ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
M.E. SOIL MECHANICS AND FOUNDATION ENGINEERING
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):
I. To prepare students to excel in research or to succeed in soil mechanics and foundation engineering profession through global, rigorous post graduate education.
II. To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve soil mechanics and foundation engineering problems
III. To train students with good scientific and engineering knowledge so as to comprehend, analyze, design, and create novel products and solutions for the real life problems.
IV. To inculcate students in professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate soil mechanics and foundation engineering issues to broader social context.
V. To provide student with an academic environment aware of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career

PROGRAMME OUTCOMES (POs):
On successful completion of the programme,
1. Graduates will demonstrate knowledge of mathematics and science associated with soil mechanics and foundation engineering applications.
2. Graduates will demonstrate an ability to identify, formulate and solve soil mechanics and foundation engineering problems.
3. Graduate will demonstrate an ability to have the necessary knowledge for performing subsurface investigation.
4. Graduates will demonstrate an ability to critically analyze and interpret soil mechanics and foundation engineering data.
5. Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.
6. Graduate will demonstrate skills to use modern engineering tools, software and equipment to analyze soil mechanics and foundation engineering problems.
7. Graduates will demonstrate knowledge of professional and ethical responsibilities.
8. Graduate will be able to communicate effectively in both verbal and written form.
9. Graduate will show the understanding of the impact of soil mechanics and foundation engineering solutions on the society and also will be aware of contemporary issues.
10. Graduate will develop confidence for self education and ability for life-long learning.
<table>
<thead>
<tr>
<th>Programme Educational Objectives</th>
<th>Programme Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>II</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>III</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>IV</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>V</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>YEAR 1</td>
<td>SEM 1</td>
</tr>
<tr>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR 2</th>
<th>SEM 2</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Deep Foundations</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Earth and Earth Retaining Structures</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ground Improvement Techniques</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shallow Foundations</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional Elective II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional Elective III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advanced Soil Mechanics Laboratory -I</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR 2</th>
<th>SEM 3</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Professional Elective IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional Elective V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional Elective VI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advanced Soil Mechanics Laboratory -II</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Design Studio</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Practical Training (2 weeks)</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project Work Phase I</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR 2</th>
<th>SEM 4</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Project Work Phase II</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>S.No.</td>
<td>COURSE CODE</td>
<td>COURSE TITLE</td>
<td>CATEGORY</td>
<td>CONTACT PERIODS</td>
<td>L</td>
<td>T</td>
<td>P</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>----------</td>
<td>----------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MA5151</td>
<td>Advanced Mathematical Methods</td>
<td>FC</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>SF5101</td>
<td>Soil Properties and Behaviour</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>SF5102</td>
<td>Strength and Deformation Behaviour of Soils</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>SF5103</td>
<td>Subsurface Investigation and Instrumentation</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>SF5104</td>
<td>Theoretical Soil Mechanics</td>
<td>PC</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Professional Elective I</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td>20</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S.No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>SEMESTER II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>SF5201</td>
<td>Deep Foundations</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>SF5202</td>
<td>Earth and Earth Retaining Structures</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>SF5203</td>
<td>Ground Improvement Techniques</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>SF5204</td>
<td>Shallow Foundations</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Professional Elective II</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Professional Elective III</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>PRACTICAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>SF5211</td>
<td>Advanced Soil Mechanics Laboratory - I</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td>22</td>
<td>18</td>
<td>0</td>
<td>4</td>
<td>20</td>
</tr>
</tbody>
</table>
### SEMESTER III

<table>
<thead>
<tr>
<th>S.No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td>Professional Elective IV</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>Professional Elective V</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Professional Elective VI</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><strong>PRACTICAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>SF5311</td>
<td>Advanced Soil Mechanics</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>SF5312</td>
<td>Design Studio</td>
<td>EEC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>6.</td>
<td>SF5313</td>
<td>Practical Training</td>
<td>EEC</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>7.</td>
<td>SF5314</td>
<td>Project Work (Phase I)</td>
<td>EEC</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>27</td>
<td>9</td>
<td>0</td>
<td>18</td>
</tr>
</tbody>
</table>

### SEMESTER IV

<table>
<thead>
<tr>
<th>S.No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRACTICAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>SF5411</td>
<td>Project Work (Phase II)</td>
<td>EEC</td>
<td>24</td>
<td>0</td>
<td>0</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24</td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
</tbody>
</table>

**TOTAL NO. OF CREDITS: 71**
### FOUNDATION COURSES (FC)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MA5151</td>
<td>Advanced Mathematical Methods</td>
<td>FC</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

### PROFESSIONAL CORE (PC)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>SF5101</td>
<td>Soil properties and Behaviour</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>SF5102</td>
<td>Strength and Deformation Behaviour of Soils</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>SF5103</td>
<td>Subsurface Investigation and Instrumentation</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>SF5104</td>
<td>Theoretical Soil Mechanics</td>
<td>PC</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>SF5201</td>
<td>Deep Foundations</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>SF5202</td>
<td>Earth and Earth Retaining Structures</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>SF5203</td>
<td>Ground Improvement Techniques</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>SF5204</td>
<td>Shallow Foundations</td>
<td>PC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>SF5211</td>
<td>Advanced Soil Mechanics Laboratory -I</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>10.</td>
<td>SF5311</td>
<td>Advanced Soil Mechanics Laboratory -II</td>
<td>PC</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

### PROFESSIONAL ELECTIVES

#### SEMESTER I

#### ELECTIVE I

<table>
<thead>
<tr>
<th>S.No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>SF5001</td>
<td>Geology for Geotechnical Applications</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>SF5002</td>
<td>Earth and Rock Fill Dams</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>SF5003</td>
<td>Mechanics of Unsaturated Soils</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>
## SEMESTER II
### ELECTIVE II & III

<table>
<thead>
<tr>
<th>S.No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>SF5004</td>
<td>Finite Element Methods and Applications</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>SF5005</td>
<td>Dynamics of Soils and Foundations</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>SF5006</td>
<td>Earthquake Resistant Design of Foundations</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>SF5007</td>
<td>Pavement Engineering</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

## SEMESTER III
### ELECTIVE IV, V & VI

<table>
<thead>
<tr>
<th>S.No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>SF5008</td>
<td>Geotechnical Earthquake Engineering</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>SF5009</td>
<td>Geotechnics for Design of Underground Structures</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>SF5010</td>
<td>Geoenvironmental Engineering</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>SF5011</td>
<td>Rock Mechanics and Applications</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>SF5012</td>
<td>Soil Structure Interaction</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>SF5013</td>
<td>Geosynthetic and Reinforced Soil Structures</td>
<td>PE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

## EMPLOYABILITY ENHANCEMENT COURSES (EEC)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>SF5312</td>
<td>Design Studio</td>
<td>EEC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>SF5313</td>
<td>Practical Training (2 weeks)</td>
<td>EEC</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>3.</td>
<td>SF5314</td>
<td>Project Work(Phase I)</td>
<td>EEC</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>4.</td>
<td>SF5411</td>
<td>Project Work(Phase II)</td>
<td>EEC</td>
<td>24</td>
<td>0</td>
<td>0</td>
<td>24</td>
<td>12</td>
</tr>
</tbody>
</table>
OBJECTIVES:
- The main objective of this course is to provide the student with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics and engineering. This course covers a broad spectrum of mathematical techniques such as Laplace Transform, Fourier Transform, Calculus of Variations, Conformal Mapping and Tensor Analysis. Application of these topics to the solution of problems in physics and engineering is stressed.

UNIT I LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 12

UNIT II FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 12

UNIT III CALCULUS OF VARIATIONS 12
Concept of variation and its properties – Euler’s equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems – Direct methods – Ritz and Kantorovich methods.

UNIT IV CONFORMAL MAPPING AND APPLICATIONS 12

UNIT V TENSOR ANALYSIS 12

TOTAL : 60 PERIODS

OUTCOMES:
After completing this course, students should demonstrate competency in the following skills:
- Application of Laplace and Fourier transforms to initial value, initial–boundary value and boundary value problems in Partial Differential Equations.
- Maximizing and minimizing the functional that occur in various branches of Engineering Disciplines.
- Construct conformal mappings between various domains and use of conformal mapping in studying problems in physics and engineering particularly to fluid flow and heat flow problems.
- Understand tensor algebra and its applications in applied sciences and engineering and develops ability to solve mathematical problems involving tensors.
- Competently use tensor analysis as a tool in the field of applied sciences and related fields.
REFERENCES:

SF5101 SOIL PROPERTIES AND BEHAVIOUR L T P C 3 0 0 3

OBJECTIVES:
- To impart knowledge on the various factors governing the Engineering behaviour of soils and the suitability of soils for various Geotechnical Engineering applications.

UNIT I SOIL DEPOSITS AND CLAY MINERALS 8

UNIT II PHYSICAL AND PHYSIO CHEMICAL BEHAVIOUR OF SOILS 9

UNIT III SWELLING, SHRINKAGE AND COMPACTION BEHAVIOUR OF SOILS 10

UNIT IV COMPRESSIBILITY, SHEAR STRENGTH AND PERMEABILITY BEHAVIOUR OF SOILS 10
Compressibility, shear strength and permeability behaviour of fine and coarse grained soils – mechanisms and factors influencing engineering properties – liquefaction potential – causes and consequences.

UNIT V CONDUCTION PHENOMENA AND PREDICTION OF SOIL BEHAVIOUR 8

TOTAL: 45 PERIODS
OUTCOME:
- Students are able to select suitable soils for various geotechnical applications based on the factors governing the Engineering behaviour of soils.

REFERENCES:

SF5102 STRENGTH AND DEFORMATION BEHAVIOUR OF SOILS

OBJECTIVES:
- To impart knowledge to characterize stress-strain behaviour of soils, the failure criteria and to evaluate the shear strength and compressibility parameters of soils.

UNIT I SHEAR STRENGTH OF COHESIONLESS SOILS

- Introduction
- Shear strength of soil-cohesion-angle of internal friction
- Shear strength of granular soils
- Direct shear
- Triaxial Testing
- Drained and undrained Stress-strain behaviour
- Dilation, contraction and critical states
- Liquefaction and cyclic mobility of saturated sands
- Factors influencing stress – strain characteristics
- shear strength.

UNIT II SHEAR STRENGTH OF COHESIVE SOILS

- Shear strength of NC and OC clays
- Stress-strain behaviour
- Total stress and effective stress approach
- Triaxial testing and stress path plotting
- pore pressure parameters of Skempton and Henkel
- shear strength of partially saturated clay in terms of stress state variables
- Factors influencing stress – strain characteristics
- shear strength.

UNIT III FAILURE THEORIES

- Concepts of yield and failure in soils
- Failure theories of Von Mises, Tresca and their extended form
- their applicability to soils
- Detailed discussion of Mohr - Coulomb failure theory.

UNIT IV CONSTITUTIVE MODEL AND DEFORMATION MODULUS OF SOILS

- Constitutive law for soil – linear, non linear model
- hyperbolic idealisation – Mohr-Columb model
- Hardening law
- Hardening soil model
- Hardening soil model with small strain stiffness
- Soft soil
- Soft soil model
- limitation of all models
- Deformation modulus for different type of loadings
- Poisson’s ratio.

UNIT V CRITICAL STATE SOIL MECHANICS

- The critical state line
- Roscoe’s surface
- Hvorslev’s surface
- Behavior of sand
- Effects of dilation
- Limitations of Taylor model
- Elastic and plastic deformation
- Camclay critical state model
- Modified Camclay model
- Parameters for design

TOTAL: 45 PERIODS
OUTCOME:
- Students are able to select the shear strength and compressibility parameters to design different structures for different conditions of loading, drainage and failure criteria.

REFERENCES:

SF5103   SUBSURFACE INVESTIGATION AND INSTRUMENTATION  L T P C
                                                  3 0 0 3

OBJECTIVES:
- Students are expected to understand the importance of site investigation, planning of subsurface investigation, interpretation of investigated data to design suitable foundation system.

UNIT I   PLANNING OF EXPLORATION AND GEOPHYSICAL METHODS  8
Scope and objectives, planning an exploration program, methods of exploration, exploration for preliminary and detailed design, spacing and depth of bores, data presentation. Geophysical exploration and interpretation, seismic method, Multichannel Analysis of Surface Waves (MASW) method and electrical methods, cross bore hole, single bore hole – up hole - down hole methods.

UNIT II   EXPLORATION TECHNIQUES  7
Methods of boring and drilling, non-displacement and displacement methods, drilling in difficult subsoil conditions, limitations of various drilling techniques, stabilization of boreholes, bore logs.

UNIT III   SOIL SAMPLING  8
Sampling Techniques – quality of samples – factors influencing sample quality - disturbed and undisturbed soil sampling advanced sampling techniques, offshore sampling, shallow penetration samplers, preservation and handling of samples.

UNIT IV   FIELD TESTING IN SOIL EXPLORATION  12
Field tests, penetration tests, Field vane shear, Insitu shear and bore hole shear test, pressuremeter test, dilatometer test - plate load test–monotonic and cyclic; field permeability tests – block vibration test. Procedure, limitations, correction and data interpretation of all methods.
UNIT V  INSTRUMENTATION  10
Instrumentation in soil engineering, strain gauges, resistance and inductance type, load cells, earth pressure cells, settlement and heave gauges, pore pressure measurements - slope indicators, sensing units, case studies.

TOTAL: 45 PERIODS

OUTCOME:
• Students are capable of planning and executing the sub soil investigation programme. They are also capable of interpreting the investigated data and can design suitable foundation system.

REFERENCES:

SF5104  THEORETICAL SOIL MECHANICS  L T P C  4 0 0 4

OBJECTIVES:
• To impart knowledge required for computing stress and settlement at any point in the semi-infinite elastic soil medium, anisotropic medium and layered deposits due to foundation loads and evaluation of stability of foundations, slopes, cuts and retaining structures both for the conditions of undrained and drained loading through theorems of plastic collapses.

UNIT I  THEORY OF ELASTICITY  12

UNIT II  STRESS AND DISPLACEMENT IN ELASTIC – HALF SPACE MEDIUM  14

UNIT III  THEOREMS OF PLASTIC COLLAPSE AND THEIR APPLICATIONS  10
UNIT IV  STABILITY OF SOIL STRUCTURE BY SLIP LINE METHOD AND LIMIT EQUILIBRIUM ANALYSIS


UNIT V  FLOW THROUGH POROUS MEDIA


OUTCOME:

- At the end of the course students will have the capacity to estimate the stresses in soil medium of any type due to foundation load and settlement of foundation. Further they will be in a position to evaluate bound and true collapse loads of soil structures.

REFERENCES:


SF5201  DEEP FOUNDATIONS

OBJECTIVES:

- The student will be exposed to the design of piles, pile groups and caissons with respect to vertical and lateral loads for various field conditions.

UNIT I  PILE CLASSIFICATIONS AND LOAD TRANSFER PRINCIPLE


UNIT II  AXIAL LOAD CAPACITY OF PIles AND PILE GROUPS

Allowable load of piles and pile groups – Static and dynamic methods – for cohesive and cohesionless soil – negative skin friction – group efficiency – pile driving formulae - limitation – Wave equation application – evaluation of axial load capacity from field test results – pile integrity test - Settlement of piles and pile group - codal provisions and IRC guide lines.
UNIT III LATERAL AND UPLIFT LOAD CAPACITY OF PILES


UNIT IV STRUCTURAL DESIGN OF PILE AND PILE GROUPS


UNIT V CAISSONS


OUTCOME:

- Students are able to select, analyse and design individual pile, group piles and caissons for different subsoil conditions.

REFERENCES:


SF5202 EARTH AND EARTH RETAINING STRUCTURES L T P C 3 0 0 3

OBJECTIVES:

- At the end of this course, students are expected to analyse and design rigid, flexible earth retaining structures, slurry supported trenches and deep cuts.

UNIT I EARTH PRESSURE THEORIES

Introduction – State of stress in retained soil mass – Earth pressure theories – Classical and graphical techniques (Culmann’s method) – Active and passive cases – Earth pressure due to external loads.
UNIT II   COMPACTON, DRAINAGE AND STABILITY OF RETAINING STRUCTURES  
Retaining structure – Selection of soil parameters - Lateral pressure due to compaction, strain softening, wall flexibility, drainage arrangements and its influence. – Stability analysis of retaining structure both for regular and earthquake forces.

UNIT III   SHEET PILE WALLS  
Types of sheet piles - Analysis and design of cantilever and anchored sheet pile walls – free earth support method – fixed earth support method. Design of anchor systems - isolated and continuous.

UNIT IV   SUPPORTED EXCAVATIONS  

UNIT V   STABILITY OF SLOPES  

OUTCOME:
• Students will be capable of analyzing and designing rigid, flexible earth retaining structures, slurry supported trenches and deep cuts.

REFERENCES:
OBJECTIVES:
- Students will be exposed to various problems associated with soil deposits and methods to evaluate them. The different techniques will be taught to them to improve the characteristics of difficult soils as well as design techniques required to implement various ground improvement methods.

UNIT I DEWATERING 9
Introduction – Scope and necessity of ground improvement in Geotechnical engineering basic concepts. Drainage – Ground Water lowering by well points, deep wells, vacuum and electro-osmotic methods. Stabilization by thermal and freezing techniques - Applications.

UNIT II COMPACTION AND SAND DRAINS 9
Insitu compaction of granular and cohesive soils, Shallow and Deep compaction methods – Sand piles – Concept, design, factors influencing compaction. Blasting and dynamic consolidation – Preloading with sand drains, fabric drains, wick drains etc. – Theories of sand drain – design and relative merits of various methods – Case studies.

UNIT III STONE COLUMN, LIME PILES AND SOIL NAILING 9

UNIT IV GEOSYNTHETICS AND ITS APPLICATIONS 9
Reinforcement – Principles and basic mechanism of reinforced earth, simple design: Synthetic and natural fiber based Geotextiles and their applications. Filtration, drainage, separation, erosion control – case studies.

UNIT V GROUTING 9

OUTCOME:
- Based on the knowledge gained student will be in a position to identify and evaluate the deficiencies if any in the deposits of the given project area and capable of providing alternative methods to improve its quality so that the structures built on it will be stable and serve the intended purpose.

REFERENCES:
4. Han, J., Principles and Practice of Ground Improvement, John Wiley and Sons, New Jersey, Canada2015.
OBJECTIVES:
- To impart knowledge to select, analyse, geotechnical and structural design of shallow foundation depending on ground conditions.

UNIT I  FOUNDATION DESIGN DECISIONS  6

UNIT II  BEARING CAPACITY  9

UNIT III  SETTLEMENT AND ALLOWABLE BEARING PRESSURE  9

UNIT IV  INTERACTIVE ANALYSIS AND DESIGN OF FOUNDATIONS  12

UNIT V  FOUNDATION FOR SPECIAL CONDITIONS  9

TOTAL: 45 PERIODS

OUTCOME:
- Students are able to select, analyse and design the shallow foundation based on both the type of soil and the loading.

REFERENCES:

SF5211 ADVANCED SOIL MECHANICS LABORATORY - I

OBJECTIVES:
- At the end of the course student attains adequate knowledge in assessing index properties, compaction, CBR, Compressibility, Swell characteristics and permeability of soils by conducting laboratory tests.

LIST OF EXPERIMENTS

UNIT I INDEX TESTS 12
Specific gravity of soil solids-Grain size distribution (Sieve analysis and Hydrometer analysis) - Liquid limit and Plastic limit tests - Shrinkage limit and Differential free swell tests - Field density Test

UNIT II CHEMICAL TESTS 12
Chemical analysis – pH – Conductivity – quantification of ions through flame Photometer – Determination of organic, sulphate and chlorite content.

UNIT III COMPACTION AND CBR TESTS 12

UNIT IV CONSOLIDATION AND PERMEABILITY TESTS 12
One dimensional consolidation test, Cv , Cc and mv determination. Permeability of soil – constant and falling head methods.

UNIT V SWELLTESTS 12
Determination of percent swell – swell pressure, constant volume method; expanded - loaded method.

TOTAL: 60 PERIODS

OUTCOME:
- Students will be capable of assessing various properties of soils by conducting appropriate tests.
REFERENCES:
8. I.S. Code of Practice (2720): Relevant Parts, as amended from time to time.

SF5311 ADVANCED SOIL MECHANICS LABORATORY - II L T P C
0 0 4 2

OBJECTIVES:
- At the end of the course student attains adequate knowledge in assessing Shear Strength, dynamic properties of soil and shear strength, indirect tensile strength and compressive strength of Rocks. Student learns to assess the different properties of geosynthetics. Student is trained to gain knowledge in assessing the properties of soils through field tests and also by conducting model tests.

UNIT I SHEAR STRENGTH TESTS 12
Direct shear – Triaxial compression (UU and CU) test – Unconfined compression test – Vane shear test.

UNIT II SUCTION TESTS 8
Soil water characteristic curves of soil by Pressure Plate apparatus – Filter paper technique.

UNIT III TEST ON GEOSYNTHETICS 12
Opening size of Geotextiles – Tensile strength of Geosynthetic materials – Interfacial friction – Permeability

UNIT IV TEST ON ROCKS 12
Point load index – Brazilian test – Direct shear test – Uniaxial compressive strength test

UNIT V MODEL AND FIELD TESTS 16
Model test on foundation elements - strain gauges - load cells. Field tests - Plate load test – static cone penetration test – standard penetration test – pressure meter test – Block vibration test – Cyclic triaxial test (demonstration only).

TOTAL: 60 PERIODS

OUTCOME:
- Students will be capable of assessing shear strength, dynamic properties of soils by conducting appropriate tests. They will be in a position to assess the properties of geosynthetics and rocks. They can also supervise different field tests.
REFERENCES:
8. I.S. Code of Practice (2720): Relevant Parts, as amended from time to time.

SF5312 DESIGN STUDIO

OBJECTIVES:
• Train the students to use various software packages for simulating and analyzing the real field problems in Geotechnical Engineering.

SYLLABUS:
Students have to work individually with software packages for simulating and analyzing the soil – structure interaction such as Foundations, Retaining walls, and Ground improvement related problems. Software use to analyze and design real challenging problems such as a deep excavation adjacent to an existing structure and slope stability analysis. Also, to predict the response of any other field problems like an embankment or surcharge adjacent to an existing structure. A detailed report on the work done should be submitted by individual students at least 10 days before the last working day of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

TOTAL: 30 PERIODS

OUTCOME:
• At the end of the course the students will have a clear idea to use software programs for arriving solutions to various practical design problems in Geotechnical Engineering.

REFERENCES:

SF5313 PRACTICAL TRAINING (2 weeks)

OBJECTIVES:
• To train the students in field work so as to have a firsthand knowledge of practical problems in carrying out Soil Mechanics and Foundation engineering tasks. To develop skills in facing and solving the geotechnical engineering field problems.
SYLLABUS:
The students individually undertake training in reputed Soil Mechanics and Foundation Engineering Companies during the summer vacation for a specified period of four weeks. At the end of training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

OUTCOME:
- Students are able to solve Soil Mechanics and Foundation engineering problems in the field either individually or in team.

SF5314 PROJECT WORK (PHASE I)

OBJECTIVES:
- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:
The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 180 PERIODS

OUTCOME:
- At the end of the course the students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.

SF5411 PROJECT WORK (PHASE II)

OBJECTIVES:
- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions.

SYLLABUS:
The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 360 PERIODS

OUTCOME:
- On completion of the project work students will be in a position to take up any research and challenging practical problem for finding better solutions.
OBJECTIVES:

- To impart knowledge and skills in assessing the quality of foundation rocks, their aggregates and building materials derived from rock; and assess the geological suitability of sites.

UNIT I ENGINEERING PROPERTIES OF ROCKS AND MINERALS

UNIT II SURFACE AND SUBSURFACE GEOLOGICAL INVESTIGATIONS
Field investigations - electrical and seismic geophysical methods in subsurface geological investigations for foundation engineering, applications of GPR in subsurface strata studies, Description of structural discontinues, Strike and dip of rocks, folds, faults and joints.

UNIT III DRILL HOLE AND CORE LOGGING

UNIT IV MAPPING TECHNIQUES
Preparation of profiles from contour map; lithological and structural mapping of shallow and deep excavated sites. Hand on exercises.

UNIT V GEOLOGICAL INVESTIGATIONS FOR FOUNDATION ENGINEERING
Ground stability studies - Scour and erosion studies-stability of slopes and geological solution for slope stability in landslides areas.

OUTCOME:

- The students will be able to assess the suitability of a construction site and the construction materials with respect to the geological parameters.

REFERENCES:
OBJECTIVES:

- Students are expected to learn reasons for failure and damages of embankments and slopes, various methods of analysis of slopes and remedial techniques to protect the slopes.

UNIT I  DESIGN CONSIDERATION

Design consideration, Factors influencing design, Types of earth and rock fill dams, Design details, Provisions to control pore pressure.

UNIT II  SLOPE STABILITY AND SEEPAGE ANALYSIS


UNIT III  HYDRAULIC FRACTURING


UNIT IV  FAILURE AND DAMAGES

Failure and damages, Nature and importance of failures in embankment and foundation - Piping, Differential settlement, Foundation slides, Earthquake damage, creep and anisotropic effects, Reservoir wave action, Dispersive piping.

UNIT V  SLOPE PROTECTION MEASURES

Special design problems, Slope protection, Filter design, Foundation treatment, Earth dams on pervious soil foundation, Application of Geosynthetic materials in filtration. Treatment of rock foundation, Construction Techniques, Quality control and performance measurement.

TOTAL: 45 PERIODS

OUTCOME:

- Students are capable of reasoning out the causes of failure and damages of embankments and slopes. They can carry out slope stability analysis using various methods. They are also capable of carrying out remedial measures and protection of slopes.

REFERENCES:

OBJECTIVES:

- To impart knowledge in assessing both physical and engineering behaviour of unsaturated soils, measurement and modeling of suction – water content and suction – hydraulic conductivity of unsaturated soils.

UNIT I — STATE OF UNSATURATED SOIL


UNIT II — PHYSICS OF SOIL WATER SYSTEM


UNIT III — STRESS STATE VARIABLES AND SHEAR STRENGTH


UNIT IV — STEADY AND TRANSIENT FLOWS


UNIT V — MATERIAL VARIABLE MEASUREMENT AND MODELLING


TOTAL: 45 PERIODS

OUTCOME:

- Students are able to assess the engineering behaviour of unsaturated soil, and understand the modeling and measurement techniques.

REFERENCES:

OBJECTIVES:
- Students are focused on acquiring the basic knowledge and computational skills in terms of finite element formulation with respect to various kinds of Geotechnical Engineering problems.

UNIT I BASIC CONCEPTS 9
Introduction – basic concepts - discretization of continuum, typical elements, the element characteristic matrix, element assembly and solution for unknowns – applications. Variational principles, variational formulation of boundary value problems, variational methods of approximation such as Ritz and weighted residual (Galerkin) methods.

UNIT II DISPLACEMENT MODELS 9

UNIT III ISOPARAMETRIC FORMULATION 8
Isoparametric element - Local and Natural Co-ordinates systems, Line, Triangular, Quadrilateral and Tetrahedral Element-Interpolation - Displacement Models Formulation of Isoparametric - Finite element matrices in Local and Global Coordinate system – refined elements – numerical integration techniques.

UNIT IV GEOTECHNICAL CONSIDERATION 9

UNIT V APPLICATION IN GEOTECHNICAL ENGINEERING 10
Use of FEM to problems in soils – description and application to consolidation – seepage - FEM to simulate soil – structure interaction problems – software package use for simulating and analyzing the real foundation problem using FEM such as footing, pile foundation and deep excavations.

TOTAL: 45 PERIODS

OUTCOME:
- Students will have the capacity to use advanced numerical techniques like FEM in various Geotechnical Engineering applications and in a capacity to use FEM based software programs for arriving solutions to various practical design problems in Geotechnical Engineering.

REFERENCES:

SF5005 DYNAMICS OF SOILS AND FOUNDATIONS L T P C
3 0 0 3

OBJECTIVES:
- To understand the basics of dynamics – dynamic behaviour of soils – effects of dynamic loads and the various design methods.

UNIT I THEORY OF VIBRATION 9

UNIT II DYNAMIC SOIL PROPERTIES AND BEHAVIOUR 9

UNIT III FOUNDATIONS FOR RECIPIROCATING MACHINES 9

UNIT IV FOUNDATION FOR IMPACT AND ROTARY MACHINES 9

UNIT V INFLUENCE OF VIBRATION AND REMEDIATION 9

TOTAL: 45 PERIODS

23
OUTCOME:
- Students are able to design foundation for different machines, assess the influence of vibrations and selection of remediation methods based on the nature of vibration, properties and behaviour of soil.

REFERENCES:

SF5006 EARTHQUAKE RESISTANT DESIGN OF FOUNDATIONS

OBJECTIVES:
- Focus is mainly on identifying the different kinds of loading induced on the foundation due to earthquake and soil - foundation interaction analysis with reference to various design parameters that including liquefaction of soil due to earthquake.

UNIT I BASIC DESIGN PARAMETERS 9
Dynamic properties of soils and its evaluation, strength and deformation characteristics of soils under earthquake loading, liquefaction hazard evaluations and remedial measures, geotechnical failure of foundations during earthquake, provision of IS 1893 and IS 13920

UNIT II SHALLOW FOUNDATION 9

UNIT III DEEP FOUNDATION 10

UNIT IV SEISMIC DESIGN OF RETAINING WALL 9
Introduction – Seismic passive lateral earth pressure, behaviour of retaining wall during earthquakes, modification of Coulomb’s Theory, Modified Culmann’s Theory, displacement analysis, Indian standard code of practice.

UNIT V STRUCTURAL DESIGN OF FOUNDATION 8
Introduction – loads acting on foundations during earthquake – fundamental failure mechanisms of foundations – essential criteria for design of foundations in liquefiable soils – structural design of foundations subjected to earthquake loading.

TOTAL: 45 PERIODS
OUTCOME:
- Students will have the capacity to perform the analysis and design of foundation under earthquake loading by considering the influence of various design parameters that includes the liquefaction of soils due to earthquake.

REFERENCES:

SF5007 PAVEMENT ENGINEERING L T P C 3 0 0 3

OBJECTIVES:
- Student gains knowledge on designing rigid and flexible pavements for different serviceability conditions of roads.

UNIT I BASIC CONCEPTS
Historical development of pavements – types, classification, components and principle of load transfer – Approaches to pavement design – vehicle and traffic considerations – behaviour of road materials under repeated loading – Stresses and deflections in layered systems.

UNIT II FLEXIBLE PAVEMENT
Factors affecting flexible pavements – material characterization for analytical pavement design – AASHO, CBR, group index methods – Importance of Resilient modulus – Fatigue subsystem – failure criteria for bituminous pavements – IRC design guidelines.

UNIT III RIGID PAVEMENT
Factors affecting rigid pavements - Design procedures for rigid pavement – Slab thickness, dowel bar, tie bar, spacing of joints – IRC guidelines – Airfield pavements – Comparison of highway and airfield pavements.

UNIT IV PAVEMENT EVALUATION AND REHABILITATION
Pavement evaluation – surface and structural - causes and types of failures in flexible and rigid pavements – Presents serviceability index of roads – Overlay design - pavements maintenance, management and construction – Drainage and its importance in pavements.
UNIT V STABILIZATION OF SOILS FOR ROAD CONSTRUCTIONS


OUTCOME:
- Students are able to design different new pavements and rehabilitate the existing roads using recent technology.

REFERENCES:

SF5008 GEOTECHNICAL EARTHQUAKE ENGINEERING

OBJECTIVES:
- To understand the dynamics of earth and its response, effect on earth structure and measures to mitigate the effects.

UNIT I ELEMENTS OF EARTHQUAKE SEISMOLOGY

UNIT II THEORY OF VIBRATION

UNIT III GROUND MOTION CHARACTERISTICS
Strong Motion Records -characteristics of ground motion - Factors influencing ground motion - Estimation of frequency content parameters - Seismic site investigations - Evaluation of Dynamic soil properties.

UNIT IV DESIGN GROUND MOTION
UNIT V SEISMIC STABILITY ANALYSIS


TOTAL: 45 PERIODS

OUTCOME:
• Students are able to perform seismic stability analysis of geotechnical structures and in-situ soil by developing the design ground motion for an area based on bed rock motion and types of soils.

REFERENCES:

SF5009 GEOTECHNICS FOR DESIGN OF UNDERGROUND STRUCTURES L T P C 3 0 0 3

OBJECTIVES:
• Students mainly focused in visualizing and critically analyzing the behavior of underground structures with reference to various supporting systems under different loading conditions due to induced earth pressure on the underground structures.

UNIT I GROUND MOVEMENTS AND ITS EFFECTS 9
Introduction – understanding the ground – Building response to ground movements – concept of limiting tensile strain – strains in simple rectangular beams – ground movement due to tunneling and excavation - lateral supporting systems – retaining walls – factors influencing on the selection of the retaining system – case history.

UNIT II ANALYSIS OF UNDERGROUND SUPPORTING SYSTEMS 9

UNIT III DESIGN OF UNDERGROUND SUPPORTING SYSTEMS 9
Introduction – principles of retaining wall design – types of wall support systems - design of structural elements – Permanent situations – bottom-up/top-down construction sequences – Props – Tied systems – Soil berms – Design of ground anchors – Retaining wall as part of complete underground structure – resistance to vertical and lateral actions
UNIT IV  DESIGN OF TUNNEL  10
Introduction - longitudinal and transverse profile of tunnel structure - tunnel protection against fire - advanced systems of anti-water insulation of underground structures - loading types of shallow and deep tunnels, rock mass classification - mining technologies of deep excavation - shield technology, execution technology of shallow underground structures, sewerage objects - trenchless technologies.

UNIT V  PROTECTION OF ADJACENT BUILDINGS  8

OUTCOME:
• Students will have the capacity to analyze and design the underground structures with reference to various supporting systems that needs for underground construction and also have an ability to protect the adjacent building due to underground construction.

REFERENCES:

SF5010  GEOENVIRONMENTAL ENGINEERING  L T P C
OBJECTIVES:
• The student acquires the knowledge on the Geotechnical engineering problems associated with soil contamination, safe disposal of waste and remediate the contaminated soils by different techniques thereby protecting environment.

UNIT I  SOIL – WASTE INTERACTION  8
UNIT II CONTAMINANT TRANSPORT AND SITE CHARACTERISATION

UNIT III WASTE CONTAINMENT AND REMEDIATION OF CONTAMINATED SITES

UNIT IV LANDFILLS AND SURFACE IMPOUNDMENTS

UNIT V STABILISATION OF WASTE

TOTAL: 45 PERIODS

OUTCOME:
• Students are able to assess the contamination in the soil and to select suitable remediation methods based on contamination. Also they are able to prepare the suitable disposal system for particular waste.

REFERENCES:
UNIT II  STRENGTH CRITERIA OF ROCKS
Behaviour of rock under hydrostatic compression and deviatoric loading - Modes of rock failure - planes of weakness and joint characteristics - joint testing, Mohr - Coulomb failure criterion and tension cut-off. Hoek and Brown Strength criteria for rocks with discontinuity sets.

UNIT III  INSITU STRESSES IN ROCKS
Insitu stresses and their measurements, Hydraulic fracturing, flat jack, over coring and under coring methods - stress around underground excavations – Design aspects of openings in rocks - case studies.

UNIT IV  SLOPE STABILITY AND BEARING CAPACITY OF ROCKS
Rock slopes - role of discontinuities in slop failure, slope analysis and factor of safety - remedial measures for critical slopes – Bearing capacity of foundations on rocks – case studies

UNIT V  ROCK REINFORCEMENT
Reinforcement of fractured and joined rocks - shotcreting, bolting, anchoring, installation methods - case studies.

OUTCOME:
- Students are capable of classifying the rock. They can understand stres-strain characteristics, failure criteria, and influence of insitu stress in the stability of various structures. They also know various technique to improve the insitu strength of rocks.

REFERENCES:

SF5012  SOIL STRUCTURE INTERACTION

OBJECTIVES:
- Focus is on idealization of soil response to closely represent continuum behavior and interaction analysis between the soil-structure with reference to relative stiffness of beams, slabs and piles under different loading conditions.

UNIT I  SOIL RESPONSE MODELS OF INTERACTION ANALYSIS
UNIT II  INFINITE AND FINITE BEAMS ON ELASTIC FOUNDATIONS  9
Infinite beam, General solution of the elastic line – concentrated and distributed loads on beams – Idealization of semi-infinite and finite beams. Classification of finite beams, different end conditions and loads – solutions - General method.

UNIT III  PLATE ON ELASTIC MEDIUM  9

UNIT IV  ANALYSIS OF PILE AND PILE GROUPS  12
Elastic analysis of single pile – Solutions for settlement and load distribution – Simplified method for constructing load settlement curve to failure – Analysis of group settlement – Two pile interaction Analysis, Analysis of general groups – Theoretical solutions for free standing groups – Settlement of groups caused by compressible underlying strata – Use of design charts – Surface settlement around a group – Observed and predicted group behaviour.

UNIT V  LATERALLY LOADED PILE  6
Load - deflection prediction for laterally loaded piles, subgrade reaction and elastic analysis, Analysis of pile group, pile raft system, solutions through influence charts.

TOTAL: 45 PERIODS

OUTCOME:
- At the end of this course students will have the capacity to idealize soil response in order to analyze and design the foundation elements subjected to different loadings.

REFERENCE:

SF5013  GEOSYNTHETIC AND REINFORCED SOIL STRUCTURES  L T P C
3  0 0 3

OBJECTIVES:
- To understand the mechanism of the reinforcement, its influence in the shear strength and design concept for various applications in geotechnical engineering.

UNIT I  PRINCIPLES AND MECHANISMS OF SOIL REINFORCEMENT  9
UNIT II  REINFORCING MATERIALS AND THEIR PROPERTIES

UNIT III  DESIGN FOR SOIL REINFORCEMENT AND SEPARATION

UNIT IV  DESIGN FOR FILTRATION, DRAINAGE AND CONTAINMENT

UNIT V  DESIGN OF SLOPES

TOTAL : 45 PERIODS

OUTCOME:
- Students are able to analyse and design the geotechnical reinforced structures based on interaction mechanism of reinforcement and soil.

REFERENCES: