

## RETROFITTING AND REHABILITATION OF STRUCTURES

<b>II Semester: ST</b>								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
BSTC22	Elective	L	T	P	C	CIA	SEE	Total
		3	0	0	3	30	70	100
<b>Contact Classes: 45</b>		<b>Total Tutorials: Nil</b>		<b>Total Practical Classes: Nil</b>		<b>Total Classes: 45</b>		
<b>I. COURSE OVERVIEW:</b>								
<p>The primary objective of this course is to introduce the concept of Rehabilitation as a precise concept, and study how to overcome the defects in regular construction practices, establish their effectiveness in overcoming the problems faced, study their efficiency and memory needs. The course consists of Retrofitting components in addition to adapting new techniques in construction practices. Retrofitting reduces the vulnerability of damage of an existing structure during a future earthquake. It aims to strengthen a structure to satisfy the requirements of the current codes for seismic design. In this respect, seismic retrofit is beyond conventional repair or even rehabilitation. The applications include different types of buildings, industrial structures, bridges, urban transport structures, marine structures and earth retaining structures. The benefits of retrofitting include the reduction in the loss of lives and damage of the essential facilities, and functional continuity of the life line structures. For an existing structure of good condition, the cost of retrofitting tends to be smaller than the replacement cost. Thus, the retrofitting of structures is an essential component of long term disaster mitigation.</p>								
<b>II. OBJECTIVES:</b>								
<b>The student will try to learn:</b>								
<ol style="list-style-type: none"> <li>I. The concepts of defects, distress and deterioration of structures, and the need of rehabilitation and retrofitting methods.</li> <li>II. The importance of maintenance, repairs and rehabilitation of structures like residential, industrial and irrigation structures.</li> <li>III. The mechanism of corrosion and surface deterioration of various materials in traditional structures.</li> <li>IV. The Modern techniques of strengthening and demolition of engineering structures in real time situations.</li> </ol>								
<b>III. COURSE OUTCOMES:</b>								
<b>After successful completion of the course, students should be able to:</b>								
CO 1	Explain the damage mechanism and preventive measures for protecting the structure from damages.						Understand	
CO 2	Interpret the importance and facets of maintenance for scheduling regular inspection of residential and industrial structures.						Understand	
CO 3	Summarize corrosion protection methods of steel and deterioration of materials for protecting structures from rusting and fatigue failures.						Understand	
CO 4	Identify the materials and technics of repair for rehabilitation and retrofitting of structures.						Apply	
CO 5	Make use of non-destructive testing procedures, demolition methods for assessing and improving the performance of structures.						Apply	
CO 6	Select suitable engineered and non-engineered techniques in existing structures for strengthening and demolition.						Apply	

#### **IV. COURSE SYLLABUS:**

##### **MODULE-I: INTRODUCTION (09)**

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

##### **MODULE-II: MAINTENANCE AND DIAGNOSIS OF FAILURE (09)**

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.

##### **MODULE-III: DAMAGES AND THEIR REMEDIES (09)**

Corrosion damage of reinforced concrete, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, cathodic protection, rust eliminators. Causes of deterioration of concrete, steel, masonry and timber structures, surface deterioration, efflorescence, causes and preventive measures; coatings for embedded steel and set concrete.

##### **MODULE-IV: MATERIALS AND TECHNIQUES OF REPAIR (09)**

Special concrete and mortar, concrete chemicals, expansive cement, polymer concrete sulphur infiltrate concrete, ferro cement, fiber reinforced concrete, methods of repair in concrete, steel, masonry and timber structures. Guniting and shotcrete, epoxy injection.

##### **MODULE-V: STRENGTHENING AND DEMOLITION ASPECT (09)**

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.

#### **V. TEXT BOOKS:**

1. P. H. Emmons, G. M. Sabnis, "Concrete repair & maintenance illustrated," Galgotia Publications Pvt. Ltd., 2001.
2. P. C. Varghese, "Maintenance, repair, rehabilitation and minor works of buildings," Prentice Hall India Learning Private Limited, 2014.
3. Shetty .M.S., "Concrete, Technology", Theory and Practice, S.Chand and Company, New Delhi 2010
4. Allen .R.T. and Edwards .S.C., "Repair of Concrete Structures" Blakie and Sons, UK 1987.

#### **VI. REFERENCE BOOKS:**

1. Poonam I. Modi, Chirag N. Patel, "Repair and Rehabilitation of Concrete Structures," PHI Learning, 2016.
2. A.R. Santakumar, "Concrete Technology," Oxford University Press.
3. Bungley, Surrey "Non-destructive evaluation of concrete structures," University Press.
4. B.L. Gupta and Amit Gupta, "Maintenance and Repair of Civil Structures," Standard Publications, 2008.

#### **VII. WEB REFERENCES:**

1. <https://www.vidyarthiplus.com/vp/thread-24896.html>
2. <https://cpwd.gov.in/Units/handbook.pdf>

#### **VIII. E-TEXT BOOKS:**

1. <https://www.amazon.in/REPAIRREHABILITATIONCONCRETESTRUCTURESPOONAMEbook/dp/B01CVPPWRW>
2. <https://www.amazon.in/Concrete-Structures-ProtectionRepairRehabilitationebook/dp/B002ZJSVJ6>