B.Tech. Degree

in

CIVIL ENGINEERING

CURRICULUM DETAILS
(For students admitted in 2019 to 2023)

DEPARTMENT OF CIVIL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI – 620015
TAMIL NADU, INDIA
INSTITUTE VISION
To be a university globally trusted for technical excellence where learning and research integrate to sustain society and industry.

INSTITUTE MISSION
1. To offer undergraduate, postgraduate, doctoral and modular programmes in multi-disciplinary / inter-disciplinary and emerging areas.
2. To create a converging learning environment to serve a dynamically evolving society.
3. To promote innovation for sustainable solutions by forging global collaborations with academia and industry in cutting-edge research.
4. To be an intellectual ecosystem where human capabilities can develop holistically.

DEPARTMENT VISION
Shaping infrastructure development with societal focus

DEPARTMENT MISSION
Achieve International Recognition by:
1. Developing Professional Civil Engineers
2. Offering Continuing Education
3. Interacting with Industry with emphasis on R&D

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)
1. Graduates of the Programme will contribute to the development of infrastructure that is sustainable.
2. Graduates of the Programme, as part of an organization or as Entrepreneurs, will continue to learn to harness evolving technologies.
3. Graduates of the Programme will be professional Civil Engineers with ethical and societal responsibility.
PROGRAMME OUTCOMES (POs)

Graduates of the Civil Engineering Programme will be able to:

a. Apply the knowledge of mathematics, science, engineering fundamentals, and Civil Engineering principles to the solution of complex problems in Civil Engineering.

b. Identify, formulate, research literature, and analyse complex Civil Engineering problems reaching substantiated conclusions using first principles of mathematics and engineering sciences.

c. Design solutions for complex Civil Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions related to Civil Engineering problems.

e. Create, select, and apply appropriate techniques, resources, and modern engineering tools such as CAD, FEM and GIS including prediction and modelling to complex Civil Engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional Civil Engineering practice.

g. Understand the impact of the professional Civil Engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the Civil Engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communicate effectively on complex Civil Engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage Civil Engineering projects and in multidisciplinary environments.

l. Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Graduates of the Civil Engineering Programme will have the

1. Ability to implement infrastructure development using sustainable technologies and materials.

2. Capacity to work as part of multidisciplinary teams or as Entrepreneurs in applying modern tools which are constantly evolving.

3. Integrity to be professional Civil Engineers with ethical and societal responsibility
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>CO</th>
<th>Course outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEPC10</td>
<td>Engineering Mechanics</td>
<td>CO1</td>
<td>Can estimate the system of forces, free-body diagrams, law of mechanics, Lami’s theorem</td>
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<td>CO2</td>
<td>Will be able to arrive sectional properties such as centroid, centre of gravity, area moment of Inertia, mass moment of inertia</td>
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<td>CO3</td>
<td>Will be able to estimate the Frictional forces, laws of friction at different planes</td>
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<td>CO4</td>
<td>Able to analyse simple stresses, strains and elastic constants</td>
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<td>CO5</td>
<td>Better understanding of trusses by method of joints, principles of dynamics, vibration of simple systems</td>
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<tr>
<td>CEPC11</td>
<td>Mechanics of Solids</td>
<td>CO1</td>
<td>Determine the strength parameters of the materials and solve principal stress and principal plane problem</td>
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<td>CO2</td>
<td>Determine shear force, bending moment, bending and shear stress distribution</td>
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<td>CO3</td>
<td>Determine deflection of a beam for various loading conditions and also trusses</td>
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<td>CO4</td>
<td>Analyze members subjected to torsion</td>
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<td>CO5</td>
<td>Visualize the behavior of column for combined bending and axial loading</td>
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<tr>
<td>CEPC12</td>
<td>Hydraulics and Fluid</td>
<td>CO1</td>
<td>Understands the basic principles of fluid mechanics.</td>
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<td>Machinery</td>
<td>CO2</td>
<td>Understands the concepts of statics and dynamics of fluid flow.</td>
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<td></td>
<td>CO3</td>
<td>Develops skills in analyzing fluid flows through the proper use of modeling and the application of the basic fluid flow principles.</td>
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<td>CO4</td>
<td>Acquire knowledge in the selection of type of turbine required with reference to available head of water and also used for Identification of type of turbine with estimated specific speed.</td>
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<td></td>
<td>CO5</td>
<td>Capable of estimating efficiency of different pumps and performance of the pumps with the study of characteristics curves.</td>
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<tr>
<td>CEPC 13</td>
<td>Strength of Materials</td>
<td>CO1</td>
<td>Determine the strength parameters of the materials</td>
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<td></td>
<td>CO2</td>
<td>Solve principal stress and principal plane problem</td>
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<td>CO3</td>
<td>Apply various methods of analysis of plane truss</td>
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<td>CO4</td>
<td>Determine shear force, bending moment, bending and shear stress distribution</td>
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<td>CO5</td>
<td>Analyze members subjected to torsion</td>
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<tr>
<td>CEPC13</td>
<td>Concrete Technology</td>
<td>CO1</td>
<td>Test all the concrete materials as per IS code</td>
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<td>CO2</td>
<td>Design the concrete mix using ACI and IS code methods</td>
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<td>CO3</td>
<td>Determine the properties of fresh and hardened of concrete</td>
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<td>CO4</td>
<td>Ensure quality control while testing/ sampling and acceptance criteria</td>
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<td>CO5</td>
<td>Design special concretes and their specific applications</td>
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<tr>
<td>CEPC14</td>
<td>Surveying</td>
<td>CO1</td>
<td>To plan a survey, taking accurate measurements, field booking, plotting and adjustment of traverse can be understood through leveling, plane table surveying etc.</td>
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<tr>
<td>Course code</td>
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<td>CO2</td>
<td>Understanding of fundamental function, use of Theodolite and tacheometry in practical applications such as road alignment, height of building, control point setting etc, with respect to utility and precision through the use of Theodolite, tacheometry.</td>
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<td>CO3</td>
<td>To understand the concepts of geodetic surveying in plan a large scale survey</td>
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<td>CO4</td>
<td>To use the principles of curve, building setting and understand the importance of advances surveying measurement techniques in civil engineering applications.</td>
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<tr>
<td>CEPC15</td>
<td>Analysis of Indeterminate Structures</td>
<td>CO1</td>
<td>Analyse the basic indeterminate beams such as Propped cantilevers, Continuous and Fixed Beams</td>
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<td>CO2</td>
<td>Use various classical methods for analysis of indeterminate structures</td>
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<td>CO3</td>
<td>Determine the effect of support settlements for indeterminate structures</td>
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<td>CO4</td>
<td>Apply the concepts of ILD and moving loads on determinate structures</td>
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<td>CO5</td>
<td>Apply approximate methods to analyse multistorey plane frames</td>
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<tr>
<td>CEPC16</td>
<td>Geotechnical Engineering - I</td>
<td>CO1</td>
<td>Understand the importance of geotechnical engineering in civil engineering and do proper soil classification and the phase system to solve problems</td>
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<td>CO2</td>
<td>Solve any practice problems related to soil stresses estimation, permeability, seepage including flow net diagram.</td>
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<td>CO3</td>
<td>Do proper stress estimation under any system of foundation loads</td>
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<td>CO4</td>
<td>Estimate appropriate soil strength parameters with respect to the drainage conditions</td>
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<td>CO5</td>
<td>Solve any practical problems related to consolidation like consolidation settlement, time rate of settlement</td>
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<tr>
<td>CEPC17</td>
<td>Environmental Engineering - I</td>
<td>CO1</td>
<td>Analyse various water quality parameters</td>
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<td>CO2</td>
<td>Forecast the population and estimate water demand</td>
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<td>CO3</td>
<td>Differentiate various intake structures and select suitable pipe material for water conveyance</td>
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<td>CO4</td>
<td>Design various water treatment units and distribution network</td>
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<td>CO5</td>
<td>General environment hygiene, food safety, rodents and vectors, disease control and sanitation</td>
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<tr>
<td>CEPC18</td>
<td>Environmental Engineering - II</td>
<td>CO1</td>
<td>Determine the various characteristics of sewage</td>
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<td>CO2</td>
<td>Design various sewage treatment units</td>
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<td>CO3</td>
<td>Predict the quality of water in river, using mass balance approach and specific models</td>
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<td>CO4</td>
<td>Select suitable treatment units for specific industries</td>
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<td>CO5</td>
<td>Identify the sources of air pollutants, effects on human health and the environment</td>
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<tr>
<td>CEPC19</td>
<td>Geotechnical Engineering - II</td>
<td>CO1</td>
<td>Understand the importance of soil investigation for any civil engineering construction</td>
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<td>CO2</td>
<td>To analyse earth retaining structures in various types of soil medium</td>
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<td>CO3</td>
<td>Do proper bearing capacity estimation including IS code methods</td>
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<td>CO4</td>
<td>Do proper foundation proportioning for any kind of shallow foundation system and also get exposed in foundation analysis</td>
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<td>CO5</td>
<td>To estimate pile and pile group capacity for any kind of soils including group efficiency and negative friction</td>
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<tr>
<td>CEPC20</td>
<td>Highway and Pavement Engineering</td>
<td>CO1</td>
<td>Carry out surveys involved in planning and highway alignment</td>
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<td>CO2</td>
<td>Design cross section elements, sight distance, horizontal and vertical alignment</td>
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<td>CO3</td>
<td>Implement traffic studies, traffic regulations and control, and intersection design</td>
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<td>Course code</td>
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<td>Course outcomes</td>
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<tr>
<td>CEPC21</td>
<td>Basic Reinforced Concrete Design</td>
<td>CO1</td>
<td>Apply the fundamental concepts of working stress method and limit state method</td>
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<td>CO2</td>
<td>Use IS code of practice for the design of concrete elements</td>
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<td>CO3</td>
<td>Design the beams, slab, stairs</td>
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<td>CO4</td>
<td>Design the column and footing</td>
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<td>CO5</td>
<td>Draw various RCC structural elements</td>
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<tr>
<td>CEPC22</td>
<td>Hydrology and Irrigation Engineering</td>
<td>CO1</td>
<td>Gain background in hydrology an understanding of water resources systems, flood</td>
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<td>flows and flood routing</td>
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<td>CO2</td>
<td>Acquire the knowledge on hydrological cycle and interpret precipitation data and</td>
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<td>evapotranspiration.</td>
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<td>CO3</td>
<td>Assess the crop water requirement for various crops in the command area and soil</td>
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<td>water relationships</td>
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<td>CO4</td>
<td>Know the knowledge in the design of diversion structures and reservoirs</td>
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<td>CO5</td>
<td>Understand the complete design of various Canal irrigation system</td>
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<tr>
<td>CEPC28</td>
<td>Railway, Airport and Harbour Engineering</td>
<td>CO1</td>
<td>Carry out the surveys for railways, airports and harbours.</td>
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<td>CO2</td>
<td>Perform geometric design for the three modes.</td>
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<td>CO3</td>
<td>Plan the layout of different types of terminals</td>
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<td>CO4</td>
<td>Apply the principles of bus transit, MRTS and LRT.</td>
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<td>CO5</td>
<td>Demonstrate the fundamentals of Intelligent Transportation Systems.</td>
</tr>
<tr>
<td>CEPC24</td>
<td>Basic Steel Structural Elements</td>
<td>CO1</td>
<td>Apply the IS code of practice for the design of steel structural elements.</td>
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<td>CO2</td>
<td>Design compression and tension members using simple and built-up sections.</td>
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<td>CO3</td>
<td>Calculate forces on the various members of the truss and design them.</td>
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<td>CO4</td>
<td>Analyze the behavior of bolted connections and design them.</td>
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<td>CO5</td>
<td>Design welded connections for both axial and eccentric forces.</td>
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</tbody>
</table>

**8. PROGRAMME ELECTIVE (PE)**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>CO</th>
<th>Course outcomes</th>
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</thead>
<tbody>
<tr>
<td>CEPE10</td>
<td>Construction Techniques and Equipments</td>
<td>CO1</td>
<td>Supervise and execute all the construction jobs with the knowledge of the different construction techniques</td>
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<tr>
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<td>CO2</td>
<td>Identify the building defects and apply suitable repair techniques to rectify them</td>
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<td>CO3</td>
<td>Evaluate the costs of equipment and make proper selection of the suitable construction equipment</td>
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<td>CO4</td>
<td>Ensure the proper completion of a construction task using particular construction equipment</td>
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<td>CO5</td>
<td>able to understand the mechanism behind equipments and appropriate applications</td>
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<tr>
<td>CEPE11</td>
<td>Elementary Structural</td>
<td>CO1</td>
<td>Apply the concepts of dynamic systems.</td>
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<td>Course code</td>
<td>Course Title</td>
<td>CO</td>
<td>Course outcomes</td>
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<tr>
<td>CEPE12</td>
<td>Maintenance and Rehabilitation of Structures</td>
<td>CO1</td>
<td>Diagnosis the damage of distress structures</td>
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<td>CO2</td>
<td>Investigate the condition assessment of structures</td>
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<td>CO3</td>
<td>Select the proper repair materials and its application</td>
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<td>CO4</td>
<td>Select the method to Strengthen the distressed structures</td>
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<td>CO5</td>
<td>able to use proper demolition techniques w.r.t the requirements</td>
</tr>
<tr>
<td>CEPE13</td>
<td>Construction Management</td>
<td>CO1</td>
<td>Perform the role of a manager efficiently with precise knowledge of the roles and responsibilities</td>
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<td>CO2</td>
<td>Estimate the man power requirement and can recruit suitable candidates for construction jobs</td>
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<td>CO3</td>
<td>Analyse and compare the cost estimates of different construction equipment</td>
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<td>CO4</td>
<td>Compute construction schedules, network diagrams and time estimates of projects</td>
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<td>CO5</td>
<td>Evaluate and make tenders and contract documents of their own</td>
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<td>CO6</td>
<td>Use the computer software to monitor real-time projects</td>
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<tr>
<td>CEPE14</td>
<td>Structural System Analysis</td>
<td>CO1</td>
<td>Apply the basic concepts of matrix methods in structural analysis</td>
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<td>CO2</td>
<td>Develop stiffness and flexibility matrices</td>
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<td>CO3</td>
<td>Analyze the structures using flexibility and stiffness method</td>
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<td>CO4</td>
<td>Transform system coordinates to element coordinates</td>
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<td>CO5</td>
<td>Determine the forces in various members due to lack of fit and thermal expansion</td>
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<tr>
<td>CEPE15</td>
<td>Prestressed Concrete Structures</td>
<td>CO1</td>
<td>Design a prestressed concrete beam accounting for losses</td>
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<td>CO2</td>
<td>Design the anchorage zone for post tensioned members</td>
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<td>CO3</td>
<td>Design composite members</td>
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<td>CO4</td>
<td>Design continuous beams</td>
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<td>CO5</td>
<td>Design water tanks</td>
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<tr>
<td>CEPE16</td>
<td>Advanced Reinforced Concrete Design</td>
<td>CO1</td>
<td>Apply the concepts of liquid retaining structures</td>
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<td>CO2</td>
<td>Design material storage structures using various theories</td>
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<td>CO3</td>
<td>Apply the concepts of environmental and transportation structures</td>
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<td>CO4</td>
<td>Demonstrate the detailing of reinforcement</td>
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<td></td>
<td>CO5</td>
<td>draw the various RCC structures</td>
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<tr>
<td>CEPE17</td>
<td>Advanced Steel Structural</td>
<td>CO1</td>
<td>Design eccentrically loaded compression members (Beam-Columns) and their baseplates.</td>
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<td>Course code</td>
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<tr>
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<td>Elements</td>
<td>CO2</td>
<td>Design welded plate girder and other components</td>
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<td>CO3</td>
<td>Design Gantry girder for industrial structures</td>
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<td>CO4</td>
<td>Calculate the wind load acting on various structures to be built in various locations.</td>
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<td>CO5</td>
<td>Design Industrial structures and their components such as girts, wind girders, bracing systems, purlins, etc.</td>
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<tr>
<td>CEPE18</td>
<td>Advanced Structural Analysis</td>
<td>CO1</td>
<td>Demonstrate the concepts of qualitative influence line diagram for continuous beams and frames.</td>
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<td>CO2</td>
<td>Apply the methods of indeterminate truss analysis.</td>
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<td>CO3</td>
<td>Demonstrate the behavior of arches and their methods of analysis.</td>
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<td>CO4</td>
<td>Analyse cable suspension bridges.</td>
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<td>CO5</td>
<td>Analyse multistory frames subjected to gravity loads and lateral loads.</td>
</tr>
<tr>
<td>CEPE19</td>
<td>Traffic Engineering and Safety</td>
<td>CO1</td>
<td>Carry out traffic surveys</td>
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<td>CO2</td>
<td>Implement traffic system management</td>
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<td>CO3</td>
<td>Carry out intersection design for safety</td>
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<td></td>
<td>CO4</td>
<td>Record and analyse accident data and suggest countermeasures</td>
</tr>
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<td>CO5</td>
<td>Carry out road safety audit</td>
</tr>
<tr>
<td>CEPE20</td>
<td>Pavement Analysis and Design</td>
<td>CO1</td>
<td>Identify the pavement components and compare highway and airport pavements.</td>
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<td>CO2</td>
<td>Calculate the stresses and ESWL in flexible pavements.</td>
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<td>CO3</td>
<td>Design the flexible pavement using empirical, semi empirical and IRC methods.</td>
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<td>CO4</td>
<td>Analyse the warping, friction, wheel load stress and calculate the combined stress.</td>
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<td>CO5</td>
<td>Design rigid pavements by IRC method and evaluate the pavements.</td>
</tr>
<tr>
<td>CEPE21</td>
<td>Transportation Planning</td>
<td>CO1</td>
<td>Apply the principles of the transportation planning process and demand estimation.</td>
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<td>CO2</td>
<td>Analyse the trip production and trip attraction models.</td>
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<td>CO3</td>
<td>Analyse the growth factor, gravity and opportunity models.</td>
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<td>CO4</td>
<td>Apply the mode choice behaviour and mode split models.</td>
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<td>CO5</td>
<td>Apply the shortest path models for route assignment</td>
</tr>
<tr>
<td>CEPE22</td>
<td>Air Pollution Management</td>
<td>CO1</td>
<td>Identify the types and sources of air pollutants</td>
</tr>
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<td>CO2</td>
<td>Predict the effects of air pollutants on human health and the environment</td>
</tr>
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<td>CO3</td>
<td>Choose appropriate technologies for removal of particulates and gaseous pollutants</td>
</tr>
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<td>CO4</td>
<td>Measure the pollutant concentration in indoor environment</td>
</tr>
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<td>CO5</td>
<td>Suggest the control techniques for indoor air pollution</td>
</tr>
<tr>
<td>CEPE23</td>
<td>Industrial Wastewater Treatment</td>
<td>CO1</td>
<td>Recognize various environmental problems due to improper management of industrial wastewater</td>
</tr>
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<td></td>
<td></td>
<td>CO2</td>
<td>Determine appropriate technologies for treatment and management of industrial pollutants</td>
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<td>CO3</td>
<td>Recommend different techniques for the safe disposal of industrial effluents</td>
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<td>Course outcomes</td>
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<tr>
<td>CEPE24</td>
<td>Environmental Management and Impact Assessment</td>
<td>CO1</td>
<td>Analyse the environmental impacts of proposed projects</td>
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<td>CO2</td>
<td>Categorize the type of EIA required for proposed projects</td>
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<td>CO3</td>
<td>Predict and assess the impact of proposed projects on the environment</td>
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<td>CO4</td>
<td>Use mathematical tools to predict the environmental impacts</td>
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<td>CO5</td>
<td>Propose proper mitigation measures to avoid environmental impacts</td>
</tr>
<tr>
<td>CEPE25</td>
<td>Solid Waste Management Techniques</td>
<td>CO1</td>
<td>Explain the various functional elements involved in solid waste management system</td>
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<td>CO2</td>
<td>Quantify and categorize solid wastes for any region</td>
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<td>CO3</td>
<td>Analyse the collection route and collection system</td>
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<td>CO4</td>
<td>Select suitable waste processing technologies and disposal methods</td>
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<td>CO5</td>
<td>Design a suitable sanitary landfill for disposal of solid waste on land</td>
</tr>
<tr>
<td>CEPE26</td>
<td>Models for Air and Water Quality</td>
<td>CO1</td>
<td>Explain various transport mechanisms in estuary and river</td>
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<td>CO2</td>
<td>Develop mathematical model for water quality</td>
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<td>CO3</td>
<td>Predict the quality of water in river, lakes and estuaries using mass balance approach and specific models</td>
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<td>CO4</td>
<td>Determine the microbial population using various growth models</td>
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<td>CO5</td>
<td>Quantify the concentration of pollutant in ambient air using dispersion models</td>
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<tr>
<td>CEPE27</td>
<td>Advanced Foundation Engineering</td>
<td>CO1</td>
<td>Analyze and design any kind of sheet pile wall system including coffer dam</td>
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<td>CO2</td>
<td>Analyze and design well foundation including complete stability analysis</td>
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<td>CO3</td>
<td>Estimate soil parameters under dynamic conditions including machine foundations</td>
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<td>CO4</td>
<td>Design a suitable foundation system for any kind of problematic soils</td>
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<td>CO5</td>
<td>Analyze the stability of any kind of slope by using both theoretical and graphical methods</td>
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<tr>
<td>CEPE28</td>
<td>Geotechnical Earthquake Engineering</td>
<td>CO1</td>
<td>Demonstrate the principles of earthquake loading</td>
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<td>CO2</td>
<td>Quantify earthquake intensity and ground motion</td>
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<td>CO3</td>
<td>Estimate seismic soil design parameters</td>
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<td>CO4</td>
<td>Analyze and design seismic resistant foundation for buildings</td>
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<td>CO5</td>
<td>Prepare soil risk and microzonation maps</td>
</tr>
<tr>
<td>CEPE29</td>
<td>Reinforced Earth and Geotextiles</td>
<td>CO1</td>
<td>Understand the principles of soil reinforcement and they can able to do any reinforced wall design using steel strip or geo-reinforcement</td>
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<td>CO2</td>
<td>Understand the application of geosynthetics in geotechnical engineering</td>
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<td>CO3</td>
<td>Decide what kind of geosynthetics should be used for the problem specific application including its design principles</td>
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<tr>
<td>CEPE30</td>
<td>Earth and Earth Retaining Structures</td>
<td>CO1</td>
<td>Do earth dam design and stability analysis for all kind of drainage conditions</td>
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<td>CO2</td>
<td>Do stability analysis of any kind of slope and its protection</td>
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<td>CO3</td>
<td>Understand the earth pressure theories and able to calculate lateral earth pressure for different conditions</td>
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<td>CO4</td>
<td>Do retaining structure design and its stability analysis</td>
</tr>
<tr>
<td>CEPE31</td>
<td>Marine Foundation Engineering</td>
<td>CO1</td>
<td>Recommend suitable offshore investigation techniques for the proposed project and able to provide appropriate soil design parameters</td>
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<td>CO2</td>
<td>Perform foundation analysis for gravity structures, jacket and jack-up kind of offshore structures</td>
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<td>CO3</td>
<td>Analysis suitable anchor system for mooring structures and able to provide foundationsystem for offshore pipeline</td>
</tr>
<tr>
<td>CEPE32</td>
<td>Geodetic Surveying</td>
<td>CO1</td>
<td>Apply geodetic methods such as Triangulation in different fields of Civil Engineering</td>
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<td></td>
<td>CO2</td>
<td>Apply geodetic methods such as Trigonometric levelling in different fields of civil engineering</td>
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<td>CO3</td>
<td>Select the correct, best suited curve and set the curve on the road</td>
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<td>CO4</td>
<td>Identify the errors present in the field observation and to adjust the errors using suitable methods</td>
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<td>CO5</td>
<td>Demonstrate the principles of the earth surface, its projections and different coordinates involved in map making</td>
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<tr>
<td>CEPE33</td>
<td>Advanced Surveying Techniques</td>
<td>CO1</td>
<td>Apply advanced surveying techniques in different fields of Civil Engineering</td>
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<td></td>
<td>CO2</td>
<td>Select the advanced technique which is best suited for a work</td>
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<td>CO3</td>
<td>Apply total station and EDM in distance measurement and traversing</td>
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<td></td>
<td>CO4</td>
<td>Demonstrate the principles of the earth surface, its projections and different coordinates involved in map making</td>
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<td>CO5</td>
<td>Apply GPS in transportation engineering, structural engineering and land use planning</td>
</tr>
<tr>
<td>CEPE34</td>
<td>Groundwater Hydrology</td>
<td>CO1</td>
<td>Identify types of aquifers</td>
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<td>CO2</td>
<td>carry out surface and subsurface investigation to locate groundwater</td>
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<td>CO3</td>
<td>visualize the occurrence and movement of groundwater</td>
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<td>CO4</td>
<td>select suitable type of ground water recharge</td>
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<td>CO5</td>
<td>Assess sea water intrusion and its control</td>
</tr>
<tr>
<td>CEPE35</td>
<td>Applied Hydraulics Engineering</td>
<td>CO1</td>
<td>Acquire specific knowledge regarding fluid flow phenomena observed in Civil Engineering systems such as flow in open channel flow</td>
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<tr>
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<td>CO2</td>
<td>Develop understanding of the basic principles of fluid flow patterns and boundary layer theory and provide skills in analyzing fluid flows in open channel hydraulics</td>
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<td>CO3</td>
<td>Understand gradually varied flow profile in detail.</td>
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<td>CO4</td>
<td>Understand rapidly varied flow profile in detail</td>
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<td>CO5</td>
<td>Knowledge is useful for the design of open channels for rectangular and non-rectangular channels for hydraulic jump phenomena.</td>
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<tr>
<td>CEPE36</td>
<td>Design of Hydraulic Structures</td>
<td>CO1</td>
<td>Perform the stability analysis of gravity dams</td>
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<td>CO2</td>
<td>Explain the causes of failure of different types of dams and their design criteria</td>
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<td>CO3</td>
<td>Design minor irrigation structures such as regulators, cross drainage works and canalfalls</td>
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<td>CO4</td>
<td>Able to design structures on pervious formations</td>
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<tr>
<td>CEPE37</td>
<td>Simulation Modelling for Water Resources Engineering</td>
<td>CO1</td>
<td>Incorporate skills in developing models for various systems</td>
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<td>CO2</td>
<td>Acquires knowledge on fundamentals of regression techniques</td>
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<td>CO3</td>
<td>Develops and improves the knowledge dynamic programming and stochastic programming.</td>
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<td>CO4</td>
<td>Provides basic knowledge on fuzzy system and optimization tools</td>
</tr>
<tr>
<td>CEPE38</td>
<td>Design of Offshore and Coastal Structures</td>
<td>CO1</td>
<td>Gain knowledge on different types of offshore structures</td>
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<td>CO2</td>
<td>Understand the different types of loads acting on offshore structures</td>
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<td>CO3</td>
<td>Gain understanding on waves in shallow water, diffraction, reflection and diffraction</td>
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<td>CO4</td>
<td>Design breakwaters and other coastal defense structures</td>
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<td>CO5</td>
<td>Understand the concepts of littoral drift, wave forces and coastal erosion protection</td>
</tr>
<tr>
<td>CEPE39</td>
<td>Coastal Engineering</td>
<td>CO1</td>
<td>Develop knowledge in basics of wave hydrodynamics</td>
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<td></td>
<td>CO2</td>
<td>Provides understanding various aspects of coastal engineering</td>
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<td>CO3</td>
<td>Describes wave forces, wave pressures and currents in the coastal areas.</td>
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<td>CO4</td>
<td>Improves knowledge on sea defence structures</td>
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<td>CO5</td>
<td>Develop knowledge in basics of wave hydrodynamics</td>
</tr>
<tr>
<td>CEPE40</td>
<td>Disaster Modelling and Management</td>
<td>CO1</td>
<td>Understand different types of disaster and its triggering features</td>
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<td>CO2</td>
<td>Understand and analyse hydrological disaster</td>
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<td>CO3</td>
<td>Understand and develop models for geological disaster</td>
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<td>CO4</td>
<td>Able to understand the coastal hazard and shore defence structures</td>
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<td>CO5</td>
<td>Capable to preparing vulnerability mapping and risk assessment and developing Emergency Management System.</td>
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<tr>
<td>CEPE41</td>
<td>Prefabricated Structures</td>
<td>CO1</td>
<td>Know the behaviour of prefabricated structures</td>
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<td>CO2</td>
<td>Become familiar with the production of prefabrication units and erection process.</td>
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<td>CO3</td>
<td>Able to perform an industry relevant design project in a team setting</td>
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<td>CO4</td>
<td>Exhibit their knowledge in designing and detailing of prefabrication units</td>
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<td>CO5</td>
<td>Able to supervise production, transportation and erection of prefabricated units</td>
</tr>
<tr>
<td>CEPE42</td>
<td>Heritage Structures</td>
<td>CO1</td>
<td>Attain in-depth knowledge on various terminologies and methodology involved for heritage structure</td>
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<td>CO2</td>
<td>Familiarise the features and building bye-laws</td>
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<td>CO3</td>
<td>Visualise the correct preservative measures and methodology</td>
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<td>CO4</td>
<td>Attain in-depth knowledge about the adaptive reuse of heritage structures</td>
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<tr>
<td>CEPE43</td>
<td>Earthquake Resistant Structures</td>
<td>CO5</td>
<td>Familiarise about the various construction techniques Involved From the collected case studies</td>
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<td></td>
<td></td>
<td>CO1</td>
<td>Apply the basics of Earthquake Engineering</td>
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<td>CO2</td>
<td>Demonstrate the dynamics of structural system under earthquake load</td>
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<td>CO3</td>
<td>Analyze the influence of the structural / geometrical design in building characteristics</td>
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<td>CO4</td>
<td>Demonstrate the cyclic loading behaviour of RC steel and pre-stressed concrete elements</td>
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<td>CO5</td>
<td>Apply Codal provisions on different types of structures</td>
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<tr>
<td>CEPE44</td>
<td>Steel Concrete Composite Structures</td>
<td>CO1</td>
<td>Apply the concepts of steel concrete composite in civil engineering construction and practices</td>
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<td>CO2</td>
<td>Analyse the behavior of shear connectors, degree of shear connection and development of composite action</td>
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<td>CO3</td>
<td>Design composite beams under propped and un-propped condition</td>
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<td>CO4</td>
<td>Design different types of composite deck slabs.</td>
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<td>CO5</td>
<td>Analyse the effects of temperature, shrinkage and creep on composite design.</td>
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<tr>
<td>CEPE45</td>
<td>Steel Structural Systems</td>
<td>CO1</td>
<td>Design various types of steel trusses</td>
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<td>CO2</td>
<td>Design of gravity and moment resistant steel structural systems</td>
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<td>CO3</td>
<td>Design of pre-engineered buildings in structural steel</td>
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<td>CO4</td>
<td>Design steel bunkers and silos</td>
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<td>CO5</td>
<td>Design steel water tanks and their staging</td>
</tr>
<tr>
<td>CEPE46</td>
<td>Basic Bridge Engineering</td>
<td>CO1</td>
<td>To be familiar with the components of bridges, classification of bridges, importance of bridges</td>
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<td>CO2</td>
<td>To understand the specification of road bridges, loads to be considered</td>
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<td>CO3</td>
<td>To be familiar with various types of concrete bridges such as slab-bridge, T-beam bridge, pre-stressed concrete bridge</td>
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<td>CO4</td>
<td>To be familiar with various types of steel bridges such truss bridge and girder bridge</td>
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<td>CO5</td>
<td>To get exposed to evaluation of sub structures, type of foundations, importance of bearings</td>
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**c. OPEN ELECTIVE (OE)**

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<th>Course code</th>
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<th>Course outcomes</th>
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<tbody>
<tr>
<td>CEOE10</td>
<td>Remote Sensing and GIS</td>
<td>CO1</td>
<td>Demonstrate the concepts of Electro Magnetic energy, spectrum and spectral signature curves.</td>
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<td>CO2</td>
<td>Apply the concepts of satellite and sensor parameters and characteristics of different platforms.</td>
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<td>CO3</td>
<td>Apply the concepts of DBMS in GIS.</td>
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<td>CO4</td>
<td>Analyze raster and vector data and modeling in GIS.</td>
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<td>Apply GIS in land use, disaster management, ITS and resource information system.</td>
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<td>Understand the basics of ocean energy sources</td>
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<td>Apply the basics of Earthquake Engineering</td>
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<td>Understand the earthquake wave generation and its propagation mechanism</td>
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<td>Understand earthquake measuring scales and instruments</td>
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<td>Quantify earthquake intensity and ground motion</td>
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<td>Identify the method to protect the structure from seismic forces</td>
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<td>Apply the laws and governmental policies related to the planning process</td>
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<td>Implement the classical urban planning principles</td>
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<td>Apply the methods of financing of plans</td>
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<td>Demonstrate the regulations and by-laws</td>
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<td>Apply the concepts of photo elastic coatings</td>
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<td>Analyze the behavior of 2-D photo elasticity</td>
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<td>Health Monitoring of Structures</td>
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<td>Perform structural health monitoring</td>
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<td>Handle emerging technologies using sensors</td>
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<td>Perform notable applications of structural health monitoring in civil applications</td>
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<td>Identify the remaining service life of the structure</td>
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<td>Understand the case studies on SHM of bridges</td>
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<td>Forensic Engineering</td>
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<td>Describe and evaluate the use of structural forensics in creating and maintaining of civil infrastructure</td>
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<td>Identify the common failure modes</td>
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<td>CO3</td>
<td>Investigate the structural failures, reverse engineer the lessons learnt and produce technical notes</td>
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<td>Familiarize the provisions in IS 1893 &amp; 4326</td>
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<td>Implement the modern techniques of retrofitting</td>
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<td>CEOE17</td>
<td>Sustainable Infrastructure</td>
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<td>Understand the values and societal importance of the built environment</td>
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<td>Understand the influence on a sustainable development</td>
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<td>Gain knowledge on how to use environmental impact assessments as a tool for design</td>
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<td>Construction and management of a sustainable built environment</td>
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### D. MINOR (MI) (offered for the students of other departments)

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<td>Construction Technology</td>
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<td>Distinguish the different construction materials and select appropriate materials</td>
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<td>CO2</td>
<td>Design suitable concrete mixes and test the concrete</td>
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<td>Execute construction jobs with the knowledge of the different construction</td>
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<td>Identify the building defects and apply suitable repair techniques to rectify them</td>
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<td>Surveying Practices</td>
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<td>Carry out preliminary surveying in the field of civil engineering</td>
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<td>Plan a survey, taking accurate measurements, field booking, plotting and</td>
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<td>adjustment of traverse</td>
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<td>Use various conventional instruments involved in surveying with respect to utility</td>
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<td>Plan a survey for applications such as road alignment and height of the building</td>
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<td>Undertake measurement and plotting in civil engineering</td>
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<td>Structural Analysis and Design</td>
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<td>Analyse and design simple structural elements</td>
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<td>CO2</td>
<td>Analyse and design simple axially loaded RC columns and beams</td>
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<td>CO3</td>
<td>Analyse and design simple axially loaded Steel columns and beams</td>
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<td>CO4</td>
<td>Able to carry out simple bolted lap and butt joints</td>
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<td>able to carry out simple welded lap and butt joints</td>
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<td>CEMI13</td>
<td>Soils and Foundations</td>
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<td>Understand the importance of geotechnical engineering in civil engineering</td>
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<td>Decide the type of foundation suitable for a particular soil condition</td>
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<td>Select the right method to improvement the problematic soil</td>
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<td>Understand the importance of soil investigation for any civil engineering</td>
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<td>CEMI14</td>
<td>Transportation Systems</td>
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<td>Design cross section elements, sight distance, horizontal and vertical alignment</td>
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<td>Determine the characteristics of pavement materials</td>
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<td>Plan the layout of railway terminals</td>
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<td>Apply principles of airport planning</td>
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<td>Implement the layout of harbours</td>
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<td>CEMI15</td>
<td>Water and Air Pollution Management</td>
<td>CO1</td>
<td>Identify the source of water and to calculate water demand.</td>
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<td>Apply the water treatment concept and methods.</td>
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<td>Prepare a layout of water distribution network.</td>
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<td>Characterize wastewater and apply suitable treatment process.</td>
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<td>Apply the various air pollution control devices to minimize the release of harmful</td>
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<td>gases into the atmosphere</td>
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<td>Irrigation Engineering and Management</td>
<td>CO1 Find the crop water requirement for various crops in the command area.</td>
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<td>CO2 Understand the complete design of Dams and channel systems.</td>
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<td>CO3 Understand the different types of cross drainage works.</td>
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<td>CO4 Understand the participatory irrigation management</td>
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<td>CO5 Capable of designing reservoir storage characteristics</td>
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<td>CEMI17</td>
<td>Quantity Estimation and Valuation</td>
<td>CO1 Apply different types of estimates in different situations</td>
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<td>CO2 Carry out analysis of rates and bill preparation at different locations</td>
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<td>CO3 Demonstrate the concepts of specification writing</td>
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<td>CO4 Carry out valuation of assets</td>
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## PROGRAM ARTICULATION MATRIX

### A. PROGRAMME CORE (PC)

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CURRICULUM

The total minimum credits for completing the B.Tech. Programme in Civil Engineering is 157 [50 + 107].

The structure of B.Tech. Programmes shall have General Institute Requirements (GIR), Programme Core (PC), Elective Courses (PE, OE and MI) and Essential Programme Laboratory Requirements (ELR) as follows:

**Table 1 Course Structure**

<table>
<thead>
<tr>
<th>Course Category</th>
<th>Courses</th>
<th>No. of Credits</th>
<th>Weightage (%)</th>
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<td>Honours (Optional)</td>
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<td>15 Additional credits</td>
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</table>

**Minimum of 4 programme core courses shall be 4 credits each**

$Out of 14 elective courses (PE/OE), the students should study at least eight programme elective courses (PE)
## (I) GENERAL INSTITUTE REQUIREMENT (GIR)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the course</th>
<th>Number of courses</th>
<th>Max. Credits</th>
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## (II) PROGRAMME CORE (PC)

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<td>Geotechnical Engineering - II</td>
<td>CEPC16</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>CEPC20</td>
<td>Highway and Pavement Engineering</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>CEPC21</td>
<td>Basic Reinforced Concrete Design</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>CEPC22</td>
<td>Hydrology and Irrigation Engineering</td>
<td>CEPC12</td>
<td>4</td>
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</tbody>
</table>

| **Total** |                              |                     |                |         |
### (III) ELECTIVES

#### a. PROGRAMME ELECTIVE (PE)

Students pursuing B.Tech. in Civil Engineering should complete at least eight courses from the Programme Electives listed below.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CEPE10</td>
<td>Construction Techniques and Equipments</td>
<td>-</td>
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<tr>
<td>2.</td>
<td>CEPE11</td>
<td>Elementary Structural Dynamics</td>
<td>CEPC10</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CEPE12</td>
<td>Maintenance and Rehabilitation of Structures</td>
<td>CEPC14</td>
<td>3</td>
</tr>
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<td>Construction Management</td>
<td>-</td>
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</tr>
<tr>
<td>5.</td>
<td>CEPE14</td>
<td>Advanced Structural Analysis</td>
<td>CEPC15</td>
<td>3</td>
</tr>
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<td>6.</td>
<td>CEPE15</td>
<td>Prestressed Concrete Structures</td>
<td>CEPC21</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>CEPE16</td>
<td>Advanced Reinforced Concrete Design</td>
<td>CEPC21</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>CEPE17</td>
<td>Advanced Steel Structural Elements</td>
<td>CEPC24</td>
<td>3</td>
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<tr>
<td>9.</td>
<td>CEPE18</td>
<td>Structural System Analysis</td>
<td>CEPC15</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>CEPE19</td>
<td>Traffic Engineering and Safety</td>
<td>CEPC20</td>
<td>3</td>
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<tr>
<td>11.</td>
<td>CEPE20</td>
<td>Pavement Analysis and Design</td>
<td>CEPC20</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>CEPE21</td>
<td>Transportation Planning</td>
<td>CEPC20</td>
<td>3</td>
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<tr>
<td>13.</td>
<td>CEPE22</td>
<td>Air Pollution Management</td>
<td>CEPC18</td>
<td>3</td>
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<tr>
<td>14.</td>
<td>CEPE23</td>
<td>Industrial Wastewater Treatment</td>
<td>CEPC18</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>CEPE24</td>
<td>Environmental Management and Impact Assessment</td>
<td>CEPC18</td>
<td>3</td>
</tr>
<tr>
<td>16.</td>
<td>CEPE25</td>
<td>Solid Waste Management Techniques</td>
<td>CEPC18</td>
<td>3</td>
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<tr>
<td>17.</td>
<td>CEPE26</td>
<td>Models for Air and Water Quality</td>
<td>CEPC18</td>
<td>3</td>
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<tr>
<td>18.</td>
<td>CEPE27</td>
<td>Advanced Foundation Engineering</td>
<td>CEPC19</td>
<td>3</td>
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<tr>
<td>19.</td>
<td>CEPE28</td>
<td>Geotechnical Earthquake Engineering</td>
<td>CEPC19</td>
<td>3</td>
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<tr>
<td>20.</td>
<td>CEPE29</td>
<td>Reinforced Earth and Geotextiles</td>
<td>CEPC19</td>
<td>3</td>
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<td>21.</td>
<td>CEPE30</td>
<td>Earth and Earth Retaining Structures</td>
<td>CEPC19</td>
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<td>22.</td>
<td>CEPE31</td>
<td>Marine Foundation Engineering</td>
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<tr>
<td>23.</td>
<td>CEPE32</td>
<td>Geodetic Surveying</td>
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<td>3</td>
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<tr>
<td>24.</td>
<td>CEPE33</td>
<td>Advanced Surveying Techniques</td>
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<td>3</td>
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<td>25.</td>
<td>CEPE34</td>
<td>Groundwater Hydrology</td>
<td>CEPC12</td>
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</table>

Total: 49 courses
b. OPEN ELECTIVE (OE)

The courses listed below are offered by the Department of Civil Engineering for students of other Departments.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CEOE10</td>
<td>Remote Sensing and GIS</td>
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<td>CEOE11</td>
<td>Ocean Energy</td>
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<td>CEOE12</td>
<td>Earthquake Engineering</td>
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<td>4.</td>
<td>CEOE13</td>
<td>Urban and Regional Planning</td>
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<td>5.</td>
<td>CEOE14</td>
<td>Experimental Stress Analysis</td>
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<td>6.</td>
<td>CEOE15</td>
<td>Health Monitoring of Structures</td>
<td>-</td>
<td>3</td>
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<tr>
<td>7.</td>
<td>CEOE16</td>
<td>Forensic Engineering</td>
<td>-</td>
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<tr>
<td>8.</td>
<td>CEOE17</td>
<td>Sustainable Infrastructure</td>
<td>-</td>
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</tbody>
</table>

c. MINOR (MI) (offered for the students of other departments)

A student can earn 15 credits, in addition to the credits specified by the department for B.Tech. degree, as optional courses from the minor electives offered by single department from the 4th semester.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CEMI10</td>
<td>Construction Technology</td>
<td>-</td>
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<tr>
<td>2.</td>
<td>CEMI11</td>
<td>Surveying Practices</td>
<td>-</td>
<td>3</td>
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<tr>
<td>3.</td>
<td>CEMI12</td>
<td>Structural Analysis and Design</td>
<td>-</td>
<td>3</td>
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<tr>
<td>4.</td>
<td>CEMI13</td>
<td>Soils and Foundations</td>
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</table>
(IV) ESSENTIAL PROGRAMME LABORATORY REQUIREMENT (ELR)

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Co requisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CELR11</td>
<td>Strength of Materials and Concrete Laboratory</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>CELR12</td>
<td>Survey Laboratory</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>CELR13</td>
<td>Fluid Mechanics Laboratory</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>CELR14</td>
<td>Building Planning &amp; Drawing</td>
<td>-</td>
<td>2</td>
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<tr>
<td>5.</td>
<td>CELR15</td>
<td>Geotechnical Engineering Laboratory</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>CELR16</td>
<td>Environmental Engineering Laboratory</td>
<td>-</td>
<td>2</td>
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<tr>
<td>7.</td>
<td>CELR17</td>
<td>Transportation Engineering Laboratory</td>
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<td>8.</td>
<td>CELR18</td>
<td>Computational Laboratory</td>
<td>-</td>
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<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>16</td>
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</tbody>
</table>

(V) ADVANCED LEVEL COURSES FOR B.Tech. (HONORS)

A student can obtain B.Tech. (Honors) degree provided;
1. Students should not have obtained “V” or “X” grade in any course
2. Maintains CGPA of 8.5 in all semesters excluding honours courses.
3. Completes additional theory courses for 15 credits from the list of honors courses, of P.G. level, offered by the department, maintaining an aggregate of at least B grade in Honours courses.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Pre requisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CEHO10</td>
<td>Dynamics of Structures</td>
<td>CEPC10, CEPE18</td>
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<td>2.</td>
<td>CEHO11</td>
<td>Finite Element Analysis</td>
<td>CEPE18</td>
<td>4</td>
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<tr>
<td>3.</td>
<td>CEHO12</td>
<td>Theory of Elasticity and</td>
<td>CEPC11</td>
<td>4</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Course Code</td>
<td>Credits</td>
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<tr>
<td>-------------</td>
<td>--------------------------------------------------------</td>
<td>-------------</td>
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<tr>
<td>4. CEHO13</td>
<td>Introduction to Plasticity</td>
<td>CEPC15</td>
<td>3</td>
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<td>5. CEHO14</td>
<td>Nonlinear Analysis of Structures</td>
<td>CEPC15</td>
<td>3</td>
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<td>6. CEHO15</td>
<td>Theory of Plates and Introduction to Shells</td>
<td>CEPC11</td>
<td>4</td>
<td></td>
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<tr>
<td>7. CEHO16</td>
<td>Theory of Traffic Flow</td>
<td>CEPC20</td>
<td>3</td>
<td></td>
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<tr>
<td>8. CEHO17</td>
<td>Pavement Construction and Management</td>
<td>CEPC20</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>9. CEHO18</td>
<td>Soil Dynamics and Machine Foundations</td>
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<td>10. CEHO19</td>
<td>Numerical Modelling in Geotechnical Engineering</td>
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<td>11. CEHO20</td>
<td>Physicochemical Methods for Water and Wastewater</td>
<td>CEPC18</td>
<td>4</td>
<td></td>
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<tr>
<td>12. CEHO21</td>
<td>Biological Treatment of Wastewater</td>
<td>CEPC18</td>
<td>4</td>
<td></td>
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<tr>
<td>13. CEHO22</td>
<td>Advanced Remote Sensing Techniques</td>
<td>CEPC13</td>
<td>4</td>
<td></td>
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<tr>
<td>14. CEHO23</td>
<td>Free Surface Flow</td>
<td>CEPC12</td>
<td>3</td>
<td></td>
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<tr>
<td>15. CEHO24</td>
<td>Computational Fluid Dynamics</td>
<td>CEPC12</td>
<td>4</td>
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<td>16. CEHO25</td>
<td>Wave Hydrodynamics</td>
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<td>3</td>
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<td>17. CEHO26</td>
<td>Advanced Remote Sensing Techniques</td>
<td>CEPC13</td>
<td>4</td>
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<td>18. CEHO27</td>
<td>River Hydraulics and Sediment Transport</td>
<td>CEPC22</td>
<td>4</td>
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# ROADMAP OF CURRICULUM

## FOR B.Tech. (CIVIL ENGINEERING) STUDENTS

### Semester I (July Session)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisite / Co-requisite</th>
<th>Credit</th>
<th>Type</th>
<th>Year of Study</th>
<th>Session/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HSIR11</td>
<td>English for Communication (Theory)</td>
<td>-</td>
<td>2</td>
<td>GIR</td>
<td>I</td>
<td>July / January</td>
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<td>2.</td>
<td>HSIR11</td>
<td>English for Communication (Lab)</td>
<td>-</td>
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<td>I</td>
<td>July / January</td>
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<td>3.</td>
<td>MAIR11</td>
<td>Matrices and Calculus</td>
<td>-</td>
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<td>GIR</td>
<td>I</td>
<td>July / January</td>
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<td>4.</td>
<td>CHIR11</td>
<td>Chemistry</td>
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<td>3</td>
<td>GIR</td>
<td>I</td>
<td>July / January</td>
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<td>5.</td>
<td>CHIR12</td>
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<td>GIR</td>
<td>I</td>
<td>July / January</td>
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<tr>
<td>6.</td>
<td>CEIR15</td>
<td>Introduction to Civil Engineering</td>
<td>-</td>
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<td>GIR</td>
<td>I</td>
<td>July / January</td>
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<tr>
<td>7.</td>
<td>EEIR11</td>
<td>Basics of Electrical and Electronics Engineering</td>
<td>-</td>
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<td>GIR</td>
<td>I</td>
<td>July / January</td>
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<tr>
<td>8.</td>
<td>MEIR11</td>
<td>Basics of Mechanical Engineering</td>
<td>-</td>
<td>2</td>
<td>GIR</td>
<td>I</td>
<td>July / January</td>
</tr>
<tr>
<td>9.</td>
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<td>GIR</td>
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**Total No. of Credits** 21

### Semester II (January Session)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisite / Co-requisite</th>
<th>Credit</th>
<th>Type</th>
<th>Year of Study</th>
<th>Session/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MAIR21</td>
<td>Complex Analysis and Differential Equations</td>
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<td>GIR</td>
<td>I</td>
<td>July / January</td>
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<td>2.</td>
<td>PHIR11</td>
<td>Physics</td>
<td>-</td>
<td>3</td>
<td>GIR</td>
<td>I</td>
<td>July / January</td>
</tr>
<tr>
<td>3.</td>
<td>PHIR12</td>
<td>Physics Lab</td>
<td>-</td>
<td>2</td>
<td>GIR</td>
<td>I</td>
<td>July / January</td>
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<tr>
<td>4.</td>
<td>CSIR11</td>
<td>Introduction to Computer Programming (Theory &amp; Lab)</td>
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<td>3</td>
<td>GIR</td>
<td>I</td>
<td>July / January</td>
</tr>
<tr>
<td>5.</td>
<td>ENIR11</td>
<td>Energy and Environmental Engineering</td>
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<td>2</td>
<td>GIR</td>
<td>I</td>
<td>July / January</td>
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<tr>
<td>6.</td>
<td>PRIR11</td>
<td>Engineering Practice</td>
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<td>GIR</td>
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**Total No. of Credits** 19
### Semester III (July Session)

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<th>Course Title</th>
<th>Prerequisite / Co-requisite</th>
<th>Credit</th>
<th>Type</th>
<th>Year of Study</th>
<th>Session/s</th>
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<tr>
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<td>HSIR13</td>
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<td>2.</td>
<td>CEPC11</td>
<td>Mechanics of Solids</td>
<td>CEPC10</td>
<td>4</td>
<td>PC</td>
<td>II</td>
<td>July / January</td>
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<td>3.</td>
<td>CEPC12</td>
<td>Hydraulics and Fluid Machinery</td>
<td>-</td>
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<td>II</td>
<td>July / January</td>
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<tr>
<td>4.</td>
<td>CEPC13</td>
<td>Concrete Technology</td>
<td>-</td>
<td>3</td>
<td>PC</td>
<td>II</td>
<td>July / January</td>
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<td>5.</td>
<td>CEPC14</td>
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<td>-</td>
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<td>II</td>
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<td>6.</td>
<td>CELR11</td>
<td>Strength of materials and concrete</td>
<td>-</td>
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<td>ELR</td>
<td>II</td>
<td>July / January</td>
</tr>
<tr>
<td>7.</td>
<td>CELR12</td>
<td>Survey Laboratory</td>
<td>-</td>
<td>2</td>
<td>ELR</td>
<td>II</td>
<td>July / January</td>
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<td>Programme Elective I</td>
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<td>-</td>
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**Total No. of Credits**: 23

### Semester IV (January Session)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisite / Co-requisite</th>
<th>Credit</th>
<th>Type</th>
<th>Year of Study</th>
<th>Session/s</th>
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<tbody>
<tr>
<td>1.</td>
<td>MAIR4*</td>
<td>Probability and Numerical Techniques</td>
<td>-</td>
<td>4</td>
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<tr>
<td>2.</td>
<td>CEPC15</td>
<td>Analysis of Indeterminate Structures</td>
<td>CEPC11</td>
<td>4</td>
<td>PC</td>
<td>II</td>
<td>July / January</td>
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<tr>
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<td>CEPC16</td>
<td>Geotechnical Engineering-I</td>
<td>-</td>
<td>3</td>
<td>PC</td>
<td>II</td>
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</tr>
<tr>
<td>4.</td>
<td>CEPC17</td>
<td>Environmental Engineering-I</td>
<td>-</td>
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<td>PC</td>
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<tr>
<td>5.</td>
<td>CELR13</td>
<td>Fluid Mechanics Laboratory</td>
<td>-</td>
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<tr>
<td>6.</td>
<td>CELR14</td>
<td>Building Planning and Drawing</td>
<td>-</td>
<td>2</td>
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<td>II</td>
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<tr>
<td>7.</td>
<td>Programme Elective II</td>
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<td>CEPC10 CEPC12 CEPC13 CEPC14</td>
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<tr>
<td>8.</td>
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<tr>
<td>9.</td>
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<td></td>
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<td>10.</td>
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</table>

**Total No. of Credits**: 24
Note: Department(s) to offer MI/OE and OC course as 2/3 credits to those willing students in addition to 24 credits.

**Semester V (July Session)**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisite / Co-requisite</th>
<th>Credit</th>
<th>Type</th>
<th>Year of Study</th>
<th>Session/s</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>CEPC18</td>
<td>Environmental Engineering-II</td>
<td>CEPC17</td>
<td>3</td>
<td>PC</td>
<td>III</td>
<td>July / January</td>
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<tr>
<td>2.</td>
<td>CEPC19</td>
<td>Geotechnical Engineering-II</td>
<td>CEPC16</td>
<td>3</td>
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<td>July / January</td>
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<tr>
<td>3.</td>
<td>CEPC20</td>
<td>Highway and Pavement Engineering</td>
<td>-</td>
<td>3</td>
<td>PC</td>
<td>III</td>
<td>July / January</td>
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<td>4.</td>
<td>CEPC21</td>
<td>Basic Reinforced Concrete Design</td>
<td>-</td>
<td>3</td>
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<td>July / January</td>
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<td>CELR15</td>
<td>Geotechnical Engineering Laboratory</td>
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<td>Environmental Engineering Laboratory</td>
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<td>7.</td>
<td>HSIR14</td>
<td>Professional Ethics</td>
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<td>GIR</td>
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<td>July / January</td>
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<tr>
<td>8.</td>
<td>Programme Elective IV</td>
<td>CEPC10 CEPC12 CEPC13 CEPC14 CEPC15</td>
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<td>III</td>
<td>July / January</td>
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<td>11.</td>
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Note: Department(s) to offer MI/OE/OC and Honours course as 2/3 credits to those willing students in addition to 22 credits.

**Semester VI (January Session)**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisite / Co-requisite</th>
<th>Credit</th>
<th>Type</th>
<th>Year of Study</th>
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<tr>
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<td>CEPC22</td>
<td>Hydrology and Irrigation Engineering</td>
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<td>III</td>
<td>July / January</td>
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<tr>
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<td>CEPC23</td>
<td>Railway, Airport and Harbour Engineering</td>
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<td>III</td>
<td>July / January</td>
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<td>CEPC24</td>
<td>Basic Steel Structural Elements</td>
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<td>Transportation Engineering Laboratory</td>
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<td>CELR18</td>
<td>Computational Laboratory</td>
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<td>III</td>
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### Semester VII (July Session)

<table>
<thead>
<tr>
<th>Sl. No.</th>
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<th>Course Title</th>
<th>Prerequisite / Co-requireise</th>
<th>Credit</th>
<th>Type</th>
<th>Year of Study</th>
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<tbody>
<tr>
<td>1.</td>
<td>CEIR16</td>
<td>Internship / Industrial Training / Academic Attachment</td>
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<td>Programme Elective VIII</td>
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<td>Programme Elective IX</td>
<td>CEPC13 CEPC14</td>
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<td>Programme Elective X</td>
<td>CEPC15 CEPC18</td>
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<td>5.</td>
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<td>Programme Elective XI</td>
<td>CEPC19 CEPC20 CEPC21 CEPC24</td>
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<td>HO</td>
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<td>July / January</td>
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</table>

**Total No. of Credits**: 24

**Note**: Department(s) may offer MI/OE/OC and Honours course to those willing students in addition to 24 credits

### Semester VIII (January Session)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisite / Co-requireise</th>
<th>Credit</th>
<th>Type</th>
<th>Year of Study</th>
<th>Session/s</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>CEIR18</td>
<td>Comprehensive Viva</td>
<td>-</td>
<td>1</td>
<td>GIR</td>
<td>IV</td>
<td>July / January</td>
</tr>
</tbody>
</table>

**Total No. of Credits**: 14

**Note**: Department(s) may offer MI/OE/OC and Honours course to those willing students in addition to 14 credits
2. CEIR19 Project work - 6 GIR IV July / January
3. Programme Elective XII CEPC10 CEPC12 CEPC13 CEPC14 CEPC15 CEPC18 CEPC19 CEPC20 CEPC21 CEPC24 3 PE IV July / January
4. Programme Elective XIII§ CEPC10 CEPC12 CEPC13 CEPC14 CEPC15 CEPC18 CEPC19 CEPC20 CEPC21 CEPC24 3 PE IV July / January
5. Programme Elective XIV§ CEPC11 CEPC14 CEPC15 CEPC18 CEPC19 CEPC20 3 PE IV July / January
6. Open Elective V*§ - 3 OE IV July / January
7. Open Elective VI*§ - 3 OE IV July / January
8. Minor V# CEPC11 CEPC14 CEPC15 CEPC18 CEPC19 CEPC20 3 MI IV July / January
9. Honors V+ CEPC11 CEPC14 CEPC15 CEPC18 CEPC19 CEPC20 3 HO IV July / January

**Note:** Department(s) may offer Minor (MI) Course, ONLINE Course (OC) and Honours Course (HO) to those willing students in addition to 10 credits

<table>
<thead>
<tr>
<th>Semester</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
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<tr>
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<td>22</td>
<td>24</td>
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<td>10</td>
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</table>

**Note:**

1. Minimum of 4 programme core courses of 4 credits each.
2. Out of 14 elective courses (PE/OE), the students should study at least eight programme elective courses (PE).
3. MI – Minor Degree: **15 credits over and above** the minimum credit as specified by the departments. The details of MINOR will be mentioned only in the transcript not in the Degree certificate.
4. HO – Honours Degree: **15 credits over and above** the minimum credit as specified by the department. The project work is not compulsory

* To be offered as an Open Elective for other Department students

# To be offered as Minor for other Department students

§ For students opting not to register for CEIR19 Project Work

+ To be offered for students who register for B.Tech. (Honours) in Civil Engineering
ELECTIVES (CHOICES)

To get a B.Tech degree in Civil Engineering, possible choices of electives in Programme Electives and Open Electives are:

I. For students opting CEIR19 Project Work

<table>
<thead>
<tr>
<th>Program Electives</th>
<th>Open Electives</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>8</td>
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<td>12</td>
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<tr>
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</table>

II. For students not opting CEIR19 Project Work

<table>
<thead>
<tr>
<th>Program Electives</th>
<th>Open Electives</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>14</td>
<td>0</td>
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</table>

Note: Out of 14 elective courses, eight should be Programme Elective courses (PE). For the remaining six electives both open and programme electives are permitted. Out of these six electives, a student can opt for Project Work instead of two electives equivalent to 6 credits.
GENERAL INSTITUTE REQUIREMENT (GIR)

HSIR13 INDUSTRIAL ECONOMICS AND FOREIGN TRADE

Course Learning Objectives
1. Give a simple yet thorough introduction into the main methods of economic analysis of industry structure and firm behaviour under various conditions of technology, competition, and organization.
2. Elaborate students’ skills and abilities to use modern theoretical and empirical tools to formulate and solve economic problems.
3. Explore in details how economists approach and answer specific empirical questions.

Course Content
Demand and Supply – Forecasting techniques – Cost and Revenues.
Competitive nature of the firms – Keynesian economics – National income.

References:

Course Outcomes:
At the end of the course student will be able to
1. Analyze the risk of decision making in a firm.
2. Describe and explain the determinants of the size and structure of firms.
4. Explain the marketing research, product life cycle, motivation and leadership.
5. Describe the competitive nature of the firm and team working.
MAIR4* PROBABILITY AND NUMERICAL TECHNIQUES

Course Learning Objectives
Objective is to introduce
1. various standard probability distributions and its applications to engineering problems.
2. testing of hypothesis and various test for testing of hypothesis.
3. correlation and regression for the given data.
4. numerical methods for Solving Linear Systems
5. numerical method for solving non-linear equations
6. numerical interpolation, differentiation and integration
7. numerical Solutions of Ordinary Differential Equations
8. numerical Methods to solve partial differential equations.

Course Content
Definitions of probability, Bayes’ theorem-Random variable –Standard distributions(Binomial, Poisson and Normal distributions), Moment generating function, Characteristic function.
Central Limit Theorem, Law of large numbers, Tests of significance, large and small samples, t-test, F-test and chi-square test for goodness of fit - Simple-Multiple and partial correlation –Regression.
Solution of nonlinear equation -Bisection method -Secant method -Regula falsi method
-Newton-Raphson method for f(x) = 0 and for f(x,y) = 0, g(x,y) = 0
Newton’s forward, backward and divided difference interpolation –Lagrange’s interpolation –Numerical Differentiation and Integration –Trapezoidal rule – Simpson’s 1/3 and 3/8 rules

References

Course outcomes
completion of the course, students should be able to:
1. find probabilistic models for statistical problem
2. apply testing of hypothesis using t-test, F-test and $\chi^2$-test.
3. Compute regression lines and calculate correlation coefficients.
5. Compute interpolating polynomial for the given data
6. Compute numerical differentiation and integration.
7. Compute numerical solution of ordinary differential equations by finite difference method.
8. Compute numerical solution of partial differential equations by finite difference method.

**HSIR14 PROFESSIONAL ETHICS**

**Course Learning Objectives**
1. Identify the core values that shape the ethical behavior of an engineer
2. To create an awareness on professional ethics and human values
3. To appreciate the rights of others

**Course Content**
Engineering as experimentation - engineers as responsible experimenters - Research ethics Codes of ethics - Industrial Standard - Balanced outlook on law - the challenger case study.
Multinational corporations - Business ethics - Environmental ethics - computer ethics - Role in Technological Development - Weapons development engineers as managers - consulting engineers - engineers as expert witnesses and advisors - Honesty - leadership - sample code of conduct ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management Institution of electronics and telecommunication engineers (IETE), India, etc.,

**Reference**

Course Outcome
At the end of the course student will be able to
1. Understood the core values that shape the ethical behaviour of an engineer
2. Exposed awareness on professional ethics and human values.
3. Known their role in technological development
CEPC10 ENGINEERING MECHANICS

Course Learning Objectives

1. To explain the importance of mechanics in the context of engineering and conservation equations
2. To explain the significance of centroid, center of gravity and moment of inertia.
3. To introduce the techniques for analyzing the forces in the bodies.
4. To analyze the internal member forces acting on cables and trusses.
5. To understand the basic principles of dynamics.

Course Content

Fundamentals: Mechanics and its relevance, concepts of forces, laws of mechanics – Lami’s Theorem, Concept of free-body diagram, centroids, center of gravity, area moment of inertia, mass, moment of inertia.

Friction: Laws of friction, application of laws of friction, wedge friction, body on inclined planes.

Statics: Principles of statics, Types of forces, concurrent and non-concurrent forces, composition of forces, forces in a plane and space, stresses and strains, elastic constant.

Beams, Cables and Trusses: Beams subjected to concentrated loads, UDL with supports at different levels- analysis of Trusses – method of joints – method of sections.

Dynamics: Principles of dynamics, D’Alembert’s principle, conservation of momentum and energy, vibrations of simple systems.

References


Course outcomes

The terminal objectives of the course is that, on successful completion of teaching-learning and evaluation activities, a student would be able to identify and analyze the problems by applying the fundamental principles of engineering mechanics and to proceed to research, design and development of various engineering systems.

CEPC11 MECHANICS OF SOLIDS

Course Learning Objectives

1. To learn about the concept of stress, strain and deformation of solids
2. To know the concepts of virtual work, strain energy and principal stress
3. To learn the bending moment, shear force and the corresponding stress distribution for different types of beams
4. To study the different methods of finding deflection of beams and trusses and understand the torsion behaviour of solid and hollow circular shafts
5. To analyse columns of varying end support conditions by Euler Theory and Rankine’s formula

Course Content
Simple, compound and thermal stresses - composite bars – strain energy and resilience - Principal stress and principal planes Mohr’s circles
Shear force and bending moment for different determinate beams – Euler Bernoulli beam theory - Stress distribution at a cross section due to Bending Moment and Shear Deflection of beams using double integration and semi graphical methods such as conjugate beam and moment area method- Principle of virtual displacement and virtual forces - Castigliano's first theorem - Maxwell's reciprocal theorem.
Strain energy and dummy unit load approaches to deflection of trusses - Theory of torsion - Torsion of circular and hollow circular shafts and shear stresses due to torsion Theory of columns: Axial load- Euler's theory-Rankines formula, combined bending and axial load

References

Course outcomes
On completion of the course, the students will be able to:
1. determine the strength parameters of the materials and solve principal stress and principal plane problems
2. determine shear force, bending moment, bending and shear stress distribution
3. determine deflection of a beam for various loading conditions and also trusses
4. analyze members subjected to torsion
5. visualize the behavior of column for combined bending and axial loading

CEPC12 HYDRAULICS AND FLUID MACHINERY

Course Learning Objectives
1. To understand the properties of fluids and fluid statics.
2. To solve kinematic problems such as finding particle paths and stream lines.
3. To use important concepts of continuity equation, Bernoulli’s equation and turbulence, and apply the same to problems.
4. To study about specific speed and performance characteristics of different types of turbines.
5. To study types of centrifugal Pumps, work done and efficiency of the different types centrifugal pumps and also study about performance of pumps & characteristic curves.

Course content
Continuum concept - CGS, MKS and SI systems - Properties of Fluids - Ideal and real fluid - Flow classification, stream lines, streak lines, continuity equation, velocity, tangential, normal, local and convective acceleration, types of fluid motions, stream function, velocity potential function, flownet.
Pressure at a point – pascal law - Hydrostatic law - pressure measurement – Hydrostatic forces on immersed plane and curved surfaces, Buoyancy, Stability of floating and submerged bodies. Bernoulli’s equation, Energy correction factor, Coefficients of contraction, velocity and discharge, free vortex motion, Analysis of free liquid Jet, Cavitation.
Laminar and turbulent flow - Reynold's number - Navier stoke equations of motion - shear stress and pressure gradient - Laminar flow between parallel plates - Couette flow - Hagen Poiseuille equation for flow through circular pipes.
Centrifugal pump - minimum speed to start the pump – multistage Pumps –Positive displacement pumps –reciprocating pump - negative slip - flow separation conditions - air vessels -indicator diagram and its variation - savings in work done- Turbines - draft tube and cavitations –classification - radial flow turbines - axial flow turbines – Impulse and Reaction turbines.

References

Course outcomes
On completion of the course, the students will be able to:
1. Understands the basic principles of fluid mechanics.
2. Understands the concepts of statics and dynamics of fluid flow.
3. Develops skills in analyzing fluid flows through the proper use of modeling and the application of the basic fluid-flow principles.
4. Acquire knowledge in the selection of type of turbine required with reference to available head of water and also used for Identification of type of turbine with estimated specific speed.
5. Capable of estimating efficiency of different pumps and performance of the pumps with the study of characteristics curves.

**CEPC13 CONCRETE TECHNOLOGY**

**Course Learning Objectives**

1. To understand the properties of ingredients of concrete
2. To study about the concrete design mix
3. To study the behaviour of concrete at its fresh and hardened state
4. To know about the procedures in concreting
5. To understand special concrete and their use

**Course content**

Introduction - Concrete materials - Cement including Special Cements - Physical tests on cement - Concrete materials - Tests on aggregates - Quality of Water for mixing and curing - use of sea water for mixing concrete - Mineral and chemical Admixtures.

Mix Design - factors influencing mix proportion - Mix design by ACI method and I.S. code method.

Batching - Mixing - Transportation - Placing of concrete - curing of Concrete. Fresh and hardened properties of Concrete - Quality control - Sampling and testing - Acceptance criteria.


Special Concrete - Lightweight concrete - High Density Concrete - Hot and Cold weathering Concrete - Fibre reinforced concrete - Polymer concrete - Ferro cement - Ready mix concrete - High Performance Concrete - Self compacting concrete - Sustainability of concrete.

**References**

5. IS 456 (2000), Plain and Reinforced Concrete - Code of Practice, Bureau of Indian Standards (BIS), New Delhi, India.
6. IS 10262 (2019), Concrete Mix Proportioning – Guidelines, Bureau of Indian Standards (BIS), New Delhi, India.
7. ACI 318 (2014), Building code requirements for structural concrete (ACI 318-2014) and Commentary (ACI 318R-2014). American Concrete Institute, Detroit, MI, USA.
Course outcomes
On completion of the course, the students will be able to:
1. test all the concrete materials as per IS code
2. design the concrete mix using ACI and IS code methods
3. determine the properties of fresh and hardened of concrete
4. ensure quality control while testing/ sampling and acceptance criteria
5. design special concretes and their specific applications

CEPC14 SURVEYING

Course Learning Objectives
1. To understand the importance of surveying in the field of civil engineering
2. To get introduced to different plane and geodetic surveying applications such as chain, compass, plane table, leveling, triangulation, trigonometric leveling etc
3. To understand the significance of each method in civil engineering and master the skill to carry out proper surveying method on the field.
4. To design numerical solutions for carrying out surveying in civil engineering field.
5. To get introduced to modern advanced surveying techniques involved such as remote sensing, Total station, GPS etc.

Course content
Introduction and Principles of surveying – Classification – Brief introduction to chain surveying – Compass surveying – Bearing of survey lines – systems and conversions – Local attraction – Latitude and departure – Traverse adjustment of closing errors
Plane Table surveying – instruments and accessories – methods of plane tabling - Levelling – Levelling instruments – Temporary and permanent adjustments – Booking – Reduction to levels – Correction for Curvature and refraction

References
Course Outcomes
On completion of the course, the students will be able to

1. to plan a survey, taking accurate measurements, field booking, plotting and adjustment of traverse can be understood through leveling, plane table surveying etc
2. Understanding of fundamental function, use of Theodolite and tacheometry in practical applications such as road alignment, height of building, control point setting etc, g with respect to utility and precision through the use of Theodolite, tacheometry
3. To understand the concepts of geodetic surveying in plan a large scale survey
4. To use the principles of curve, building setting and understand the importance of advances surveying measurement techniques in civil engineering applications.

CEPC15 ANALYSIS OF INDETERMINATE STRUCTURES

Course Learning Objectives
1. To learn the concepts of indeterminacy and methods for calculating bending moment and shear force on basic indeterminate beams
2. To understand the concept of analysis of indeterminate structures by various classical methods
3. To study the use of ILD for determinate structure
4. To learn the concepts of moving loads and its effect on structures
5. To understand the approximate methods for analysis multistorey plane frames

Course Content
Propped cantilevers, Continuous and Fixed Beams – Clapeyron’s 3 moment theorem- Bending moment and shear force diagrams – static and kinematic indeterminacy
Moving loads -single load - two point loads - several points loads - maximum bending moment and maximum shear force - equivalent u.d.l. - absolute maximum bending moment.
Enveloping curves for maximum bending moment and maximum shear force and determination of equivalent UDL, ILD for shear, moment and reactions for beams and trusses - Reversal of stresses under live load.
Analysis of multistorey frames for gravity and lateral loads by approximate methods - Portal and Cantilever methods

References
1. Hibbeler, R.C., Structural Analysis, Pearson, 2017
Course outcomes
On completion of the course, the students will be able to:

1. Analyse the basic indeterminate beams such as Propped cantilevers, Continuous and Fixed Beams
2. use various classical methods for analysis of indeterminate structures
3. determine the effect of support settlements for indeterminate structures
4. apply the concepts of ILD and moving loads on determinate structures
5. apply approximate methods to analyse multistorey plane frames

Course Learning Objectives
1. To explain how three phase system is used in soil and how are soil properties estimated using three phase system
2. To explain the role of water in soil behaviour and how soil stresses, permeability and quantity of seepage including flow net are estimated
3. To emphasise the importance of soil stress distribution and stress influence due to varies loads.
4. To explain how soil shear parameters are affected by drainage conditions
5. To estimate the magnitude and time-rate of settlement due to consolidation

Course content
Historical development of Soil Engineering - Origin and general types of soils - soil structure, clay minerals-Three phase system- Identification and Classification of soils.

Soil water - capillary phenomena - concept of effective and neutral stresses – Permeability - determination of coefficient of permeability in the laboratory - Seepage flow - Head, gradient, pressure - steady state flow - two dimensional - flow net.

Vertical stress distribution in soil - Boussinesq and Westergaard's equation - Newmark's influence chart - principle, construction and use - Equivalent point load and other approximate methods - pressure bulb - Compaction.

Shear strength - Mohr-Coulomb failure criterion - shear strength tests – Different drainage conditions - Shear properties of cohesionless and cohesive soils - Use of Mohr's circle - relationship between principal stresses and shear parameters.

Compressibility and consolidation - Terzaghi's one dimensional consolidation theory - pressure void ratio relationship - preconsolidation pressure - Total settlement and time rate of settlement - coefficient of consolidation - curve fitting methods - Correction for construction time.

References

Course Outcomes
Upon completion of this course, the students will be able to

1. Understand the importance of geotechnical engineering in civil engineering and do proper soil classification and the phase system to solve problems
2. Solve any practice problems related to soil stresses estimation, permeability, seepage including flow net diagram.
3. Do proper stress estimation under any system of foundation loads
4. Estimate appropriate soil strength parameters with respect to the drainage conditions
5. Solve any practical problems related to consolidation like consolidation settlement, time rate of settlement

CEPC17 ENVIRONMENTAL ENGINEERING – I

Course Learning Objectives
1. To make the students conversant with sources of water and its demand
2. To understand the basic characteristics of water and its determination
3. To expose the students to understand components of water supply lines
4. To provide adequate knowledge about the water treatment processes and its design
5. To have adequate knowledge on distribution network and water supply to buildings

Course Content
References

Course Outcomes
On completion of the course, the students will be able to
1. analyze various water quality parameters
2. forecast the population and estimate water demand
3. differentiate various intake structures and select suitable pipe material for water conveyance
4. design various water treatment units and distribution network

CEPC18 ENVIRONMENTAL ENGINEERING-II

Course Learning Objectives
1. To learn the basics of sewage composition and its characteristics
2. To have adequate knowledge about various sewage treatment processes and its design
3. To provide the adequate information on various disposal standards for industrial effluents
4. To study the effect of air pollution and its control measures
5. To gain knowledge about solid waste disposal and Environmental Impact Assessment

Course Content

References

Course Outcomes
On completion of the course, the students will be able to
1. determine the various characteristics of sewage
2. design various sewage treatment units
3. predict the quality of water in river, using mass balance approach and specific models
4. select suitable treatment units for specific industries
5. identify the sources of air pollutants, effects on human health and the environment

CEPC19 GEOTECHNICAL ENGINEERING-II

Course Learning Objective
1. To emphasize the importance of soil investigations including destructive and non-destructive methods.
2. To explain how earth pressure theory is important in retaining structure design
3. To explain the concept of bearing capacity and how to estimate the safe bearing capacity for various foundation system including settlement consideration
4. To explain how to select a suitable shallow foundation system for various site conditions and also to carry out analysis of different foundation system
5. To explain in what circumstances pile is needed and how to estimate pile and pile group capacity under various soil conditions

Course content
Soil exploration - Planning - Augur boring - Soundings - Sampling - Plate load test, static and dynamic penetrations tests - geophysical explorations
Lateral Earth Pressure – Plastic equilibrium - Rankine's theory - Active and passive earth pressure for cohesionless and cohesive soils - Earth pressure at rest - Coloumb's wedge theory - Rebhann's and Culmann's graphical solutions, Stability analysis
Foundation - functions and requisites- Different types - choice of foundation type – general principles of design. Bearing capacity - types of failures - Prandtl's and Terzaghi's bearing capacity analysis - Bearing capacity based on settlement and building codes
Shallow foundation - spread footings - combined footings - trapezoidal and strap footings -Raft foundation - Contact pressure distribution - settlement analysis - Types of settlement, Control
Deep foundation - piles - types - load carrying capacity of pile - static and dynamic formula - pile load test - penetration test - pile groups - Efficiency - Feld's rule – Converse Labarre formula, Settlement of piles and pile groups - Negative skin friction – under-reamed piles
References


Course outcomes

Upon completion of this course, the students will be able to

1. Understand the importance of soil investigation for any civil engineering construction
2. To analyse earth retaining structures in various types of soil medium
3. Do proper bearing capacity estimation including IS code methods
4. Do proper foundation proportioning for any kind of shallow foundation system and also get exposed in foundation analysis
5. To estimate pile and pile group capacity for any kind of soils including group efficiency and negative friction

CEPC20 HIGHWAY AND PAVEMENT ENGINEERING

Course Learning Objectives

1. To understand the importance of transportation, characteristics of road transport, highway planning, alignment and surveys
2. To know the geometric design of highways
3. To study traffic characteristics and principles of intersection design
4. To know about pavement materials and design
5. To understand pavement construction, distresses in pavements and maintenance options

Course Content


Pavement Materials and Design: Desirable properties of subgrade soil, road aggregates and bituminous materials - Pavement components and their functions - Factors influencing the design of pavements - Design of flexible and rigid pavements as per IRC.


References


Course outcomes

Upon completion of this course, the students will be able to

1. carry out surveys involved in planning and highway alignment
2. design cross section elements, sight distance, horizontal and vertical alignment
3. implement traffic studies, traffic regulations and control, and intersection design
4. determine the characteristics of pavement materials and design of pavements
5. understand construction and maintenance of pavements

CEPC21 BASIC REINFORCED CONCRETE DESIGN

Course Learning Objectives

1. To study the stress strain behavior of steel and concrete
2. To understand the concept of working stress and limit state methods
3. To gain the knowledge of limit state design for flexure, shear, torsion, bond and anchorage
4. To understand the behavior of columns subjected to eccentric load and use of interaction diagrams
5. To study the design of various foundation

Course Content

Stress-strain behavior of steel and concrete- Introduction to working stress method (WSM) - permissible stresses. Ultimate load method (ULM) - Limit state method--
Probabilistic Analysis and Design - Characteristic strength and load - Partial safety factor – Codal recommendations
Behavior in flexure – Modular ratio and cracking moment, Transformed sections, Analysis at WSM and ULM - Design of singly and doubly reinforced beams, T and L beams – Serviceability Limit States: Deflection and Cracking
Design of Slabs - one way and two way slabs for different edge conditions - Yield line theory - Flat slabs - Stair cases - different types.
Design of compression members - Columns - axially loaded and eccentrically loaded columns Interaction diagrams - biaxial bending and slender columns– effective length
Footings - isolated footings - square, rectangular and circular footings - Combined footing

**Note:** Assignments include the design and drawings of various R.C.C structural elements.

**References**
7. ACI 318 (2014), Building code requirements for structural concrete (ACI 318-2014) and Commentary (ACI 318R-2014). American Concrete Institute, Detroit, MI, USA

**Course outcomes**
On completion of the course, the students will be able to:
1. apply the fundamental concepts of working stress method and limit state method
2. use IS code of practice for the design of concrete elements
3. design the beams, slab, stairs, column and footing
4. draw various RCC structural elements
CEPC22 HYDROLOGY AND IRRIGATION ENGINEERING

Course Learning Objectives

1. To provide knowledge on principles and processes governing the movement of water through the hydrologic cycle, including surface runoff, infiltration, and groundwater flow.
2. To develop the skills in understanding design storm estimation, hydrologic statistics, and frequency analysis techniques applied to problems of engineering hydrologic design.
3. To understand the basic types of irrigation, crop water assessment and command area development and water management, managing climate change impacts on the water resources.
4. To provide knowledge on design of diversion, impounding and canal network structures

Course Content

The global hydrological cycle, components of the hydrological cycle, Surface water hydrology and groundwater hydrology, measurement of precipitation, evapotranspiration, infiltration, and streamflow. Water balances, urban hydrology, surface runoff, hyetograph, unit hydrograph and S-hydrograph, Flow duration curve, Synthetic and GIUH derivation for flood estimation, hydrological effects of climate change.

Design storm, Probable Maximum Precipitation, Probable Maximum Flood Design Flood, Flood frequency analysis, Intercity-Duration-Return period, Statistical analysis of hydrological data -Flood and drought.


Diversion and impounding structures-Types of impounding structures, Gravity dam, Earth dams, Forces on a dam -Design of Gravity and Earth dams, Diversion Head works, Distributory Regulators, Offtake alignment, cross regulators, their functions, design of Distributory, Head regulators – their functions and design, Canal fall, Canal drop, Canal escape and Cross drainage works, seepage and waterlogging.


References

Course outcomes
By the end of this course the students will
1. gain background in hydrology an understanding of water resources systems, flood flows and flood routing
2. acquire the knowledge on hydrological cycle and interpret precipitation data and evapotranspiration.
3. assess the crop water requirement for various crops in the command area and soil water relationships
4. know the knowledge in the design of diversion structures and reservoirs
5. understand the complete design of various Canal irrigation system

CEPC23 RAILWAY, AIRPORT AND HARBOUR ENGINEERING

Course Learning Objectives
1. To know about the basics and design of various components of railway engineering.
2. To study about the types and functions of track, junctions and railway stations.
3. To learn about the aircraft characteristics, planning and components of airport.
4. To study about the types and components of docks and harbours.
5. To know about various urban transportation systems and Intelligent Transportation Systems.

Course content
Railway Engineering - Location surveys and alignment - Permanent way - Gauges - Components - Functions and requirements - Geometric design
Track Junctions-Points and crossings - types and functions - design and layout - simple problems - Railway stations and yards. Signaling and interlocking - control systems of train movements.
Airport Engineering-Aircraft characteristics - Airport obstructions and zoning - Runway - taxiways and aprons- Terminal area planning
Docks and Harbours - Types - Layout and planning principles- breakwaters - docks-wharves and quays - Transit sheds- warehouses- navigation aids.

References

Course outcomes
On completion of the course, the students will be able to:
1. Carry out the surveys for railways, airports and harbours.
2. Perform geometric design for the three modes.
3. Plan the layout of different types of terminals.
4. Apply the principles of bus transit, MRTS and LRT.
5. Demonstrate the fundamentals of Intelligent Transportation Systems.

**CEPC24 BASIC STEEL STRUCTURAL ELEMENTS**

**Course Learning Objectives**

1. To understand the provisions of IS800-2007 code of practice for the design of Compression, Tension and Flexural members using various cross-sections.
2. To study the behavior and design of compression and tension members using simple and built-up sections.
3. To understand behavior of flexural members and the design laterally restrained and unrestrained beams.
4. To study the design of bolted and welded connections and arranging field visit to industries.

**Course content**

Introduction - elastic and plastic properties of steel sections – stress distribution under various internal forces. Design of axially loaded tension members - Types of tension members - modes of failures

Design of axially loaded compression members – Plastic moment and shape factor - section classifications - effective length - slenderness ratio – simple sections – built-up sections - design of lacings and battens - single angle and double angle strut – continuous and discontinuous strut.


Bolted connections - types of bolts - resistance of bolted connections under various failure modes – shear moment resistant connections - design of beam and columns splice.

Welded connections - types - strength of welds - design of fillet and butt welds - shear and moment resistant connections - design and detailing of connections.

**Note:** Assignments include the design and drawings of various steel structural elements.

**References**

6) Online Teaching Material – Institute for Steel Development and Growth (INSDAG)

Course outcomes

On completion of the course, the students will be able to:

1. Apply the IS code of practice for the design of steel structural elements.
2. Design compression and tension members using simple and built-up sections.
3. Calculate forces on the various members of the truss and design them.
4. Analyze the behavior of bolted connections and design them.
5. Design welded connections for both axial and eccentric forces.
(III.a) PROGRAMME ELECTIVE (PE)

CEPE10 CONSTRUCTION TECHNIQUES AND EQUIPMENTS

Course Learning Objectives:
1. To learn the principles of construction of building components
2. To know about prefabricated construction and building services
3. To study the different repair and rehabilitation technique
4. To understand the planning and operation of various construction equipment

Course Content

Prefabricated structures and building services: Prefabricated panels & structures, Production, Transportation and Erection of structures, Sound insulations, Ventilations, Fire resisting construction, Damp proofing, Termite proofing.

Basics of construction equipment: Factors affecting the selection of equipment, economic life of equipment, cost of equipment, maintenance of equipment.

Construction equipment and machinery: Earthwork equipment, Hoisting and lifting equipment, Material handling equipment, Concrete equipment, Dewatering equipment.

Construction automation and robotics - construction equipment: graders, scrapers, rollers, etc.

References

Course outcomes
On completion of the course, the students will be able to:
1. Supervise and execute all the construction jobs with the knowledge of the different construction techniques
2. Identify the building defects and apply suitable repair techniques to rectify them
3. Evaluate the costs of equipment and make proper selection of the suitable construction equipment
4. Ensure the proper completion of a construction task using particular construction equipment
CEPE11 ELEMENTARY STRUCTURAL DYNAMICS

Course Learning Objectives
1. To introduce the concepts of dynamic systems
2. To study the dynamic response of SDOF
3. To study the dynamic response of MDOF
4. To introduce the continuous systems subjected to different types of dynamic loads
5. To learn free and forced vibrations response of structural systems

Course content
Dynamic analysis - Elements of vibratory systems and Simple Harmonic Motion.
Free vibration of Single Degree of Freedom Systems; undamped and damped systems. Viscous damping and Coulomb damping. Evaluation of damping
Forced vibration of undamped and damped systems – Structures subjected to harmonic loads
Differential equation of motion – Thin Beam flexural vibration analysis – Beam functions.
Free vibration of Multi-Degree of freedom systems- Solution of the eigen value problem - Iteration due to Holzer and Stodola. Idealization of multi-storeyed - lumped SDOF system

References

Course outcomes
On completion of the course, the students will be able to:
1. Apply the concepts of dynamic systems.
2. Identify, formulate and solve dynamic response of SDOF.
3. Identify, formulate and solve dynamic response of MDOF.
4. Analyse continuous systems subjected to different types of dynamic loads.
5. Identify, formulate and solve free and forced vibrations response of structural systems.

CEPE12 MAINTENANCE AND REHABILITATION OF STRUCTURES

Course Learning Objective
To provide a comprehensive knowledge on the diagnosis the damage, condition assessment of structures and quality of material application relating to maintenance and rehabilitation of structures.
Course content
Performance of construction materials and components in services for strength, permeability, thermal properties and cracking effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, Effects of cover thickness

Maintenance and Diagnosis
Maintenance, Repair and rehabilitation, Facets of Maintenance, Importance of Maintenance, Preventive measures based on various aspects of inspection- Condition assessment and rating procedure for evaluating a damaged structure. Diagnosis of construction failures. Different types of concrete deterioration

Corrosion damages and protection

Materials and Techniques

Strengthening and demolition
Strengthening of existing structures - repairs to overcome low member strength, deflection, cracking, chemical disruption, weathering, wear, fire, leakage, marine exposure, coatings for set concrete and steel reinforcement. Demolition techniques of structures - case studies.

References

Course outcomes
On completion of the course, the students will be able to:
1. Diagnosis the damage of distress structures
2. Investigate the condition assessment of structures
3. Select the proper repair materials and its application  
4. Select the method to Strengthen the distressed structures

CEPE13 CONSTRUCTION MANAGEMENT

Course Learning Objectives
1. To know the managerial duties and responsibilities 
2. To learn about man power planning and estimation of equipment cost  
3. To understand project planning and scheduling concepts  
4. To know the types of construction contracts and their drafting 
5. To learn the application of computer software in construction management

Course content
Introduction: project forms, management objectives and functions; organizational chart of a construction company; manager’s duties and responsibilities; public relations; Leadership and team - work; ethics, morale, delegation and accountability.

Man and Machine: Man-power planning, training, recruitment, motivation, welfare measures and safety laws; machinery for Civil Engineering., earth movers and hauling costs, factors affecting purchase, rent, and lease of equipment, and cost- benefit estimation.

Planning, scheduling and Project Management: Planning stages, construction schedules and project specification, monitoring and evaluation; Bar-chart, CPM, PERT, network- formulation and time computation.

Contracts: Types of contracts, Formation of contract – Contract conditions – Contract for labour, material, design, construction – Drafting of contract documents based on IBRD/ MORTH Standard bidding documents – Construction contracts – Contract problems – Arbitration and legal requirements

Computer applications in construction management: Software for project planning, scheduling and control.

References

Course outcomes
On completion of the course, the students will be able to:
1. Perform the role of a manager efficiently with precise knowledge of the roles and responsibilities 
2. Estimate the man power requirement and can recruit suitable candidates for construction jobs
3. Analyse and compare the cost estimates of different construction equipment
4. Compute construction schedules, network diagrams and time estimates of projects
5. Evaluate and make tenders and contract documents of their own
6. Use the computer software to monitor real-time projects

**CEPE14 STRUCTURAL SYSTEM ANALYSIS**

**Course Learning Objectives**

1. To understand the importance of degrees of freedom and the concept of principle of superposition
2. To know about the concept of strain energy and principle of virtual work
3. To study the transformation of system matrices and element matrices for the determinate and indeterminate structures
4. To analyze the forces in structures like continuous beam, truss and frames using stiffness and flexibility method
5. To understand the behaviour of structures due to thermal expansion and lack of fit

**Course Content**


Determinate and indeterminate structures - Transformation of element matrices to system matrices - Transformation of system vectors to element vectors - Normal coordinates and orthogonal transformations.

Flexibility method applied to statically determinate and indeterminate structures - Choice of redundants - Transformation of redundants - Internal forces due to thermal expansion and lack of fit.

Development of the method - Internal forces due to thermal expansion and lack of fit - Application to symmetrical structures - Comparison between stiffness and flexibility methods.

**References**

2. Rajasekaran S, Computational Structural Mechanics, Prentice Hall of India, New Delhi, 2001

**Course outcomes**

On completion of the course, the students will be able to:

1. apply the basic concepts of matrix methods in structural analysis
2. develop stiffness and flexibility matrices
3. analyze the structures using flexibility and stiffness method
4. transform system coordinates to element coordinates
5. determine the forces in various members due to lack of fit and thermal expansion

CEPE15 PRESTRESSED CONCRETE STRUCTURES

Course Learning Objectives
1. To learn the principles, materials, methods and systems of prestressing
2. To know the different types of losses and deflection of prestressed members
3. To learn the design of prestressed concrete beams for flexural, shear and tension and to calculate ultimate flexural strength of beam
4. To learn the design of anchorage zones, composite beams, analysis and design of continuous beam
5. To learn the design of water tanks

Course Content
Principles of prestressing - Materials of prestressing - Systems of prestressing - Losses in prestress – Analysis of members - Deflection of Prestressed Concrete members.
Analysis of Cantilever and Continuous beams - Cable layout - Linear transformation - Concordant cables.
Design of compression members and tension members. Special topics Circular prestressing - Water tanks - Pipes - Analysis and design - IS Codal provisions.

References
5. IS 1343: 2012. Prestressed concrete - code of practice, Bureau of Indian Standards (BIS), New Delhi, India., 2012

Course outcomes
On completion of the course, the students will be able to:
1. design a prestressed concrete beam accounting for losses
2. design the anchorage zone for post tensioned members
3. design composite members
4. design continuous beams
5. design water tanks

CEPE16 ADVANCED REINFORCED CONCRETE DESIGN

Course Learning Objectives:
1. To understand the design concept of various structures and detailing of reinforcements
2. To understand the design of underground and elevated liquid retaining structures
3. To study the design of material storage structures
4. To know the effect of temperature on concrete structures
5. To study the design of bridges subjected to IRC loading

Course Content
Earth Retaining structures - Retaining walls - types - cantilever and counterfort - design - drainage and other construction details. Liquid Retaining structure - Water tanks - types - square, rectangular, circular - Design of underground and elevated tanks - design of staging - spherical & conical roof for circular tanks. Material storage structures - Determination of lateral pressure on side walls of bunker - Rankine's theory - design of bunker - design of circular silo using Jansen's theory. Environmental Structures - Chimneys - Principles and Design - Design of long columns. Transportation structures - Bridges - Slab bridge - Design of single span slab bridge - Tee beam bridge - Design of Tee beam bridge with stiffness - Tee beam bridge with cross girders - Introduction to earthquake design

Note: Assignments include the design and drawings of various RCC structures.

References

Course outcomes:
On completion of the course, the students will be able to:
1. apply the concepts of liquid retaining structures
2. design material storage structures using various theories
3. apply the concepts of environmental and transportation structures
4. demonstrate the detailing of reinforcement
5. draw the various RCC structures
CEPE17 ADVANCED STEEL STRUCTURAL ELEMENTS

Course Learning Objectives
1. To study the behavior and design of member subjected to combined forces
2. To understand the analysis procedure and design of base plate subjected to different loading conditions
3. To study the design of Gantry girder, welded plate girder, stiffeners and connections.
4. To calculate the wind forces on various types of structures.
5. To understand the design of industrial buildings/bents/
6. To understand the design of moment resisting connections used in steel frames

Course content
Introduction to beam-column - behavior - strength interaction - design of beamcolumn - beam - column subjected to combined forces - column bases - slab base - gusseted base - moment resistant base plate.
Design of industrial building - roofing, cladding and wall material - structural components and framing - types of roof trusses - components - wind load estimation for different type of structures for various zones.
Approximate analysis of industrial bents/PEB - design of purlins and wall girts using Channel and Angle sections; cold formed steel purlin – Design of wind bracings – wind girders – gable columns.
Analysis and design of framed connections.
Note: Assignments include the design and drawings of various steel structures.

References
5. SP6 (1) - 1964, IS hand book for structural Engineers. Bureau of Indian Standards, New Delhi.

Course outcomes
On completion of the course, the students will be able to:
1. Design eccentrically loaded compression members (Beam-Columns) and their base plates.
2. Design welded plate girder and other components.
3. Design Gantry girder for industrial structures
4. Calculate the wind load acting on various structures to be built in various locations.
5. Design Industrial structures and their components such as girts, wind girders, bracings systems purlins etc

**CEPE18 ADVANCED STRUCTURAL ANALYSIS**

**Course Learning Objectives**
1. To understand the influence line concepts for indeterminate structures
2. To understand the methods of analysis of intermediate trusses for external loads, lack of fit and thermal effect
3. To study behaviour of arches and their methods of analysis
4. To know the concept and analysis of cable stayed bridge
5. To study the multi storey frames subjected to gravity loads and lateral loads

**Course content**
Influence lines - Maxwell Betti’s theorem - Muller Breslau's principle and its application. Influence lines for continuous beams and single bay, single storey portals with prismatic members.
Analysis of plane truss with one or two redundants - trusses with lack of fit - Thermal stresses - Settlement of supports - Trussed beams.
Theory of arches - Analysis of three hinged, two hinged and fixed arches - influence lines, rib shortening, settlement and temperature effects.
Analysis of cables - Suspension bridges with three and two hinged stiffening girders - influence lines.
Analysis of multistorey frames for gravity and lateral loads by approximate methods - Substitute frame - Portal and Cantilever methods – Introduction to earthquake load

**References**

**Course outcomes**
On completion of the course, the students will be able to:
1. Demonstrate the concepts of qualitative influence line diagram for continuous beams and frames.
2. Apply the methods of indeterminate truss analysis.
3. Demonstrate the behavior of arches and their methods of analysis.
4. Analyse cable suspension bridges.
5. Analyse multistory frames subjected to gravity loads and lateral loads.

CEPE19 TRAFFIC ENGINEERING AND SAFETY

Course Learning Objectives
1. To understand the fundamentals of traffic stream characteristics
2. To learn the skills of traffic control and management
3. To learn the methods of safe intersection design
4. To learn the importance and methods of accident investigation and prevention
5. To understand the concepts of road safety audit and safety improvement methods

Course Content


References
3. IRC SP: 88 – 2010
Course Outcomes
On completion of the course, the students will be able to:

1. Carry out traffic surveys
2. Implement traffic system management
3. Carry out intersection design for safety
4. Record and analyse accident data and suggest countermeasures
5. Carry out road safety audit

CEPE20 PAVEMENT ANALYSIS AND DESIGN

Course Learning Objectives

1. To study about the types and components of pavements
2. To learn about the stresses in flexible pavements and equivalent single wheel load
3. To study the design of flexible pavements
4. To learn about the stresses in rigid pavements
5. To study the design of rigid pavements

Course content
Pavements - Types and Components - Factors affecting Design and Performance of Pavements, Comparison between Highway and Airport pavements - Functions and Significance of Sub grade properties.

Stresses in Flexible Pavements - Stresses and Deflections in Homogeneous Masses - Burmister's 2-layer, 3-layer Theories - Wheel Load Stresses, ESWL of Multiple Wheels, Repeated Loads and EWL factors.


Stresses in Rigid Pavements - Types of Stresses and Causes - Factors influencing the Stresses, General conditions in Rigid Pavement Analysis, ESWL, Wheel Load Stresses, Warping Stresses, Friction Stresses, Combined Stresses.

Rigid Pavement Design - Types of Joints in Cement Concrete Pavements and their Functions, Joint Spacing, Design of Slab Thickness, Design of Joint Details for Longitudinal Joints, Contraction Joints and Expansion Joints, IRC Method of Design.

References

Course outcomes
On completion of the course, the students will be able to:

1. Identify the pavement components and compare highway and airport pavements.
2. Calculate the stresses and ESWL in flexible pavements.
3. Design the flexible pavement using empirical, semi empirical and IRC methods.
4. Analyze the warping, friction, wheel load stress and calculate the combined stress.
5. Design rigid pavements by IRC method and evaluate the pavements.

**CEPE21 TRANSPORTATION PLANNING**

**Course Learning Objectives**
1. To know about the processes and concepts of transportation planning
2. To study about trip generation
3. To study about trip distribution
4. To study about modal split analysis
5. To study about trip assignment

**Course content**
Transportation Planning Process and Concepts - Role of transportation - Transportation problems - Urban travel characteristics - Concept of travel demand - Demand function - demand estimation - Sequential, recursive and simultaneous processes
Trip Generation Analysis - Zoning - Types and sources of data – O-D studies - Expansion factors - Accuracy checks - Trip generation models - Zonal models - Household models - Category analysis - Trip attractions of work centers.
Trip Distribution Analysis - Trip distribution models - Growth factor models - Gravity models - Opportunity models.
Mode Split Analysis - Mode split Models - Mode choice behaviour, competing modes, Mode split curves, Probabilistic models.
Traffic Assignment - Route split analysis: Elements of transportation networks, Nodes and links - minimum path trees - all-or-nothing assignment - Multipath assignment - Capacity restraint.

**References**

**Course outcomes**
On completion of the course, the students will be able to:
1. Apply the principles of the transportation planning process and demand estimation.
2. Analyse the trip production and trip attraction models.
3. Analyse the growth factor, gravity and opportunity models.
4. Apply the mode choice behaviour and mode split models.
5. Apply the shortest path models for route assignment.

**CEPE22 AIR POLLUTION MANAGEMENT**

**Course Learning Objectives**

1. To provide general understanding of air quality and its impact on the environment
2. To understand the fundamentals of meteorology and stability of atmosphere
3. To study the fate and transport of air pollutants and its measurement techniques
4. To discuss the different control methods and its principles for gaseous pollutant
5. To review the sources and control of indoor air pollution

**Course Content**


**References**


**Course Outcomes**

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

1. identify the types and sources of air pollutants
2. predict the effects of air pollutants on human health and the environment
3. choose appropriate technologies for removal of particulates and gaseous pollutants
4. measure the pollutant concentration in indoor environment
5. suggest the control techniques for indoor air pollution

CEPE23 INDUSTRIAL WASTEWATER TREATMENT

Course Learning Objectives
1. To study characteristics of industrial wastewater and its effects on water bodies
2. To know the quality of industrial effluents required before disposal on environment
3. To learn various physico-chemical and biological treatment techniques to treat industrial wastewater
4. To gain knowledge about the reuse of treated industrial effluents
5. To give exposure on common effluent treatment plants

Course Content

References

Course Outcomes
At the end of the course, the students will be able to
1. recognize various environmental problems due to improper management of industrial wastewater
2. determine appropriate technologies for treatment and management of industrial pollutants
3. recommend different techniques for the safe disposal of industrial effluents
4. analyse the quality requirements for reuse of industrial effluents

CEPE24 ENVIRONMENTAL MANAGEMENT AND IMPACT ASSESSMENT

Course Learning Objectives
1. To learn the importance of environmental impact assessment in various development projects
2. To understand the legal provisions on EIA and EIA notifications
3. To brief the various methodologies involved in environmental impact assessment
4. To identify the prediction tools for the assessment of different environmental impacts
5. To describe the concepts of environmental management system.

Course Content

References

Course Outcomes
At the end of the course, the students will be able to
1. analyse the environmental impacts of proposed projects
2. categorize the type of EIA required for proposed projects
3. predict and assess the impact of proposed projects on the environment
4. use mathematical tools to predict the environmental impacts
5. propose proper mitigation measures to avoid environmental impacts
CEPE25 SOLID WASTE MANAGEMENT TECHNIQUES

Course Learning Objectives
1. To understand the sources, types and composition of municipal solid waste and the factors governing their generation
2. To acquire an understanding on the reduction, segregation and storage of wastes at source
3. To familiarize the different waste collection systems and their analysis
4. To study the importance of transfer stations and processing technologies for resource recovery
5. To enumerate and describe different disposal and treatment methods for municipal solid waste

Course Content

References

Course Outcomes
At the end of the course the students will be able to:
1. explain the various functional elements involved in solid waste management system
2. quantify and categorize solid wastes for any region
3. analyse the collection route and collection system
4. select suitable waste processing technologies and disposal methods
5. design a suitable sanitary landfill for disposal of solid waste on land

CEPE26 MODELS FOR AIR AND WATER QUALITY

Course Learning Objectives
1. To provide an understanding of mass balance approach for the prediction of air and water quality
2. To study the transport phenomena of contaminants in surface water
3. To develop mathematical model for transport of contaminants in river and estuaries
4. To brief the models for lakes, and microorganisms growth and decay
5. To give an idea of micro meteorological processes and its role in the transport of air pollutants

Course Content

References

Course Outcome
On completion of the course, the students will be able to
1. explain various transport mechanisms in estuary and river
2. develop mathematical model for water quality
3. predict the quality of water in river, lakes and estuaries using mass balance approach and specific models
4. determine the microbial population using various growth models
5. quantify the concentration of pollutant in ambient air using dispersion models
CEPE27 ADVANCED FOUNDATION ENGINEERING

Course Learning Objectives
1. To explain the analysis of sheet pile wall under different support conditions
2. To explain overall stability analysis of well foundation
3. To explain fundamentals of soil dynamics and its application to machine foundation analysis including Codal provisions
4. To explain problems related to expansive soils and solution to overcome
5. To explain the concept of slope stability analysis for various slope conditions including graphical methods

Course Content
Sheet pile structures - cantilever sheet pile walls in granular and cohesive soils - Anchored bulk heads - Free earth support and fixed earth support methods - Anchors.
Cofferdams - types - cellular cofferdam - uses - Design by TVA and Cumming's method.
Well foundations - Types of caissons - Analysis of well foundations - determination of scourdepth - staining thickness - well sinking.
Foundations subjected to vibrations - elements of vibrations - Free, damped, free and forced vibrations - Design criteria - Pauw's analogy - IS Code of practice for impact and reciprocating machines.
Foundation drainage and water proofing - Dewatering well points system, sanddrains.
Foundations in expansive soils - Mechanism - factors influencing swelling - Use of Geosynthetics.
Stability analysis of slopes - infinite slopes in sand and clays - finite slope - Swedish circle - stability of earth dam slope during steady and sudden draw down - friction circle method - Taylor's stability number. Sheet pile structures - Anchored bulk heads

References

Course outcomes
On completion of the course, the students will be able to:
1. analyze and design any kind of sheet pile wall system including coffer dam
2. analyze and design well foundation including complete stability analysis
3. estimate soil parameters under dynamic conditions including machine foundations
4. design a suitable foundation system for any kind of problematic soils
5. analyze the stability of any kind of slope by using both theoretical and graphical methods
CEPE28 GEOTECHNICAL EARTHQUAKE ENGINEERING

Course Learning Objectives
1. To explain the mechanism of earthquake and its related causes to build structures and in-situ soils
2. To explain how ground motion is recorded and how do quantify the earthquake intensity and frequency related parameters
3. To explain how seismic site investigation will be done and seismic soil design parameters are estimated
4. To explain how seismic resistant design of foundation will be done and also explain the concept of liquefaction and related causes including codal recommendations
5. To explain how to do hazard assessment and mitigation and explain how do prepare a risk and microzonation mapping

Course Content
Mechanism of Earthquakes - Causes of earthquake - Earthquake Fault sources - Elastic Rebound theory - Seismic wave in Earthquake shaking - terminology - Locating an earthquake - Quantification of earthquakes. Strong Motion Records - characteristics of ground motion - Factors influencing Ground motion - Estimation of frequency content parameters
Design Ground Motion - Developing Design Ground Motion-Codal recommendations.
Risk mapping - Hazard assessment – Mitigation measures - Seismic microzonation and its importance

References

Course outcomes
On completion of the course, the students will be able to:
1. demonstrate the principles of earthquake loading
2. quantify earthquake intensity and ground motion
3. estimate seismic soil design parameters
4. analyze and design seismic resistant foundation for buildings
5. prepare soil risk and microzonation maps
CEPE29 REINFORCED EARTH AND GEOTEXTILES

Course Learning Objectives
1. To explain the basic mechanisms of soil reinforcement and design principles in reinforced earth wall
2. To understand the applications of geosynthetics in geotechnical problems and its design principles
3. To explain the usage of geosynthetics in geoenvironmental and pavement engineering with design
4. To explain the present status of development in geo-synthetics and filed instrumentation and control

Course content
Geo Synthetics: Recent research and Developments. Control of Improvement – Field Instrumentation – design and analysis for bearing capacity and settlement of improved deposits.

References

Course outcomes
Upon completion of this course, the students will be able to
1. Understand the principles of soil reinforcement and they can able to do any reinforced wall design using steel strip or geo-reinforcement
2. Understand the application of geosynthetics in geotechnical engineering
3. Decided what kind of geosynthetics should be used for the problem specific application including its design principles
4. Do proper field test using the recent development in geosynthetics
CEPE30 EARTH AND EARTH RETAINING STRUCTURES

Course Learning Objective
1. To explain the concept of earth dam design including stability analysis under seepage
2. To evaluate stability of slopes under different drainage conditions using different methods including slope protection and quality control
3. To estimate active and passive earth pressure using different earth pressure theory including graphical method
4. To explain design principles of retaining structures and coffer dams

Course content
Introduction: Earth dams – types of dams – selection of type of dam based on material availability – foundation conditions and topography- Design details – crest, free board, upstream and downstream slopes, upstream and downstream slope protection – central and inclined cores – types and design of filters- Seeage analysis and control – seepage through dam and foundations – control of seepage in earth dam and foundation.


Rigid retaining structures – active and passive earth pressures against gravity retaining walls – Surcharge - computation of earth pressures by Trial wedge method – a mathematical approach for completely submerged and partly submerged backfills – importance of capillarity tension in earth pressure.

Graphical methods of earth pressure computation – trial wedge method for coulomb’s and Rankine’s conditions, for regular and irregular ground and wall conditions – Rebhan’s construction for active pressure – friction circle method – logarithmic spiral method.


References

Course outcomes
Upon completion of this course, the students will be able to
1. Do earth dam design and stability analysis for all kind of drainage conditions
2. Do stability analysis of any kind of slope and its protection
3. Understand the earth pressure theories and able to calculate lateral earth pressure for different conditions
4. Do retaining structure design and its stability analysis

CEPE31 MARINE FOUNDATION ENGINEERING

Course Learning Objective
1. To emphasize the importance of offshore soil investigations for offshore structures
2. To analysis the response of foundations of gravity structures under offshore environmental loading
3. To analysis the foundation response of jacket and jack-up platforms under static and dynamic loading
4. To provide a suitable foundation system for mooring structures and offshore pipe lines

Course content
Offshore soil investigation: General characteristics of offshore soil exploration – sampling using free corer, gravity corer, tethered systems and manned submersibles – deep penetration sampling using wire line techniques – sampling disturbances – mechanical and environmental - In-situ determination of strength of submarine soils – penetrometer, piezocone, vane and pressure meter techniques – penetration tests from tethered submersible platforms, manned submersibles and using wire line techniques - classification of marine soils – relative distribution of marine soils in the different marine regions – general characteristics of marine deposits in some specific locations and in the Indian sub continent.


Foundation for jacket type structures: Types – installation techniques – design considerations – axial and lateral load capacity of piles – lateral load deformation behaviour of piles – calculation of bearing capacity of piles- design of piles subjected to lateral loads – Reese-Matlock method and p-y curves method


Sea bed anchors, submarine pipe lines: General introduction to sea bed anchors, moorings, submarine pipe line etc., - general design considerations (brief outline only) – geotechnical aspects in the design and installation of sea bed anchors, moorings, submarine pipelines etc

References
1. Arous, D.A. (Ed.), Offshore Site Investigation, Graham Trotman
2. Chaney, R.C and Demars, K.R , Strength Testing of Marine Sediments – Laboratory and In-situ Measurements, ASTM, STP-883

Course outcomes
Upon completion of this course, the students will be able to
1. Recommend suitable offshore investigation techniques for the proposed project and able to provide appropriate soil design parameters
2. Perform foundation analysis for gravity structures, jacket and jack-up kind of offshore structures
3. Analysis suitable anchor system for mooring structures and able to provide foundation system for offshore pipeline.

CEPE32 GEODETIC SURVEYING

Course Learning Objectives
1. To know the significance of geodetic surveying in field measurements in terms of utility and precision of data collection
2. To learn the principles of Triangulation, Trigonometric levelling and their procedures
3. To get introduced to the concept of curves and curve setting
4. To know in detail different types of errors and their adjustments
5. To get introduced to the coordinate systems, reference plans and projections

Course content
Trignometrical levelling – Plane Observations – Geodetic observations – Corrections for refraction, curvature, axis signal – Reciprocal observations
Curve setting – Horizontal curves - Elements of simple and compound curves – Methods of setting out – Reverse curve – Transition curve – Length of curve – Elements of cubic parabola, true spiral and cubic spiral – Vertical curve – parabola
Reference Surfaces – Datums – Geoids – Coordinate systems – Map Projections

References

Course Outcomes
On completion of the course, the students will be able to:

1. Apply geodetic methods such as Triangulation in different fields of Civil Engineering
2. Apply geodetic methods such as Trigonometric levelling in different fields of civil engineering
3. Select the correct, best suited curve and set the curve on the road
4. Identify the errors present in the field observation and to adjust the errors using suitable methods
5. Demonstrate the principles of the earth surface, its projections and different coordinates involved in map making

CEPE33 ADVANCED SURVEYING TECHNIQUES

Course Learning Objectives
1. To know the significance of advanced surveying in field measurements in terms of utility and precision of data collection
2. To learn the principles of Electromagnetic distance measurement, Total Station and their accuracy
3. To get introduced to the concept of photogrammetry in preliminary identification and map making
4. To know in detail the concept of remote sensing in identification of land features from space and to get introduced to different data acquisition techniques like LIDAR, RADAR etc.
5. To get introduced to the field of geodesy, coordinate systems, Map projections, GPS, its working principle, data collection, data processing and analysis

Course content
Photogrammetry – Terrestrial and Aerial Photogrammetry – Horizontal position of a point from photographic measurement – elevation of a point – Determination of focal length of camera – determination of scale – Ground co-ordinates - Relief displacement – Photo interpretation.
Geodesy – Figure of earth – Classification – Earth surface - Geodetic reference surfaces - Coordinate systems – Geodetic datums and elements – Map – Scale of map – projection – UTM – Map projection of India – Space Geodesy.

References

Course Outcomes
On completion of the course, the students will be able to:
1. Apply advanced surveying techniques in different fields of Civil Engineering
2. Select the advanced technique which is best suited for a work
3. Apply total station and EDM in distance measurement and traversing
4. Demonstrate the principles of the earth surface, its projections and different coordinates involved in map making
5. Apply GPS in transportation engineering, structural engineering and land use planning

CEPE34 GROUNDWATER HYDROLOGY

Course Learning Objectives
1. To know different types of aquifers
2. To understand the surface and subsurface investigation in detail
3. To integrate the fundamental and basic knowledge of ground water movement
4. To understand the process of sea water intrusion and recharge
5. To introduce the different model studies

Course content
Subsurface investigation - test drilling - resistivity logging- potential logging - temperature and caliper logging.
Steady unidirectional flow - well in a uniform flow - steady flow with uniform recharge - unsteady radial flow to a well - well flow near aquifer boundaries - Multiple well systems - partially penetrating wells - characteristic well losses.
Secular and seasonal variations - Fluctuations due to evapo-transpiration, Meteorological phenomena, tides, external loads and earthquakes - control by drains and wells. Recharge through sewage pits, shafts and wells.
Occurrence of sea water intrusion - Ghypon-Heizberg relation between fresh and saline waters - shape length and structure of the fresh salt water interface -
prevention and control of seawater intrusion - role of sea water in ground water - coastal zoning.

Sand models - Electrical models - Viscous fluid models - membrane models - numerical analysis methods

References

Course outcomes
On completion of the course, the students will be able to:
1. Identify types of aquifers
2. carry out surface and subsurface investigation to locate groundwater
3. visualise the occurrence and movement of groundwater
4. select suitable type of ground water recharge
5. Assess sea water intrusion and its control

CEPE35 APPLIED HYDRAULICS ENGINEERING

Course Learning Objectives
1. To classify the types of flows in open channel and also to design open channel sections in a most economical manner.
2. To study about non uniform flows in open channel and longitudinal slopes in open channel and also to learn about the characteristics of hydraulic jump.
3. To develop an understanding of fluid flow patterns and learn to use boundary layer theory and Drag.
4. To Provide insights to the Open channel hydraulics and introduce dimensional analysis for fluid flow problems.

Course content
Open channel flow and its classifications, and properties, energy and momentum principles, Critical flow computation and its applications, transitions with sub critical and super critical flows. Types and regimes of flow – Velocity distribution in open channel – Wide open channel

Design of non- erodible channels for uniform flow, most efficient channel section, compound Sections. Velocity measurement – Manning’s and Chezy’s formula – Determination of roughness coefficients – Determination of normal depth and velocity.

Gradually varied flow: Theory and analysis, gradually-varied flow computations in prismatic channels, gradually varied flow in non-prismatic channels. Characteristics of flow profiles –

Draw down and back water curves – Profile determination – Graphical integration, direct step

And standard step method – Flow through transitions

Rapidly varied flow- Theory of hydraulic jump, evaluation of jump elements in rectangular and non-rectangular channel, location of jump on horizontal floor, channel controls and transition – surges
Boundary Layer Theory: Introduction, Development of boundary layer over a flat plate, boundary layer thickness, displacement, momentum and energy thicknesses, Application of momentum equation to boundary layer flow, local and mean drag coefficients.

References

Course outcomes
By the end of this course, the students will be able to
1. Acquire specific knowledge regarding fluid flow phenomena observed in Civil Engineering systems such as flow in open channel flow
2. Develop understanding of the basic principles of fluid flow patterns and boundary layer theory and provide skills in analyzing fluid flows in open channel hydraulics
3. Understand gradually varied flow profile in detail.
4. Understand rapidly varied flow profile in detail
5. Knowledge is useful for the design of open channels for rectangular and non-rectangular channels for hydraulic jump phenomena.

CEPE36 - DESIGN OF HYDRAULIC STRUCTURES

Course Learning Objective
1. To impart knowledge regarding the design of the various minor irrigation structures
2. To convey the knowledge on the causes of failure, design criteria and stability analysis of different types of dams
3. To design and analyse energy dissipators
4. To understand the basic design of structures on pervious formations

Course Content
Reservoir Planning: Investigations, Capacities, Zones of storage, Mass Inflow and Mass Demand curves, Life of Reservoir. Earth Dams: Types, causes of failure and design criteria, soils suitability for earth dam construction, construction methods, foundation requirements, typical earth dam sections, estimation of seepage through and below the dam, seepage control, stability of slopes by slip circle method of analysis, pore pressures, sudden draw down, steady seepage and construction pore pressure condition.
Gravity dams: Design Criteria, forces acting on gravity dams, elementary profile, low and high gravity dams, stability analysis, practical profile, evaluation of profile by method of zoning, foundation treatment, construction joints, galleries in gravity dams.
Spillways: Ogee spillway and its design, details of syphon, shaft, chute and side channel spillways, emergency spillways. Design of outlets and rating curves Energy dissipators: Principles of energy dissipation Energy dissipators based on tail water rating curve and jump height curves Spillway crest gates - vertical lift and radial gates, their design principles. Design of canal regulating structures, Design of Channel transitions, Design of Sarda type Falls, Design of cross drainage works viz Syphon aquaduct and Canal syphon.

Structures on Pervious formations: Bligh’s creep theory, limitations, Khoslas’s theory of independent variable, Khosla’s corrections, Design of Weir and Barrages: design of waterways and crest levels, design of impervious floors and protection works.

Canal Structures and Hydropower Plants: Design of canal falls, Regulators, Cross drainage works, Introduction of Hydropower development, general features of hydroelectric schemes, selection of turbines.

References
1. Engineering for Dams (Volumes I, II & III) by Creager, Justin & Hinds
2. Hydroelectric Hand Book by Creager
3. Hydraulic Structures by Varshney
4. Irrigation & Water Power Engg. by Punmia & Pandey B.B.Lal
5. Water Power Engineering by Dandekar

Course outcomes
The students will be able to
1. Perform the stability analysis of gravity dams
2. Explain the causes of failure of different types of dams and their design criteria
3. Design minor irrigation structures such as regulators, cross drainage works and canal falls
4. Able to design structures on pervious formations

CEPE37 SIMULATION MODELLING FOR WATER RESOURCES ENGINEERING

Course Learning Objectives
1. To build on the student's background in basics of simulation modelling.
2. To develop the skills in modelling of linear and nonlinear regression.
3. To develop skills in the artificial intelligence tools such as fuzzy systems, neural networks and genetic programming.
4. To provide wide knowledge on optimization tools.

Course content
Optimization tool- roulette wheel selection – mutation – crossover- case studies
Reservoir optimization – Fuzzy inference system – Fuzzy linear programming.

References

Course outcomes
By the end of this course the students are able to
1. Incorporate skills in developing models for various systems.
2. Acquires knowledge on fundamentals of regression techniques.
3. Develops and improves the knowledge dynamic programming and stochastic programming.
4. Provides basic knowledge on fuzzy system and optimization tools.

CEPE38 DESIGN OF OFFSHORE AND COASTAL STRUCTURES

Course Learning Objectives
1. To understand different types of offshore structures
2. To study the different types of operational loads and environmental loads
3. To understand the different types of waves and wave deformation
4. To learn about breakwaters and coastal features

Course Content
Types of offshore structures and conceptual development - Analytical models for jacket structures - Materials and their behaviour under static and dynamic loads - Statutory regulations - Allowable stresses - Various design methods and Code Provisions - Design specification of API, DNV, Lloyd's and other classification societies - Construction of jacket and gravity platforms
Operational loads - Environmental loads due to wind, wave, current and buoyancy - Morison's Equation - Maximum wave force on offshore structure - Concept of Return waves - Principles of Static and dynamic analyses of fixed platforms - Use of approximate methods - Design of structural elements.
Waves in shallow waters - shoaling, refraction, diffraction and breaking- Interaction currents and waves Sediment characteristics - Initiation of sediment motion under waves - Wave run-up and overtopping Radiation stress-wave set-up and wave set-down Mechanics of Coastal Sediment transport - Limits for littoral drift

Coastal Features - Beach Features - Beach cycles - Beach Stability - Beach profiles.
Coastal erosion, Planning and methods of coast protection works - Design of shore defense structures - Case studies on coastal erosion and protection.

References

Course Outcome
By the end of this the students will be able to:
1. Gain knowledge on different types of offshore structures.
2. Understand the different types of loads acting on offshore structures.
3. Gain understanding on waves in shallow water, diffraction, reflection and diffraction.
4. Design breakwaters and other coastal defense structures.
5. Understand the concepts of littoral drift, wave forces and coastal erosion protection.

CEPE39 COASTAL ENGINEERING

Course Learning Objectives
1. To provide basic knowledge on two dimensional wave equation.
2. To describe the various types of wave theories.
3. To study the effect of wave loads on different coastal structures.
4. To improve the knowledge on physical modelling tools in offshore and onshore activities.

Course content
Basic Fluid Mechanics: Conservation of mass and momentum, Euler Equation, Bernoullis equation, potential flow, stream function. Waves: Classification of water waves - Two dimensional wave equation and wave characteristics.

Wave theories - Small amplitude waves – Finite amplitude waves - Stoke, Solitary and Cnoidal Water particle kinematics - wave refraction; wave breaking; wave diffraction random and 3D waves- Short term wave analysis – wave spectra and its utilities - Long term wave analysis- Statistics analysis of grouped wave data –Currents: Classification - Behaviour - Design Criteria, Scour and other effects of currents
Dynamic beach profile; cross-shore transport; along shore transport (Littoral transport), sediment movement – Estuaries – Creek – Harbour – Littoral drift. Field measurement; models, groins, sea walls, offshore breakwaters, artificial beach nourishment - planning of coast protection works - Design of shore defense structures –Case studies.

References
3. Coastal Engineering Research reports.

Course outcomes
By the end of this course the students will be able to
1. Develop knowledge in basics of wave hydrodynamics
2. Provides understanding various aspects of coastal engineering
3. Describes wave forces, wave pressures and currents in the coastal areas.
4. Improves knowledge on sea defence structures.

CEPE40 DISASTER MODELLING AND MANAGEMENT

Course Learning Objectives
1. To know the types of Disasters and its triggering facts.
2. Understand the stages of disaster in hydrological disaster and kinds of data are required to support emergency management work during the disasters.
3. Develop and understand the causes, effects, impacts and analysis of hydrological, geological and coastal hazards.
4. Assess the potential of new, evolving technologies to meet vulnerability mapping, modelling and emergency management needs for geological hazards, hydrological and coastal hazards.

Course content


References

Course outcomes
By the end of this course the students will be able to
1. Understand different types of disaster and its triggering features
2. Understand and analyse hydrological disaster
3. Understand and develop models for geological disaster
4. Able to understand the coastal hazard and shore defence structures
5. Capable to preparing vulnerability mapping and risk assessment and developing Emergency Management System.

CEPE41 PREFABRICATED STRUCTURES

Course learning Objectives
The objective of the course is to
1. Understand the concepts and behaviour of prefabrication and types and its systems.
2. perform analysis and design of cross section and the joints in structures
3. to analyze and design of prefabricated concrete members
4. Obtain knowledge in design of cross section and the joints.

Course content
Production, Transportation and erection- shuttering and mould design – Dimensional tolerances- Design and detailing of prefabricated units

**References**

7. Elliot K. M., *Precast Concrete Structures*, A Butterworth-Heinemann,
8. *Handbook on Precast Concrete Structures*, Indian Concrete Institute, 2016

**Course outcomes**

On completion of this course students should be able to:

1. Know the behaviour of prefabricated structures
2. Become familiar with the production of prefabrication units and erection process.
3. Able to perform an industry relevant design project in a team setting
4. Exhibit their knowledge in designing and detailing of prefabrication units

**CEPE42 HERITAGE STRUCTURES**

**Course Learning Objectives**

1. To study the terminologies and criteria for heritage structure
2. To know the salient features and grading of heritage structures
3. To study the preservation techniques of various heritage structures
4. To create awareness on the adaptive reuse of heritage structures
5. To get into more case studies on the protected heritage structures

**Course content**

Introduction-terminologies- history of conservation- methodology and criteria for listing heritage structure
Grading of heritage structures- model building bye-laws - salient features and mapping of historic settlements
Factors deteriorating heritage structures- conservation and preservation techniques
Conservation projects - heritage conservation and adaptive reuse of heritage structures
Protected sites and monuments - case studies
References

Course outcomes
The student will be able to
1. Attain in-depth knowledge on various terminologies and methodology involved for heritage structure.
2. Familiarise the features and building bye-laws
3. Visualise the correct preservative measures and methodology
4. Attain in-depth knowledge about the adaptive reuse of heritage structures
5. Familiarise about the various construction techniques Involved From the collected case Studies

CEPE43 EARTHQUAKE RESISTANT STRUCTURES

Course Learning Objectives
1. To introduce the basics of Earthquake Engineering
2. To introduce the engineering seismology, building geometrics & characteristics, structural irregularities,
3. To introduce tips on earthquake engineering - do’s and don’ts
4. To introduce cyclic loading behaviour of RC, steel and pre-stressed concrete elements
5. To discuss code provisions and their application on different types of structures

Course Content
Seismic Design Concepts - Cyclic loading behavior of RC, Steel and Prestressed Concrete elements - Response Spectrum- Design spectrum - capacity based design.
Provision of Seismic Code frames, shear walls, Braced frames, Combinations - Torsion.
Performance of Regular Buildings 3D Computer Analysis of Building Systems (Theory only) - Design and Detailing of frames - Shear walls and Frame walls.

References

Course outcomes
On completion of the course, the students will be able to:
1. apply the basics of Earthquake Engineering
2. demonstrate the dynamics of structural system under earthquake load
3. analyze the influence of the structural / geometrical design in building characteristics
4. demonstrate the cyclic loading behaviour of RC steel and pre-stressed concrete elements
5. apply Codal provisions on different types of structures

CEPE44 STEEL CONCRETE COMPOSITE STRUCTURES

Course Learning Objectives
1. To introduce the concept of steel concrete composite design and construction in civil engineering
2. To discuss shear connector types, degree of shear connector, their interaction and the design of composite beams under propped and un-propped condition
3. To introduce design of different types of composite deck slabs
4. To introduce the design of composite columns under axial load and bending moments
5. To discuss effects of temperature, shrinkage and creep on composite sections

Course content
Analysis and design of composite beams without profile sheet - propped condition – un-propped condition – deflection – design of partial shear connection.
Design of composite beam with profile sheet – propped and un-propped condition – deflection of composite beams – design of partial shear connection.
Effect of temperature loads on composite action – creep and shrinkage of concrete on composite design and construction

References

Course outcomes
On completion of the course, the students will be able to:
1. Apply the concepts of steel concrete composite in civil engineering construction and practices.
2. Analyse the behavior of shear connectors, degree of shear connection and development of composite action.
3. Design composite beams under propped and un-propped condition.
4. Design different types of composite deck slabs.
5. Analyse the effects of temperature, shrinkage and creep on composite design.

CEPE45 STEEL STRUCTURAL SYSTEMS

Course Learning Objectives
1. To learn the analysis and design procedure of various types of steel trusses
2. To learn the analysis and design procedure of moment resisting steel frames for gravity and lateral loads
3. To learn the analysis and design procedure of steel pre-engineered buildings (PEBs)
4. To learn the analysis and design procedure of steel bunkers and silos
5. To learn the analysis and design procedure of various types of steel water tanks and their staging.

Course content
Various types of steel trusses – functional and structural requirements – application for bridges and large span systems – stability aspects
Multi-storey buildings – structural framing for gravity and lateral loads resistant systems – shear connections and moment connections – base plate and anchor bolt – foundation design criteria.
Introduction to the concept of PEBs – preliminary sizing and design of purlins and rafters – bracing system and arrangement – connection detailing.
Design of steel bunkers and silos – janssen’s theory – Airy’s theory – design parameters – design criteria – analysis of Bins – Hopper bottoms –design of bins
Note: Assignments include the design and drawings of various steel structures.

References
2. Dayaratnam, P., Design of Steel Structures, S. Chand & Company LTD, New Delhi, 2003

Course outcomes
On completion of the course, the students will be able to:

1. Design various types of steel trusses
2. Design of gravity and moment resistant steel structural systems
3. Design of pre-engineered buildings in structural steel
4. Design steel bunkers and silos
5. Design steel water tanks and their staging

CEPE46 BASIC BRIDGE ENGINEERING

Course Learning Objectives
1. To learn the components of bridges, classification of bridges, importance of bridges
2. To study the specification of road bridges, loads to be considered
3. To familiarize students with various types of concrete bridges such as slab-bridge, T-beam bridge
4. To familiarize students with various types of steel bridges such as truss bridge and girder bridge and also railway bridges by IRS loadings
5. To get exposure the substructure of bridge substructures and the evaluation and importance of bearings

Course content
Components of Bridges –Classification –Importance of Bridges –Investigation for Bridges –Selection of Bridge site –Economical span –Choice of bridge type.
General design considerations –Concrete bridges - Slab Bridge –Design of T-beam bridge (superstructure only)
Steel bridges - truss bridge-plate girder bridge (superstructure only)
Note: Assignments include the design and drawings of bridge superstructures.

References
Course outcomes

On completion of the course, the students will be able:

1. To be familiar with the components of bridges, classification of bridges, importance of bridges
2. To understand the specification of road bridges, loads to be considered
3. To be familiar with various types of concrete bridges such as slab-bridge, T-beam bridge, pre-stressed concrete bridge
4. To be familiar with various types of steel bridges such as truss bridge and girder bridge
5. To get exposed to evaluation of sub structures, type of foundations, importance of bearings
(III.b) OPEN ELECTIVE (OE)

CEOE10 REMOTE SENSING AND GIS

Course Learning Objectives
1. To know about the principles of remote sensing and spectral signatures
2. To know about satellites, types of remote sensing and digital image processing
3. To study about the history and components of GIS
4. To study about data types and operations.
5. To know the applications of remote sensing and GIS for various fields of Civil Engineering

Course content

References

Course outcomes
On completion of the course, the students will be able to:
1. Demonstrate the concepts of Electro Magnetic energy, spectrum and spectral signature curves.
2. Apply the concepts of satellite and sensor parameters and characteristics of different platforms.
3. Apply the concepts of DBMS in GIS.
4. Analyze raster and vector data and modeling in GIS.
5. Apply GIS in land use, disaster management, ITS and resource information system.

**CEOE11 OCEAN ENERGY**

**Course Learning Objectives**

1. Learn the basics of ocean environment
2. Understand the concept of wave measurement and linear wave theory
3. Learn the ocean tidal current turbulence and wave energy systems
4. Develop model testing techniques for marine current turbines

**Course Content**

Introduction to the ocean environment - Ocean circulation and stratification - Ocean habitat - Ocean economy - Ocean surface waves - Wave measurement - Linear wave theory - Wave spectrum - Wave energy resource

Ocean tidal currents - Current measurement - Current turbulence - Current energy resource - Site selection and characterization for ocean energy system - Wave energy systems - Types of wave energy converters - Linear wave-structure interactions - Frequency domain analysis - Hydrodynamic coefficients and their computation - Time domain analysis - Phase control Arrays

Model testing techniques - Marine current turbines - Types of marine current turbines

Hydrodynamic models (BEM, Lifting line, IBEM) - Hydrofoil data and analysis

Cavitation and strength - Design criteria - Multiple turbine interaction - Other types of energy systems - Ocean Thermal Energy Conversion (OTEC) - Energy from salinity gradient

Power take-off systems - Air turbines, Water turbines - High pressure hydraulic systems - Electrical generation - Energy storage - Mooring and anchoring systems. Operation and maintenance of ocean energy devices - Offshore operations - Maritime safety issues

**References**


**Course Outcomes**

By the end of this course the students will be able to

1. Understand the basics of ocean energy sources
2. Capable of understanding the concepts of measurements of current and tides by using measuring devices
3. Understand the different types of marine turbines
4. Improves knowledge on water turbines, Electrical operations and marine safety
5. Understand OTEC

**CEOE12 EARTHQUAKE ENGINEERING**

**Course Learning Objectives**
1. To introduce the basics of Earthquake Engineering
2. To understand the mechanism of earthquake wave propagation
3. To explain about seismic measuring devices and scales
4. To explain how to do hazard assessment and mitigation and explain how do prepare a risk and microzonation mapping
5. To explain about various seismic protection methods

**Course content**
Importance of earthquake engineering – Earth structure – Plate tectonics - Faults – Earthquake generation mechanism – terminologies
Earthquake propagation - Seismic waves in Earthquake shaking – body waves and surface waves – attenuation of wave amplitudes
Measurement of earthquakes – Intensity scales – Seismographs and Seismograms – Magnitude scales – seismic moment and moment magnitude – Accelerographs and Accelerograms
Seismic hazard assessment – methods – ground motion intensity at given site and in given time interval – probabilistic and semi-probabilistic approaches – seismic zonation and microzonation maps
Seismic protection methods – base isolation – energy dissipating devices - Codal provisions

**References**

**Course outcomes**
On completion of the course, the students will be able to:
1. apply the basics of Earthquake Engineering
2. understand the earthquake wave generation and its propagation mechanism
3. knowledge on earthquake measuring scales and instruments
4. quantify earthquake intensity and ground motion
5. identify the method to protect the structure from seismic forces

**CEOE13 URBAN AND REGIONAL PLANNING**

**Course Learning Objectives**
1. To develop an awareness about the trends in urbanization
2. To understand the basic principles and concepts of urban planning
3. To learn the laws and regulations related to the planning process existing in the country.
Course Content

Definition and classification of urban areas - Trend of urbanization - Planning process - Various stages of the planning process - Surveys in planning.

Plans - Delineation of planning areas - Regional plan, Master plan, Structure plan, detailed development plan and Transportation plan.

Planning principles of Ebenezer Howard (Garden city movement), Patrick Geddes, Dr. C. A. Doxiades, Soria Y Mata (Linear city) and Clarence, A. Perry (The neighbourhood concept).


Development control regulations - Town and country planning act - Building bye- laws.

References


Course Outcomes

On completion of the course, the students will be able to:

1. Demonstrate the various process involved in urban planning
2. Apply the laws and governmental policies related to the planning process
3. Implement the classical urban planning principles
4. Apply the methods of financing of plans
5. Demonstrate the regulations and by-laws

CEOE14 EXPERIMENTAL STRESS ANALYSIS

Course Learning Objectives

1. To study the working principles of different types of strain gauges
2. To understand the model analysis
3. To know the fundamentals of photo elastic coatings
4. To study the effects of 2-D photo elasticity
5. To study the working principle of load, pressure and displacement transducers

Course Content

Strain gauges – Mechanical, optical, acoustic, electrical inductance and capacitance pneumatic types – description and working principles
Electrical resistance strain gauges, gauge characteristics and types – Equipment for recording static strain – reduction of strain gauge data. Load, pressure and displacement transducers.

Model analysis – direct and indirect models – law of structural similitude – choice of scales – Model materials – limitations of model studies –Buckingham PI theorem – design of direct and indirect models – Beggs deformeter and its applications.

Two dimensional photo – elasticity – optical principles stress optic law – Methods of producing isoclines and isochromatics using polariscopes – Methods of measuring fractional fringe orders – model materials – separation techniques

Fundamental of Photo elastic coatings, Moire fringe and brittle coating techniques – Introduction to stress freezing techniques – Introduction to non-destructive testings

References


Course outcomes

On completion of the course, the students will be able to:

1. identify the different types of strain gauges
2. carry out model analysis
3. apply the concepts of photo elastic coatings
4. analyze the behavior of 2-D photo elasticity
5. apply the working principles of transducers

CEOE15 HEALTH MONITORING OF STRUCTURES

Course Learning Objectives

To investigate the materials, products, structures or components that fall or do not operate or function as intended causing personal injury or damage the property.

Course content

Introduction- Qualitative and non-continuous methods of evaluation of structures- SHM definition- Detecting the existence of the damage on the structure- Locating the damage- Identifying the types of damage- Quantifying the severity of the damage-Sensors- Feature extraction through signal processing and statistical classification- Structure- Data acquisition systems-Data transfer and storage mechanism-Data management- Data interpretation and diagnosis : System Identification-Structural model update-Structural condition assessment-Prediction of remaining service life

Different sensors - accelerometers, strain gauges, displacement transducers, level sensing stations, anemometers, temperature sensors and dynamic weight-in-motion sensors- Case studies- SHM for bridges

References


Course outcomes
On completion of the course the students will be able to:
1. Perform structural health monitoring
2. Handle emerging technologies using sensors
3. Perform notable applications of structural health monitoring in civil applications

CEO16 FORENSIC ENGINEERING

Course Learning Objectives
1. To undertake problem diagnostics and treatment during the structural design and construction phase
2. To identify, diagnosis and treat complex problem in relation to whole-of-life reliability and resilient performance during occupancy
3. To study the concepts and application of forensic engineering for analysing failure and damage mitigation of structures

Course content

References


Course outcomes
On completion of the course, the students will be able to:
1. Describe and evaluate the use of structural forensics in creating and maintaining of civil infrastructure
2. Identify the common failure modes
3. Investigate the structural failures, reverse engineer the lessons learnt and produce technical notes

CEOE17 SUSTAINABLE INFRASTRUCTURE

Course Learning Objectives
1. To explain the importance of sustainable built environment
2. To emphasis the significance of sustainable development and construction
3. To introduce the techniques and for assessing environmental impact
4. To perform the service life and life cycle assessments

Course content
Extent and values of infrastructure (buildings, structures, plants and networks for communication and transport, water and wastewater treatment, production and distribution of energy); relations between infrastructure and sustainable development; regulations and standards; indicators of sustainability; consequences of climate change; vulnerability and safety of infrastructure; materials and technology for construction and management; Applications for sustainable communities; service life and life cycle assessments (LCA, LCC, MFA, environmental assessment); an international perspective with case studies from around the world.

References

Course outcomes
On completion of the course, the students will be able to:
1. understand the values and societal importance of the built environment
2. understand the influence on a sustainable development
3. gain knowledge on how to use environmental impact assessments as a tool for design
4. construction and management of a sustainable built environment
Course Learning Objectives
1. To know the properties and applications of different construction materials
2. To understand the production, processing and testing of concrete
3. To learn the construction principles, formwork and other construction methods
4. To study the types of building finishes and building services
5. To learn the different repair techniques in construction

Course content
Building materials: Classification and requirements of good stone and brick, Brick manufacturing, Harmful ingredients, testing, Constituent of a good brick earth, Lime, manufacturing, Field-testing, Artificial hydraulic lime; Timber: classification, structure, seasoning, defects; Paints: Constituents, types, characteristics of varnishes.
Concrete technology: High grade cements, Advances in manufacture of cement, Concrete Mix Design; Process of manufacture of concrete, Batching, mixing, transporting, placing, compaction, curing, finishing; Testing of fresh and hardened concrete; Non-destructive testing.
Building items: Plastering & pointing, Painting, Distempering and white washing; Damp proof course (DPC), Anti-termite measures and treatments; Construction joints; Plumbing and electrification, various types of fittings and laying procedure.
Construction damages & repair techniques: Causes of damage and deterioration in masonry and concrete structures, Symptoms & Diagnosis, Types of repair and rehabilitation techniques; Case studies.

References
6. Shetty, M.S., Concrete Technology, S.Chand and Company., 2011

Course outcomes
On completion of the course, the students will be able to:
1. Distinguish the different construction materials and select appropriate materials for construction
2. Design suitable concrete mixes and test the concrete
3. Execute construction jobs with the knowledge of the different construction techniques and building services
4. Identify the building defects and apply suitable repair techniques to rectify them

CEMI11 SURVEYING PRACTICES

Course Learning Objectives
1. To understand the importance of surveying in the field of civil engineering
2. To get introduced to different plane and geodetic surveying applications such as chain, compass, plane table, leveling, triangulation, trigonometric leveling etc
3. To understand the significance of each method in civil engineering and master the skill to carry out the proper surveying method in the field.
4. To design numerical solutions for carrying out surveying in civil engineering field.
5. To get introduced to modern advanced surveying techniques involved such as remote sensing, Total station, GPS etc.

Course content
Datums – Reference planes – Geoid – Ellipsoid – Coordinate systems – Coordinate Transformation – Maps – Map Projections and Transformations – Coordinate systems and Map projections of various countries
Conventional Surveying procedures – Data acquisition – Chain – Tape – Theodolite – Levelling – Output, Applications and importance

References

Course outcomes
On completion of the course, the students will be able to:
1. carry out preliminary surveying in the field of civil engineering
2. plan a survey, taking accurate measurements, field booking, plotting and adjustment of traverse
3. use various conventional instruments involved in surveying with respect to utility and precision
4. plan a survey for applications such as road alignment and height of the building
5. undertake measurement and plotting in civil engineering
CEMI12 STRUCTURAL ANALYSIS AND DESIGN

Course Learning Objectives
1. To introduce the concept of structural elements and their analysis
2. To understand and design simple axially loaded RC columns and beams
3. To understand and design simple axially loaded Steel columns and beams

Course content
Introduction to reinforced concrete elements – Analysis and design of axially loaded column - Analysis and design of determinate beams
Analysis and design of laterally restrained and unrestrained steel beams
Analysis and design of axially loaded compression member
Design of lap and butt joints using bolts ad welds

References

Course outcomes
On completion of the course, the students will be able to:
1. Analyse and design simple structural elements
2. Analyse and design simple axially loaded RC columns and beams
3. Analyse and design simple axially loaded Steel columns and beams

CEMI13 SOILS AND FOUNDATIONS

Course Learning Objectives:
1. To explain how soils are formed and its classification
2. To emphasis the importance of identifying problematic soil and ground improvement
3. To explain the mechanism of soil slope failures
4. To emphasize the importance of soil investigations including destructive and non-destructive methods
5. To explain how to select a suitable foundation system for various site conditions

Course content
Origin, formation and classification of Soil – Structure and properties of clay minerals - Problematic Soils – Permeability and seepage – Permeability testing of soils and applications
Introduction to compaction and Consolidation – suitability of soil for foundations – methods of ground improvement
Soil slopes and its failure mechanisms – Types - infinite slopes – finite slopes – slope protection measures
Soil exploration and its importance - Plate load test, static and dynamic penetrations tests - geophysical explorations

References

Course outcomes
Upon completion of this course, the students will be able to
1. Understand the importance of geotechnical engineering in civil engineering
2. decide the type of foundation suitable for a particular soil condition
3. select the right method to improvement the problematic soil
4. Understand the importance of soil investigation for any civil engineering construction

CEMI14 TRANSPORTATION SYSTEMS

Course Learning Objectives
1. To study about the geometric design of highways
2. To know about pavement materials and design
3. To study about the types and functions of track, junctions and railway stations.
4. To learn about the aircraft characteristics, planning and components of airport.
5. To study about the types and components of docks and harbours.

Course Content
Highway Engineering - Classification of roads, highway alignment and surveys; Geometric Design - Cross section elements, sight distance, design of horizontal and vertical alignment.
Pavement Materials and Design - Specifications and tests on pavement materials, pavement design factors, design of flexible and rigid pavements.
Railway Engineering - Location surveys and alignment - Gauges - Components of Permanent way; Track Junctions - Points and crossings - Railway stations and yards.
Airport Engineering - Aircraft characteristics - Airport obstructions and zoning - Runway - Taxiways and aprons - Terminal area planning
Docks and Harbours - Layout and planning principles - Breakwaters – Docks - Wharves and quays - Navigational aids.

References

Course Outcomes
On completion of the course, the students will be able to:
1. Design cross section elements, sight distance, horizontal and vertical alignment
2. Determine the characteristics of pavement materials
3. Plan the layout of railway terminals
4. Apply principles of airport planning
5. Implement the layout of harbours

CEMI15 WATER AND AIR POLLUTION MANAGEMENT

Course Learning Objectives
1. To understand and determine the basic characteristics of water both qualitatively and quantitatively
2. To expose the students to understand the water distribution system and the water treatment processes
3. To provide adequate knowledge about wastewater characteristics and its treatment processes
4. To give an idea about the disposal of wastewater into water bodies and their effects on river systems
5. To study the various treatment techniques for industrial wastewater and understand the concepts of air pollution and its control measures

Course content

References

Course outcomes
On completion of the course, the students will be able to:
1. Identify the source of water and to calculate water demand.
2. Apply the water treatment concept and methods.
3. Prepare a layout of water distribution network.
4. Characterize wastewater and apply suitable treatment process.
5. Apply the various air pollution control devices to minimize the release of harmful gases into the atmosphere.

CEMI16 IRRIGATION ENGINEERING AND MANAGEMENT

Course Learning Objectives
1. To understand the basic types of irrigation, irrigation standards and crop water assessment
2. To know the irrigation management practices of the past, present and future
3. To study the different aspects of design of hydraulic structures
4. To provide knowledge on various hydraulic structures

Course Content

References

Course outcomes
On completion of the course, the students will be able to:
1. Find the crop water requirement for various crops in the command area.
2. Understand the complete design of Dams and channel systems.
3. Understand the different types of cross drainage works.
4. Understand the participatory irrigation management

CEMI17 QUANTITY ESTIMATION AND VALUATION

Course Learning Objectives
1. To know the importance of preparing the types of estimates under different conditions
2. To know about the rate analysis and bill preparations
3. To study about the specification writing
4. To understand the valuation of land and buildings

Course Content

References

Course outcomes
On completion of the course, the students will be able to:
1. apply different types of estimates in different situations
2. carry out analysis of rates and bill preparation at different locations
3. demonstrate the concepts of specification writing
4. carry out valuation of assets
ESSENTIAL LABORATORY REQUIREMENT (ELR)

CELRL11 STRENGTH OF MATERIALS AND CONCRETE LABORATORY

Course Learning Objectives
1. To find the Young Modulus, torsional strength, hardness and tensile strength of given specimens
2. To find impact value and crushing value of coarse aggregates
3. To find the compressive strength of concrete cubes and bricks
4. To find stiffness of open coiled and closed coiled springs
5. To find the physical properties of given coarse aggregate, fine aggregate and cement samples

Course content
1. Tests on springs - modulus of rigidity of the spring.
2. Stress-strain characteristics of HYSD bars.
3. Young's modulus of the given material (steel or wood) by conducting bending test on simply supported beam.
4. Brinel’s, Vickers, Rockwell hardness tester.
5. Normal consistency, fineness, Initial setting and final setting time of cement.
7. Specific gravity of fine and coarse aggregates.
8. Fineness modulus of fine aggregate and coarse aggregate.
10. Concrete mix design (IS method).
11. Tests on Concrete.
14. Permeability test and NDT Tests (only Demonstration)

Course outcomes
On completion of the course, the students will be able to:
1. Evaluate Young Modulus, torsional strength, hardness and tensile strength of given specimens.
2. Determine the strength of coarse aggregates.
3. Design concrete mixes and find the compressive strength of concrete cubes and bricks.
4. Find stiffness of open coiled and closed coiled springs.
5. Determine the physical properties of given coarse aggregates, fine aggregates and cement samples.
CEL12 SURVEY LABORATORY

Course Learning Objectives
The Lab sessions would include experiments on
1. Introduction to Chain Surveying and Compass Surveying.
2. Plane Table Surveying – Radiation, intersection, Traverse, Resection Leveling.
3. Tacheometry and Theodolite survey
4. Trigonometric levelling to determine heights/elevations.
5. Total Station.

Course content
1) Chain and Compass surveying
2) Plane table surveying
3) Leveling: Fly leveling and contouring
4) Radiation, intersection-Traverse- Resection
5) Theodolite surveying
6) Single and two plane observation of trigonometric leveling
7) Determination of Tacheometric Constants
8) Tangential Tacheometry
9) Subtense Bar
10) Total station
11) Survey Camp

Course outcomes
On completion of the course, the students will be able to:
1. Use conventional surveying tools such as chain/tape, compass, plane table, level in the field of civil engineering applications such as structural plotting and highway profiling.
2. Apply the procedures involved in field work and to work as a surveying team.
3. Plan a survey appropriately with the skill to understand the surroundings.
4. Take accurate measurements, field booking, plotting and adjustment of errors can be understood.

CEL13 FLUID MECHANICS LABORATORY

Course Learning Objectives
1. To understand the flow measurement in a pipe flow
2. To determine the energy loss in pipe flow
3. To study the characteristics of turbines
4. To study the characteristics of pumps
5. To measure the discharge in a open channel flow

Course Content
1. Determination of pipe friction
2. Calibration of flow meters - Venturimeter and Orifice meter
3. Determination of discharge coefficients for notches
4. Determination of minor losses
5. Pressure gauge calibration.
6. Centrifugal pump
7. Submersible pump
8. Reciprocating pump
9. Jet pump
10. Gear pump
11. Screw pump
12. Francis Turbine

Course outcomes
On completion of the course, the students will be able to:
1. measure discharge in pipes
2. determine the energy loss in conduits
3. demonstrate the characteristics curves of pumps
4. demonstrate the characteristics curves of turbines
5. carry out discharge measurements in open channel

CEL14 BUILDING PLANNING AND DRAWING

Course Learning Objectives
1. To understand the principles of planning and bylaws
2. To draw plan, elevation and section of public and industrial load bearing and framed structures
3. To draw plan, elevation and section of public and industrial structures
4. To prepare detailed working drawing for doors, windows, etc.

Course Content
Classification of buildings - Principles of planning - Dimensions of buildings - Building bye-laws for floor area ratio, open spaces - Orientation of buildings - Lighting and Ventilation - Planning and preparing sketches and working drawings of Residential buildings (Flat and sloping roof), Schools, Hostels, Hospitals, Single-storey factory buildings with trusses. Detailed working drawings of the component parts - Doors and Windows - Roof Trusses - Staircases - Toilets

References

Course outcomes
On completion of the course, the students will be able to:
1. apply the principles of planning and bylaws used for building planning
2. draw plan, elevation and section for various structures
CELR15 GEOTECHNICAL ENGINEERING LABORATORY

Course Learning Objectives
1. To estimate index properties of soils (coarse and fine)
2. To estimate consistency limit of fine grained soils
3. To estimate shear strength of soils by direct shear test, triaxial shear test, vane shear test & unconfined compressive test
4. To estimate the engineering properties of the soils by density test, CBR test permeability test and consolidation test

Course content
1. Grain Size analysis.
2. Consistency limits
3. Specific gravity.
4. Permeability tests
5. Unconfined compression test.
6. Direct shear test.
7. Core cutter and sand replacement
8. Compaction test
9. California bearing ratio test
10. Vane shear test.
11. Tri-axial test
12. Consolidation test

Course outcomes
Upon completion of this course, the students will be able to
1. Proper soil classification and comments its suitability construction
2. Estimate soil consistency and compaction characteristics
3. Estimate soil design parameter for strength estimation
4. Proper interpretation among the estimated soil design parameters

CELR16 ENVIRONMENTAL ENGINEERING LABORATORY

Course Learning Objectives
1. To analyze the physical and chemical characteristics of water and wastewater
2. To quantify the chemical requirement for turbidity removal
3. To familiarize the methods to estimate the organic strength of wastewater
4. To study the growth of microorganisms and its quantification

Course Content

Course Outcomes
On completion of the course, the students will be able to
1. apply different analysis techniques for the measurement of physical and chemical parameters of wastewater
2. quantify the pollutant concentration in water and wastewater
3. recommend the degree of treatment required for the water and wastewater
4. assess the microbial contamination in water

CELR17 TRANSPORTATION ENGINEERING LABORATORY

Course Learning Objectives
1. To organize traffic surveys
2. To collect wide variety of traffic data
3. To conduct standard tests on aggregate and bitumen
4. To do mix design for GSB
5. To carry out design of bituminous mixes

Course Content

Traffic Surveys
1. Volume count
2. Intersection turning movements
3. Speed study
4. Speed and delay study
5. Moving observer survey
6. Parking study

Tests on aggregate
7. Shape Test - Flakiness and Elongation Index
8. Los Angeles Abrasion Test

Tests on bitumen
9. Specific Gravity
10. Penetration Grade
11. Softening Point
12. Ductility Value
13. Flash and Fire Point
14. Viscosity Value

Mix design
15. Granular Sub-base
16. Bituminous Layer

References
4. Relevant IRC Codes of Practices
5. Ministry of Road Transport and Highways, Specifications for Road and Bridge Works, Indian Roads Congress 2004
Course Outcomes
Upon completion of this course, the students should be able to:

1. conduct various traffic surveys
2. collect traffic data
3. perform laboratory tests on aggregate and bitumen
4. conduct mix design for GSB
5. carry out mix design for Bituminous mixes

CELR18 COMPUTATIONAL LABORATORY

Course Learning Objectives
1. To learn the software developing skills for structural design.
2. To understand the computing techniques in the field of transportation.
3. To gain knowledge in problem solving in water resources.
4. To learn the software skills in structural engineering, transportation engineering, water resources engineering, geotechnical engineering and GIS and Remote Sensing, construction management and project scheduling

Course Content
Usage of commercially established software for
1) Design of the structural elements in concrete and steel.
2) Transportation Engineering problems: Highway geometrics, pavement design.
3) Geotechnical Engineering problems: Earth pressure, Foundation settlement and stress analysis, Consolidation.
4) Problems in Environmental and Water resources engineering: Treatment systems, Pipe networks analysis, Synthetic Unit hydrograph derivation, Flood routing, Water balance model.
5) Problems in BIM, construction management and scheduling for PERT and CPM
6) GIS and Remote sensing applications

References

Course outcomes
1. Apply the software skills in the transportation engineering, water resources and environmental engineering.
2. Apply computing skills to geotechnical engineering.
3. Apply computing skills to structural engineering.
4. Apply computing skills to construction management and project scheduling
(V) ADVANCED LEVEL COURSES FOR B.Tech. (HONOURS)

CEH010 DYNAMICS OF STRUCTURES

Course Learning Objectives
1. To introduce the concepts of dynamic loading and to study the dynamic response of SDOF, MDOF and continuous systems subjected to different types of dynamic loads.
2. To learn free and forced vibration response of structural systems.
3. To familiarize students with mathematical models representing real time problems of discrete and continuous vibratory systems.
4. To make students understand the principle of virtual displacements.
5. To expose students to the concept of resonance.

Course Content
Introduction; SDOF system: Derivation of Equation of Motion, Free and Force vibration of undamped and viscously damped system, response due to Harmonic excitation; analysis under general forcing function – periodic and pulse loading

Numerical techniques to determine response of SDOF system; Elastic Response Spectra: Earthquake excitation; Generalized SDOF system

Two degrees of freedom system: Derivation of equation of motion, synchronous motion; Free Vibration – Natural frequencies and mode shapes, Principal coordinates, Semi-definite system, Tuned vibration absorber

Multi-degree of freedom system: Mass and stiffness matrices for discrete system; Orthogonality of mode shapes; mode superposition method; Damping in structures – Classical and non-classical damping matrix; Free and Forced response; Determination of Natural Frequencies and mode Shapes – Dunkerley’s Formula; Holzer method; Matrix iteration method; Jacobi’s method; Rayleigh’s quotient

Elements of analytical dynamics: Hamilton’s principle – Lagrange’s Equation – Virtual work

Continuous system: Relation between discrete and continuous system; axial vibration of bar and bending vibration of beam; Effects of shear deformation and rotary inertia; Free vibration; modal analysis; Approximate methods – Rayleigh-Ritz method; Assumed mode. Introduction to FEM for bar and beams – element mass and stiffness matrices; assembly; equation of motion for complete system

References
6. Elements of Vibration Analysis by Leonard Meirovitch
7. Dynamics of Structures by Jagmohan L. Humar

Course outcomes
On completion of the course, the students will be able to:
1. apply the concepts of dynamic systems
2. identify, formulate and solve dynamic response of SDOF
3. identify, formulate and solve dynamic response of MDOF
4. analyze continuous systems subjected to different types of dynamic loads
5. identify, formulate and solve free and forced vibrations response of structural systems

CEHO11 FINITE ELEMENT METHODS ANALYSIS

Course Learning Objectives
1. To study the modelling aspects of Discrete and Continua elements
2. To develop equilibrium equation and solving problem through Direct stiffness method for discrete elements
3. To study the strain – displacement and linear constitutive relation
4. To derive Element Stiffness Matrix through various shape functions for 1D and 2D elements.
5. To study and apply the 2-D isoparametric elements
6. To apply equilibrium equations, strain displacement relation, linear constitutive relation in practical problems.

Course Content

Differential equilibrium equations - strain displacement relation - linear constitutive relation - special cases - Principle of stationary potential energy - application to finite element methods - Some numerical techniques in finite element Analysis


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.

(Assignment includes Modelling and Analysis of structural members using any general-purpose finite element software)

References

Course outcomes
On completion of the course, the students will be able to:
1. demonstrate the differential equilibrium equations and their relationship
2. apply numerical methods to FEM
3. demonstrate the displacement models and load vectors
4. compute the stiffness matrix for isoperimetric elements
5. analyze plane stress and plane strain problems

CEHO12 THEORY OF ELASTICITY AND INTRODUCTION TO PLASTICITY

Course Learning Objectives
1. To learn about the concept of deformation, stress, strain and constitutive relations of solids
2. To understand practically useful stress definitions such as principal, hydrostatic, octahedral etc
3. To know the usage of Airy Stress functions and solution to problems using the approach
4. To understand the behaviour of non-circular and open sections in torsion
5. To gain a basic introduction to the plastic behaviour in materials and application of failure theories of brittle and ductile materials

Course content
Basic concepts of deformation of bodies – deformation gradient- Tensor notations of stress and strain in 3D field - Traction - Engineering and Cauchy stress and Green-Lagrange Strains - Cauchy form of equilibrium equation - Transformation of stress and strain in a 3D field - Equilibrium equations in 2D and 3D Cartesian coordinates
Compatibility equations - Stresses: Principal, Octahedral, Hydrostatic and deviatoric
- Derivation of Constitutive law - reduction to isotropic and uniaxial case

Plane stress and plane strain problems - 2D problems in Cartesian coordinates as applied to beam bending using Airy’s stress function and examples - Problems in 2D - stress concentration in holes - Circular disc subjected to diametral compressive loading - semi-infinite solid subjected to different types of loads – Analysis of Thick Cylinders

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 - Torsion of thin walled tubes

Plasticity – Introduction - Reasons of plasticity - slip lines - Plastic stress-strain relations - Flow rules (associated and non associated) - Different hardening rules - Yield criteria for ductile and brittle materials - Graphical representation of yield criteria

References

Course outcomes
On completion of the course, the students will be able to:
1. 1. Relate various stress and strain measures and perform transformation between different bases.
2. determine principal, hydrostatic and octahedral stresses for given stress state
3. obtain the solution to classical problems using the Airy stress function approach
4. analyse non-circular and open sections subjected to torsion
5. apply hardening rules in the plastic range and determine the failure of brittle and ductile materials using various failure theories.

CEHO13 NONLINEAR ANALYSIS OF STRUCTURES

Course Learning Objective
1. To understand the factors influencing nonlinear response of structures
2. To study about the elastic and plastic analysis of structures
3. To learn the various techniques on nonlinear analysis of structures
4. To provide the knowledge on solution techniques

Course content
Introduction – Factors influencing nonlinear response of structures – Geometrical effect, Material effects, Instability phenomena – Snap through, Bifurcation, Post buckling behaviour


Geometrically nonlinear static analysis of trusses – Member force-deformation relationships – Member tangent stiffness matrices – System equilibrium equations

Solution techniques - static analysis – Linearized incremental procedures – Iterative techniques – Detection of instability

Geometrically nonlinear static analysis of frames – Large rotations – Analysis of individual members – Member tangent stiffness matrices – Solution techniques

References

Course outcomes
At the end of the course student will be able
1. Identify the factors affect the nonlinear response of structures
2. Analyze the elastic-plastic properties of trusses, beams and frames
3. Carry out various methods on analysis of nonlinear response of structure
4. Apply the solution techniques for nonlinear static analysis of frames and members

CEHO14 THEORY OF PLATES AND INTRODUCTION TO SHELLS

Course Learning Objectives
1. To introduce the concept of plate theory and study the behaviour and analysis of thin plates.
2. To study the procedure for rectangular plates and circular plates subjected to lateral loads
3. To learn about folded plate analysis and the stability of thin plates in normal and shear stresses
4. To introduce the different types of shells and common first order theories like membrane theory and bending theory
5. To gain a basic introduction to advanced concepts of Foppl-von Karman plate theory, thick-plate theory, higher order shell theories, DKJ theory etc

Course content
Thin plates with small deflection; assumptions - Long plates in cylindrical bending, strain energy in rectangular plates - governing differential equations (Kirchhoff Plate) and various boundary conditions.
Simply supported rectangular plates - Navier solution with various types of loads, rectangular plates with various boundary conditions - Naviers method for patch/point loads - Levy’s method, Axi-symmetric circular plates

Demonstration of numerical methods – Finite difference method and Kantorovich method - Approximate analysis of Grids– Analysis of Folded Plates by Winter-Pei distribution

Overview on Orthotropic plates – Overview on Large deflection of plates and mid-plane stretching (Foppl - von Karman plate) – Overview on Mindlin Reissner Theory - Stability of rectangular plates fundamentals - some edge conditions- design applications such as section classification and simple postcritical method

Shells: structural behavior, classification, translational and rotational shells- hyperbolic paraboloid- elliptic paraboloid- Gaussian curvature - Overviews on Shell theories such as Higher order theories, Marguerre theory, DKJ Theory etc - Membrane theory of shells- cylindrical shells- shells of revolution including design

References
3. Varghese, P.C., Design of Reinforced Concrete Shells and Folded Plates, PHI, 2010

Course outcomes
On completion of the course, the students will be able to:
1. Assess the strength of thin plates under different types of loads
2. Analyze thin plates using Navier’s method and Levy’s method and circular plates under axi-symmetric deflection
3. Ascertaining the stability of thin plates in normal and shear stress states
4. Classify different types of shells and analyze them using membrane theory
5. Explain advanced theories related to large deflection of plates and thick plates and higher order shell theories.

Course Learning Objectives
1. To be introduced to traffic flow theory.
2. To study macroscopic modelling
3. To learn microscopic modelling
4. To study car following models
5. To learn the fundamentals of ITS.

**Course Content**


Macroscopic models - Heat flow and fluid flow analogies - Shock waves and bottleneck control approach.

Microscopic models - Application of queuing theory - Queue discipline - Waiting time in single channel queues and extension to multiple channels.

Linear and non-linear car following models - Determination of car following variables - Acceleration noise.

Intelligent Transportation Systems - Area Traffic Control – Automatic Toll Collection – Smart Cards – Collision Detection System.

**References**


**Course Outcomes**

Upon completion of this course, the student will be able to:

1. analyze the traffic stream parameters
2. demonstrate fluid flow modeling
3. apply the queuing theory
4. implement car following models
5. define the significance of ITS under Indian conditions.

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**CEHO16 PAVEMENT CONSTRUCTION AND MANAGEMENT**

**Course Learning Objectives**

1. To learn the concept of flexible pavement construction
2. To learn the concept of flexible pavement construction
3. To study about the stabilization, recycling and use of geosynthetics
4. To study the structural and functions failure
5. To understand the concept of Pavement Management System

**Course Content**

Flexible Pavement Construction: Earthwork, compaction and construction of embankments, specifications of materials, construction methods and field control checks for various types of flexible pavement materials in sub-base, base, binder and surface course layers and their choice.

Cement Concrete Pavement Layers: Specifications and method of cement concrete pavement construction; Construction of interlocking block pavements, Quality control tests; Construction of various types of joints.
Soil Stabilized Pavement Layers: Principles of gradation/proportioning of soilaggregate mixes and compaction; mechanical, soil-cement, soil-bitumen and soil-lime stabilisation methods. Use of additives, Numerical problems on mix design and applications. Design and construction of surface and sub-surface drainage system for highways and airports, Recycling Techniques in Bituminous Pavements, Use of Geosynthetics in Highway Construction

Pavement Evaluation - Pavement Distress - Functional and structural condition of pavements, Pavement distress survey. Functional condition evaluation of pavements- Roughness, Skid Resistance. Structural evaluation of pavements - non-destructive testing, Benkelman beam and Falling Weight Deflectometer, Pavement strengthening based on deflection as per IRC, Maintenance and rehabilitation techniques.

Pavement Management Systems - Pavement Management Systems- Components, structure, data requirements, Project level and Network level needs, Pavement performance prediction – concepts, modelling techniques, Budget forecasting for maintenance and rehabilitation, Ranking and optimization methodologies, life cycle costing

References

Course Outcomes
Upon completion of this course, the student will be able to:
1. carry out the construction of flexible pavements
2. carry out the construction of rigid pavements and joints
3. use different stabilization methods, recycling techniques and geosynthetics
4. evaluate of the pavements based on the functional and structural characteristics
5. do develop pavement management systems

CEH017 SOIL DYNAMICS AND MACHINE FOUNDATIONS

Course Learning Objectives
1. To explain the significance of dynamic load in machine foundation analysis
2. To explain theory of vibration for different field conditions
3. To explain the principles of machine foundation design for reciprocating and impact machines
4. To explain the concept and method of foundation isolation

Course content
Introduction - nature of dynamic loads - stress conditions on soil elements under earthquake loading - dynamic loads imposed by simple crank mechanism - type of machine foundations - special considerations for design of machine foundations.
Theory of vibration: general definitions - properties of harmonic motion - free vibrations of a mass- spring system - free vibrations with viscous damping - forced
vibrations with viscous damping - frequency dependent exciting force - systems under transient forces - Raleigh’s method - logarithmic decrement - determination of viscous damping - principle of vibration measuring instruments - systems with two degrees of freedom.


Foundations subjected to impact loads - design criteria - analysis of vertical vibrations - computation of dynamic forces - design of hammer foundations (IS code method) - vibration isolation - active and passive isolation - transmissibility - method of isolation in machine foundations.

References
4. IS 2974 - Part I and II, Design Considerations for Machine Foundations
5. IS 5249: Method of Test for Determination of Dynamic Properties of Soils

Course outcomes
Upon completion of this course, the students will be able to
1. Understand the influence of dynamic load in the machine foundation analysis and design
2. Use vibration theory in soil dynamics and ascertain soil behaviour accordingly
3. Do machine foundation analysis and design for reciprocating and impact machines
4. Understand foundation isolation and its significance in machine foundation

CEHO18 NUMERICAL MODELLING IN GEOTECHNICAL ENGINEERING

Course Learning Objectives
1. To explain modelling of soil behaviour considering field aspects
2. To explain constitutive relations in soil modelling
3. To explain material modelling with respect to soil behaviour
4. To give an exposure to numerical methods in geotechnical problems
5. To give hand on experience using geotechnical software

Course content
Modelling of Soil Behaviour: Critical state theory; stress paths within and on the state boundary surface; shear strength of clays related to the critical state concept.

Basic Concept of Continuum Mechanics: Notations; stresses and strains in three dimensions; equations of equilibrium, geometric conditions and constitutive relations.

Material modelling: Elastic models; perfect plasticity models-Coulomb model- Drucker-Prager model; Hardening plasticity models; generalized stress-strain relations and stiffness formulations; cap model in isotropic consolidation test and triaxial shear test; simulation of pore pressure; case studies on implementing the models.

Finite element modelling: Introduction to numerical methods - FEM, FDM, BEM; FEM for 1D and 2D problems; FEM for non-linear problems.

Application of Finite element modelling: Effective stress analysis, seepage and consolidation problems; practical aspects related to foundations, embankments and retaining structures; application examples-use of ABAQUS, PLAXIS, FLAC, MIDAS_GTS programs etc.

References
2. Fethi Azizi, Applied Analyses in Geotechnics, E andN Spon of Taylor and Francis group, 2000

Course outcomes
Upon completion of this course, the students will be able to
1. Do proper soil modeling with respect to the soil behaviour
2. Understand the constitute relations
3. Select proper material modeling for the FE analysis
4. Use geotechnical software like PLAXIS, FLAC etc.

CEHO19 PHYSICOCHEMICAL METHODS FOR WATER AND WASTEWATER TREATMENT

Course Learning Objectives
1. To learn the physical, chemical and biological characteristics of water and wastewater.
2. To provide an understanding of various physicochemical methods for treatment of water and wastewater.
3. To explain the limitations, advantages and disadvantages of each unit operations and processes.
4. To study the principle and design of the physical and chemical treatment units used for the removal of undesirable constituents (contaminants) from water and wastewater

**Course Content**


**References**


**Course outcomes**

At the end of the course student will be able
1. to evaluate various physical and chemical treatment options for treatment of water and wastewater
2. to explain the mechanism behind the treatment processes and their advantages and disadvantages
3. to design various physico-chemical units for the treatment of water and wastewater
4. to use the modelling concepts in the real field applications

**CEHO20 BIOLOGICAL TREATMENT OF WASTEWATER**

**Course Learning Objectives**

1. To learn the fundamentals of process kinetics and bioreactors
2. To study about various biological treatment processes and its operations for the wastewater treatment.
3. To provide the knowledge about the kinetics of biological growth and its application in the design of biological reactors
4. To explain the design principles and operational problems involved in various biological treatment processes

**Course Content**

References

Course outcomes
At the end of the course student will be able to
1. describe the range of conventional and advanced biological treatment processes for the treatment of bulk organics, nutrients and micro pollutants.
2. design the biological reactors based on biokinetics
3. select appropriate processes for specific applications, and have some knowledge of practical design considerations.
4. execute and assess the performance of bioreactors in laboratory scale

CEHO21 FREE SURFACE FLOW

Course Learning Objectives
1. To introduce the concepts of free surface flow and its applications in flood control, design of drainage and water ways.
2. To develop an understanding of free surface flow and enclosed flow in the real field but in the controlled environment.
3. To study the variation of dependent hydraulic variables with independent variables of pipe flow and open channel flow.
4. To verify the theoretical results with the experimental results.
5. To understand different flow condition and able to solve the related problems.

Course content
Free surface flows, velocity distribution, resistance relationships, specific energy and specific force, normal and critical depths computations, governing equation and computation of gradually varied flows.

Elements of hydraulic jump, hydraulic jump in variety of situations including contracting and expanding geometries and rise in floor levels, control of hydraulic jump using baffle walls and cross jets.

Bulking of flow, mechanism of air entrainments, modelling of aerated flows, development of self-aerated flows, uniform aerated region, aeration over spillway.

St. Venant’s equations and their solution using method of characteristics and finite difference schemes; dam break problem, hydraulic flood routing, Sub-critical and supercritical.

References
5. K. Subramanya, Engineering Hydrology, Tata McGraw Hill, Information on hydraulics and hydrology

Course outcomes
At the end of the course student can
1. Become efficient in knowledge on the different hydraulics properties involved in River and channel flow problems.
2. know about theoretical models and perform experimental project work and the theory becomes easier.
3. Design pipe and open channel flow for different geometric, roughness and flow parameters.
4. Design and solve the hydraulic jump, flood routing, critical flow and related problems.
5. Students be able to describe design side weirs, flow past bottom racks, trench weirs and waste water gutters.

CEHO22 COMPUTATIONAL FLUID DYNAMICS

Course Learning Objectives
1. To understand the basic concepts in turbulence modelling.
2. To provide fundamental knowledge on finite difference/element and volume methods.
3. To describe the solution methodologies for discretized equations.
4. To develop models using structured and unstructured grids.

Course content
Derivation of flow governing equations; turbulence modeling; modeling approaches for multiphase flow; initial and boundary conditions; wellposedness.

Discretization of the governing equations using finite difference/volume/element methods; concepts of consistency, stability and convergence; template for the discretization of a generic unsteady transport equation.
Solution of discretized equations; direct methods; classical iterative methods; advanced methods for structured matrices; conjugate gradient techniques; multigrid methods.

Solution of coupled equations: methods for compressible flows; evaluation of pressure in incompressible flows; pressure-velocity coupling algorithms.

Structured and unstructured grids; structured grid generation; unstructured grid generation. Benchmarking; calibration.

References
3. Anil W. Date, Introduction to Computational Fluid Dynamics, Cambridge, 2005

Course outcomes
By the end of this course, the students will be able to
1. Develop knowledge on non linear problems
2. Improve knowledge on finite element, difference and volume methods.
3. Provide solution methodologies for real time problems.
4. Develop hydrological and hydrodynamic models.

CEHO23 WAVE HYDRODYNAMICS

Course Learning Objectives
1. To understand the basics of wave motion.
2. To study the different aspects of linear wave theory
3. To enhance the knowledge on wave transformation
4. To provide knowledge on various other wave theories and wave forces

Course Content
Linear wave theory: Governing Equation, Boundary Conditions and solutions, Dispersion relation, Constancy of wave period.
Shoaling, bottom friction and damping, refraction, reflection and diffraction. Wave Breaking: Type of breaking, Surf similarity parameter. Keulegan-Carpenter number, Ursell Parameter, Scattering parameter, Reynolds Number, Currents – Classification and Design criteria
Non breaking wave forces on slender structures – Morison equation; Diffraction theory, source distribution method. Introduction to non-linear wave theories-Strokes, Cnoidal and Solitary wave theory. Mass transport velocity, Introduction to Random and directional waves.
References

Course outcomes
On completion of the course, the students will be able to:
1. Derive the linear wave theory dispersion relationship.
2. Understand the complete details of wave parameters.
3. Understand the concept of wave transformation.
4. Compute wave forces on slender cylindrical members.

CEHO24 ADVANCED REMOTE SENSING

Course Learning Objectives
1. To learn the advanced concepts of Remote Sensing technology and Geographic Information System and its data types
2. To gain knowledge about the various classifiers and artificial intelligence tools adopted in geospatial techniques
3. To familiarize with the various remote sensing and GIS data set for civil engineering applications
4. To apply various MCDA, metaheuristic algorithm for vulnerability modelling
5. To learn how to use the soft computing techniques with GIS for vulnerability and susceptibility modelling

Course content
Microwave-SAR, optical Hyperspectral data for geological, geomorphological, and terrain analysis, geological hazard interpretation and analysis, flood and coastal hazard assessment, application of GEE and soft computing tools in remote sensing.

Advance Classifiers and feature extraction methods: Fuzzy, ANN and sub-pixel-based classification methods, Automatic feature extraction methods, Image segmentation and texture analysis of satellite images; Multivariate and Geostatistics - Random variables and distributions, ANOVA, Statistical Tests, Regression Analysis, Trend surface analysis, correlation and PCA, Regionalized variables, semi variogram, assessment of various interpolation techniques.
Application of DEM and DTM, Sensitivity analysis of various open source DEM, DEM derivatives and its applications, Flood inundation and submergence modelling.

Application of MCDA techniques using Geospatial data for susceptibility and vulnerability modeling, AHP, Fuzzy, TOPSIS, VIKOR, EDAS, ANFIS for Forest fire, flood, Drought, Landslide vulnerability, MSW solid waste dump site location, wind& solar power site suitability analysis.


References

Course outcomes
At the end of the course student will be able
1. Acquire knowledge on the various Understand the satellite data products for various civil engineering applications.
2. Get a sound knowledge on the various remote sensing data products for mapping and modelling of susceptibility and vulnerability.
3. Acquire knowledge about soft computing techniques, advanced GIS and remote sensing tools.
4. Execute and evaluate the real-time problems using advanced geospatial techniques.
5. Gain knowledge to develop the technical and technological measures for vulnerability and susceptibility modelling.

CEHO25 RIVER HYDRAULICS AND SEDIMENT TRANSPORT

Course Learning Objectives
1. To understand the behaviour free surface flow conditions under varying depths of flow in open channel
2. To understand the process of the steady, unsteady and Gradually varying flow in rivers and open channels
3. To Illustrate the design methods of cross section of channels for different flow and geometry conditions.
4. To Provide idea on flow computation, velocity distribution in a river or artificial channel with complex geometry, plan form and flow conditions (steady and unsteady).
5. To understand the Sediment generation and transportation behaviours in Rivers and channels.

Course content
Derivation of the general one-dimensional equations of continuity, momentum and energy used in open channel flow analysis. Steady non-uniform flows, channel transitions and controls, hydraulic jumps surges-Surface profile for gradually varied flow.


River Engineering: Classification of Rivers, Causes of Meandering, The Aggrading type of River, Stage-discharge curves for meandering channels Degrading type of River, Cutoffs, river Training, Types of Training Works.

Origin and formation of sediments- properties of sediments, lift force, tractive stress concept on cohesion less and cohesive soils. Velocity of flow of sediments, regimes of flow; Resistance to flow in alluvial streams, resistance relations based on total resistance and division of resistance into grain and form resistance.

velocity distribution in alluvial channel, Scouring, Bed load computation by empirical equations, dimensional considerations and semi-theoretical equations, siltation, Mechanism of suspension, general equations of diffusion.

Essential Reading/ Text books

Course Outcomes
At the end of the course student can able to
1. Know the fundamental of free surface flow and sediment transport in rivers and channels.
2. Compute the flow velocity distribution, roughness in a channel with given geometry, plan form and flow conditions.
3. Able to understand the characteristic of nonuniform flow and unsteady flow in a Channel.
4. Able to solve the problem of propagation of flood wave, flood routing and surges in channels.
5. Understand the hydraulics of sediment transport in mobile bed channel.