIT – I**  
**Accidents and Related Law**  
Hours : 12

**UNIT – II**  
**Safety Procedures**  
Hours : 12

**UNIT – III**  
**Safety Methods**  
Hours : 12
Total loss control and damage control-Safety sampling- Safety audit - Safety equipment -Planning and site preparation- Safety system of storing construction materials - Excavation – Blasting – Timbering –Scaffolding - Safe use of ladders.

**UNIT – IV**  
**Safety Equipments**  
Hours : 12

**UNIT – V**  
**Safety Workers and Managements**  
Hours : 12

Total Contact Hours : 60  
Total Tutorials : -  
Total Practical Class : -  
Total Hours : 60

**Reference Books:**
Department: Civil Engineering  
Programme: M.Tech. Structural Engineering  
Semester:  
Category: TY  

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE87</td>
<td>Disaster Resistant Structures</td>
<td>4 0 0 4</td>
<td>40</td>
<td>60 100</td>
</tr>
</tbody>
</table>

Prerequisite

Objectives
- To get an exposure to types of disaster and understand the concept behind the design of disaster resistant structures.

Outcome
- To understand philosophy for design of structures resistant to earthquake, cyclone and flood.
- To know the basic concepts related to disaster managements and urban and semi urban laws.
- To apply methods of testing evaluation strengthening of dams, bridges and buildings.

UNIT – I  
Behaviour of Life Line Structures  
Hours : 12

Design philosophy to resist flood, cyclone, and earthquake and fire disasters - National and International Codes of practice - By-laws of urban and semi urban areas - Past history and lessons from disasters - Approach to traditional and Modern Structures - Concept of life period based Design - case studies.

UNIT – II  
Community Structures  
Hours : 12

Safety analysis and rating - Reliability assessment repairs and Retrofitting techniques of Community Structures - Protection of Nuclear Structures, dams, bridges and buildings.

UNIT – III  
Techniques of Damage Assessment  
Hours : 12

Damage surveys - Maintenance and modification to improve hazard resistance - Application GIS in disaster management – Foundation improvement techniques.

UNIT – IV  
Materials, Design and Detailing  
Hours : 12

Modern Materials for disasters reduction - Detailing aspects of structures subject to probable disasters - Construction techniques – Analysis methodology - Techniques for optimal performance - Provisions for artificial disasters - Blast and impact.

UNIT – V  
Rehabilitation and Retrofitting  
Hours : 12

Testing and evaluation - Classification according to safety level – Methods and materials for strengthening for different disasters - Qualification test.

Total Contact Hours : 60  
Total Tutorials : -  
Total Practical Class : -  
Total Hours : 60

Reference Books:
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE88</td>
<td>Matrix Methods of Structural Analysis</td>
<td>L 3 T 1 P 0 C 4 CA 40 SE 60 TM 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**

- To know the matrix analysis of rigid frames, semi-rigid frames and pin-jointed frames.

**Objectives**

- The student is able to form matrix to analyses of the structures for finding the displacements and redundant forces.

**UNIT – I**

**Introduction to Flexibility method**


**UNIT – II**

**Analysis of Structures by Flexibility method**

Matrix flexibility method Analysis of pin–jointed frames – effects due to lack of fit and temperature changes. Application to beams and frames – Direct flexibility approach.

**UNIT – III**

**Introduction to Stiffness method**

Matrix stiffness method – Transformation of displacements – Elements stiffness to system stiffness – Application to continuous beams – effects of support settlements and elastic supports.

**UNIT – IV**

**Analysis of Structures by Stiffness method**

Matrix stiffness method — Application to pin-jointed plane frames - support settlements – lack of fit and temperature effect. Analysis of three dimensional pinned frames.

**UNIT – V**

**Solution Techniques**

Special analysis techniques – Condensation, Sub structuring – reanalysis techniques – transfer matrix method. Analysis of frames with semi rigid connections.

**Total Contact Hours**: 45  
**Total Tutorials**: 15  
**Total Practical Class**:  
**Total Hours**: 60

**Reference Books**: