INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

MAINTENANCE AND REHABILITATION OF STRUCTURES								
II Semester: STE								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
BSTE22	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Concrete Technology, Reinforced Concrete Design, Steel Design								

I. COURSE OVERVIEW:

Maintenance and Rehabilitation of Structures focus on extending the service life of civil engineering structures through systematic inspection, repair, strengthening, and preventive measures. This course provides an overview of structural deterioration mechanisms, condition assessment methods, and modern rehabilitation techniques in line with national and international standards. It emphasizes durability, safety, and sustainability by integrating advanced repair materials, non-destructive testing (NDT) technologies, and retrofitting strategies. Topics include causes of structural damage, evaluation and monitoring tools, repair and strengthening methods, rehabilitation of concrete, steel, and masonry structures, use of composites and polymers, seismic retrofitting, and case studies of restoration projects to ensure structural resilience and long-term performance.

II. COURSE OBJECTIVES:

The students will try to learn:

I. Fundamentals of structural deterioration, distress mechanisms, and durability concerns affecting the service life of civil engineering structures.
II. Structural health assessment using non-destructive testing (NDT), condition evaluation, and monitoring techniques for identifying damage and performance issues.
III. Advanced repair, strengthening, and retrofitting techniques using modern materials and sustainable technologies to enhance structural performance and resilience.
IV. Case studies on maintenance, rehabilitation, and seismic retrofitting to understand effective practices, challenges, and strategies for extending structural life cycles.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1 Explain the concepts of repair, retrofitting, strengthening, and rehabilitation by analyzing deterioration mechanisms and preventive measures for improving the durability of concrete structures.
CO 2 Evaluate corrosion mechanisms in steel reinforcement and assess structural damages due to fire, climate, and material deficiencies by applying destructive, non-destructive, and semi-destructive testing systems.
CO 3 Apply modern repair and strengthening techniques such as grouting, shotcreting, jacketing, and fiber wrapping for effective rehabilitation of masonry and concrete structures.
CO 4 Evaluate corrosion protection methods and crack repair techniques for improving durability and long-term performance of concrete and masonry structures.
CO 5 Analyze maintenance and retrofitting techniques such as jacketing, externally bonded reinforcement, and seismic rehabilitation strategies for enhancing safety and service life.
CO 6 Utilize advanced materials such as fiber-reinforced polymers, epoxy resins, special concretes, and monitoring tools for effective repair, retrofitting, and health assessment of structures.

IV. COURSE CONTENT:

MODULE –I: MAINTENANCE AND REPAIR STRATEGIES (9)
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.

MODULE -II: CORROSION OF STEEL REINFORCEMENT (9)
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.

MODULE -III: REPAIRS TO MASONRY AND CONCRETE STRUCTURES (9)
Methods of crack repair in masonry and concrete structures, routing and sealing of cracks, removal and surface preparation in masonry and concrete structures, reinforcement repair, anchorage, placement methods; Shot-creting and guniting, Grouting- Portland cement grouting, chemical grouting, Dry packing, polymer impregnation.

Strengthening of structures flexural strengthening, Shear Strengthening, strengthening of columns- jacketing of Columns, strengthening by interior and external reinforcing, external Pre- stressing, Fiber wrapping, Corrosion Protection: surface treatment, joint sealants, cathodic protection.

MODULE -IV: MAINTENANCE AND RETROFITTING TECHNIQUES (9)
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.

MODULE -V: MATERIALS FOR REPAIR AND RETROFITTING (9)
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, Gunite and Shot Crete Epoxy injection, Mortar repair for cracks, shoring and underpinning- Health Monitoring of Structures – Use of Sensors – Building Instrumentation.

V. TEXTBOOKS:

1. Den Campbell, Allen and Harold Roper, "*Concrete Structures Materials, Maintenance and Repair*", Longman Scientific and Technical, UK, 1991.
2. Allen R.T and Edwards S.C, "*Repair of Concrete Structures*", Blakie and Sons, UK, 1987.
3. Philip H. Perkins, "*Repair, Protection and Waterproofing of Concrete Structures*", Elsevier Applied Science Publisher, London, New York, 1986.
4. P.C. Guha "*Maintenance and Repairs of Buildings* ", New Central Book Agency, Kolkata 2006.

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, 2018.
3. Bungley, Surrey "*Non-destructive evaluation of concrete structures*," University Press, 2012.
4. B.L. Gupta and Amit Gupta, "*Maintenance and Repair of Civil Structures*," Standard Publications, 2008

VII. ELECTRONICS RESOURCES:

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

VIII. MATERIAL ONLINE:

1. Course Outline Description
2. Tutorial Question Bank
3. Assignments
4. Model Question Paper – I
5. Model Question Paper - II
6. Lecture Notes
7. Early Lecture Readiness Videos
8. Power point presentation