

## REHABILITATION & RETROFITTING OF STRUCTURES

<b>VII Semester: CIVIL</b>								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
ACE505	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
<b>Contact Classes: 45</b>		<b>Tutorial Classes: 15</b>		<b>Practical Classes: Nil</b>			<b>Total Classes: 60</b>	
<p><b>COURSE OBJECTIVES:</b>  <b>The course should enable the students to:</b></p> <ol style="list-style-type: none"> <li>I. Explain different types of deterioration of structures, distress in structures and damage mechanism.</li> <li>II. Understand the aspects of repair and rehabilitation and facets of maintenance.</li> <li>III. Apply the various techniques of repair for corrosion protection in structures.</li> <li>IV. Illustrate different methods for strengthening the existing structures and methods of demolition of structures using engineered and non-engineered techniques.</li> </ol> <p><b>COURSE OUTCOMES (COs):</b></p> <p>CO 1: Recognize the mechanisms of deterioration of structures and conduct Preliminary forensic assessment of deteriorated concrete structures.</p> <p>CO 2: Analyze the maintenance and diagnosis of failure</p> <p>CO 3: Able to Examine the damages occurred in reinforced concrete building and knowing the remedies for damages.</p> <p>CO 4: Knowing about different types of special materials used for repair techniques</p> <p>CO 5: Identifying different types of strengthening techniques used for existing structures.</p> <p><b>COURSE LEARNING OUTCOMES (CLOs):</b></p> <ol style="list-style-type: none"> <li>1. Describe the deterioration of structures, rehabilitation and retrofitting.</li> <li>2. Identifying the causes for deterioration of structures and able to give the preventive measures for it.</li> <li>3. Describe the mechanism of damage and types of damage.</li> <li>4. Analyzing the damage of structures in detail.</li> <li>5. Understand the distress in structures.</li> <li>6. Understand what is meant by Maintenance, repair and rehabilitation</li> <li>7. Understand the facets of maintenance i)Prevention ii)Repair</li> <li>8. Describe the various aspects of inspection.</li> <li>9. Understand the Assessment procedure for evaluating a damaged structure.</li> <li>10. Identifying the diagnosis of construction failures.</li> <li>11. Describe the Corrosion damage of reinforced concrete.</li> <li>12. Describe the Corrosion inhibitors, Corrosion resistant steels, cathodic protection and rust eliminators.</li> <li>13. Describe the causes for deterioration of concrete, steel, masonry and timber structures.</li> <li>14. Discuss the concept of surface deterioration, efflorescence and corrosion protection.</li> <li>15. Discuss different causes and preventive measures of surface deterioration and efflorescence.</li> <li>16. Describe special concrete and mortar.</li> <li>17. Discuss different types of special concrete such as polymer concrete sulphur infiltrated concrete, fiber reinforced concrete, ferro cement and expansive cement.</li> <li>18. Discuss different methods of repair in concrete.</li> <li>19. Describe about expansive cement.</li> <li>20. Describe about sulphur infiltrated cement.</li> </ol>								

<p>21. Describe strengthening techniques for existing structures.</p> <p>22. Describe Various repair works to overcome low member strength, deflection, cracking, chemical disruption, weathering, wear, fire, leakage, marine exposure.</p> <p>23. Describe the use of Non –destructive techniques for evaluation.</p> <p>24. Describe a case study of demolition of structure using engineered technique.</p> <p>25. Describe some of the non engineered techniques used for demolition of structures.</p>		
<b>UNIT-I</b>	<b>INTRODUCTION</b>	<b>Classes: 09</b>
<p>Deterioration of structures; distress in structures; causes and prevention, mechanism of damage; types of damage; damage under accidental and cyclic loads, cracking in structures, evaluation of damage.</p>		
<b>UNIT -II</b>	<b>MAINTENANCE AND DIAGNOSIS OF FAILURE</b>	<b>Classes: 09</b>
<p>Maintenance, repair and rehabilitation, facets of maintenance, importance of maintenance, various aspects of inspection; Assessment procedure for evaluating a damaged structure; Diagnosis of construction failures.</p>		
<b>UNIT-III</b>	<b>DAMAGES AND THEIR REMEDIES</b>	<b>Classes: 09</b>
<p>Corrosion damage of reinforced concrete, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, cathodic protection, rust eliminators.</p> <p>Causes of deterioration of concrete, steel, masonry and timber structures, surface deterioration, efflorescence, causes and preventive measures; coatings for embedded steel and set concrete.</p>		
<b>UNIT-IV</b>	<b>MATERIALS AND TECHNIQUES OF REPAIR</b>	<b>Classes: 09</b>
<p>Special concrete and mortar, concrete chemicals, expansive cement, polymer concrete sulphur infiltrated concrete, ferro cement, fiber reinforced concrete, methods of repair in concrete, steel, masonry and timber structures. Guniting and shotcrete, epoxy injection.</p>		
<b>UNIT-V</b>	<b>STRENGTHENING AND DEMOLITION ASPECT</b>	<b>Classes: 09</b>
<p>Strengthening of existing structures; repairs to overcome low member strength, deflection, cracking, chemical disruption, weathering, wear, fire, leakage, marine exposure, use of non-destructive testing techniques for evaluation, load testing of structure; demolition of structures using engineered and non-engineered techniques; case studies.</p>		
<b>Text Books:</b>		
<ol style="list-style-type: none"> <li>1. Shetty .M.S., "Concrete, Technology", Theory and Practice, S.Chand and Company, New Delhi 2010</li> <li>2. Allen .R.T. and Edwards .S.C., "Repair of Concrete Structures" Blakie and Sons, UK 1987.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. Raiker .R.N. "Learning from Failures, Deficiencies in Design, Construction and Service", R&amp;D Centre (SDCPL), Raikar Bhavan, Bombay 1987.</li> <li>2. "Repair &amp; Rehabilitation" "Compilation from The Indian Concrete Journal", - ACC - RCD Publication 2001.</li> <li>3. Revision compbell, Allen and Itarold Roper, "Concrete Structures Materials Maintenance and Repair" Longman Scientific and Technical UK 1991.</li> </ol>		

**Web References:**

1. [cpwd.gov.in/Units/handbook.pdf](http://cpwd.gov.in/Units/handbook.pdf)
2. <http://www.alljntuworld.in/wp-content/uploads/2016/01/Rehabilitation-and-Retrofitting-ofStructuresNotes.pdf>
3. [http://www.tn.gov.in/tsunami/digitallibrary/ebooksweb/04%20REPAIR\\_RESTORATION\\_AND\\_RETROFITTING.pdf](http://www.tn.gov.in/tsunami/digitallibrary/ebooksweb/04%20REPAIR_RESTORATION_AND_RETROFITTING.pdf)

**E-Text Books:**

1. [https://books.google.co.in/books/about/Case\\_Studies\\_of\\_Rehabilitation\\_Repair\\_Re.html?id=zraEpIyEpCYC](https://books.google.co.in/books/about/Case_Studies_of_Rehabilitation_Repair_Re.html?id=zraEpIyEpCYC)
2. [https://books.google.co.in/books/about/Retrofitting\\_Design\\_of\\_Building\\_Structur.html?id=5XhbZW6JS4YC&redir\\_esc=y](https://books.google.co.in/books/about/Retrofitting_Design_of_Building_Structur.html?id=5XhbZW6JS4YC&redir_esc=y)
3. [https://books.google.es/books/about/Concrete\\_Repair\\_Rehabilitation\\_and\\_Retro.html?hl=es&id=nwbNBQAAQBAJ](https://books.google.es/books/about/Concrete_Repair_Rehabilitation_and_Retro.html?hl=es&id=nwbNBQAAQBAJ)