

## COURSECONTENT

| <b>REHABILITATION AND RETRO FITTING OF STRUCTURES</b>                               |          |                              |   |                              |         |                        |     |       |
|---|----------|------------------------------|---|------------------------------|---------|------------------------|-----|-------|
| <b>III semester -SE</b>   |          |                              |   |                              |         |                        |     |       |
| Course Code   | Category | Hours/<br>Week               |   |                              | Credits | Maximum Marks          |     |       |
| 2532055   | Core     | L                            | T | P                            | C       | CIA                    | SEE | Total |
|   |          | 3                            | 0 | 0                            | 3       | 40                     | 60  | 100   |
| <b>Contact Classes:45</b>   |          | <b>Tutorial Classes :Nil</b> |   | <b>Practical Classes:Nil</b> |         | <b>TotalClasses:45</b> |     |       |
| <b>Prerequisites:</b> Reinforced Concrete Design, Steel Design, Concrete Technology |          |                              |   |                              |         |                        |     |       |

### Course Overview:

This course covers the causes, assessment, and repair of structural deterioration in concrete structures. It introduces concepts of repair, retrofitting, strengthening, and rehabilitation, along with mechanisms of damage due to environmental, chemical, and seismic effects. The course explains corrosion, fire damage, and assessment techniques including NDT methods. It also focuses on maintenance and modern retrofitting methods like jacketing and FRP systems. Finally, it highlights advanced materials, repair techniques, and structural health monitoring using sensors for durability and safety.

### Course Objectives:

1. To understand the causes and mechanisms of deterioration in concrete structures, including physical, chemical, and earthquake-induced damages.
2. To learn corrosion mechanisms, fire-induced damages, and assessment techniques using destructive, non-destructive, and semi-destructive testing.
3. To gain knowledge of maintenance and retrofitting techniques, including jacketing, external bonding, NSM, post-tensioning, and seismic rehabilitation guidelines.
4. To develop skills in repair methods and strengthening strategies such as guniting, shotcrete, underpinning, and underwater structural repairs.
5. To understand the materials used for repair and retrofitting, including FRPs, epoxy resins, special concretes, and monitoring systems using sensors and instrumentation.

**Course Outcomes:** After studying this course, students will be able to:

1. Explain the causes and types of deterioration in concrete structures.
2. Assess damage in various types of structures using appropriate testing methods.
3. Summarize the fundamental principles of repair and rehabilitation techniques for structures.
4. Select suitable materials and techniques for different repair and retrofitting methods including Gunite, Shotcrete, epoxy injection, and mortar repair.
5. Utilize sensors and building instrumentation for health monitoring of structures.

### SYLLABUS:

#### UNIT – I

Introduction – Definition of Repair, Retrofitting, Strengthening and rehabilitation, Deterioration of Structures – Distress in Structures – Causes and Prevention, Mechanism of Damage – Types of Damage, Physical and Chemical Causes of deterioration of concrete structures, Evaluation of structural damages to the concrete structural elements due to earthquake



### UNIT – II

Corrosion of Steel Reinforcement – Causes – Mechanism and Prevention. Damage of Structures due to Fire – Fire Rating of Structures – Phenomena of Desiccation, Damage Assessment – Purpose of assessment, Rapid assessment, Investigation of damage, Evaluation of surface and structural cracks, Damage assessment procedure, destructive, non-destructive and semi destructive testing systems - Influence on Serviceability and Durability - Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, and cathodic protection.

### UNIT – III

Maintenance and Retrofitting Techniques: Definitions: Maintenance, Facts of Maintenance and importance of Maintenance Need for retrofitting, retrofitting of structural members i.e., column and beams by Jacketing technique, Externally bonding (ERB) technique, near surface mounted (NSM) technique, External post-tensioning, Section enlargement and guidelines for seismic rehabilitation of existing building, Inspection and Testing – Symptoms and Diagnosis of Distress - Damage assessment – NDT.

### UNIT – IV

Repair of Structure – Common Types of Repairs – Repair in Concrete Structures – Repairs in Under Water Structures – Guniting – Shot Create – Underpinning. Strengthening of Structures – Strengthening Methods – Retrofitting – Jacketing.

### UNIT – V

Materials for Repair and Retrofitting: Artificial fibre reinforced polymer like CFRP, GFRP, AFRP and natural fiber like Sisal and Jute. Adhesive like, Epoxy Resin, Special concretes and mortars, concrete chemicals, special elements for accelerated strength gain, Techniques for Repair: Rust eliminators and polymers coating for rebar during repair foamed concrete, mortar and dry pack, vacuum concrete, Guniting and Shot Crete Epoxy injection, Mortar repair for cracks, shoring and underpinning - Health Monitoring of Structures – Use of Sensors – Building Instrumentation.

### REFERENCES:

1. Concrete Technology by A. R. Santakumar, Oxford University press
2. Defects and Deterioration in Buildings, E F & N Spon, London
3. Non-Destructive Evaluation of Concrete Structures by Bungey - Surrey University Press
4. Maintenance and Repair of Civil Structures, B. L. Gupta and Amit Gupta, Standard Publications.
5. Concrete Repair and Maintenance Illustrated, RS Means Company Inc W. H. Ranso, (1981)
6. Building Failures: Diagnosis and Avoidance, E F & N Spon, London, B. A. Richardson, (1991).
7. "Deterioration, Maintenance and Repair of Structures", Sidney, M. Johnson
8. "Concrete Structures – Materials, Maintenance and Repair" - Denison Campbell, Allen & Harold Roper, Longman Scientific and Technical.
9. "Learning for failure from Deficiencies in Design, Construction and Service" R. T. Allen and S. C. Edwards, "Repair of Concrete Structures" - Blakie and Sons Raiker R. N., - R & D Center (SDCPL).



# **MARRI LAXMAN REDDY** **INSTITUTE OF TECHNOLOGY AND MANAGEMENT**

**(AN AUTONOMOUS INSTITUTION)**

(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)

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## **ELECTRONICRESOURCES:**

<https://nptel.ac.in/courses/105105213>.

<https://nptel.ac.in/courses/105106202>

## **MATERIALSONLINE:**

1. Course template
2. Tutorial question bank
3. Definitions and terminology
4. Assignments
5. Model question paper – I
6. Model question paper – II
7. Lecture notes
8. E-Learning Readiness Videos (ELRV)