**20CE41E9 – REPAIR AND REHABILITATION OF STRUCTURES**

**(Civil Engineering)**

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| **Course Category**  | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | Concrete Technology | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Outcomes** | CO1 | Apply maintenance and repair strategies to evaluate damaged structures. |
| CO2 | Evaluate strength and durability characteristics of concrete. |
| CO3 | Identify various materials used for repair and their applications. |
| CO4 | Apply non-destructive testing techniques and protective methods to field problems. |
| CO5 | Recommend repair and demolition procedures of structures. |
| CO6 | Assess corrosion of embedded steel in concrete and suggest repair techniques. |
| **Course****Content** | **UNIT -I** **MAINTENANCE AND REPAIR STRATEGIES:** Maintenance – Repair and rehabilitation – Facets of maintenance – Importance of maintenance – Various aspects of inspection – Assessment procedure for evaluating a damaged structure – Causes of deterioration.**UNIT -II** **STRENGTH AND DURABILITY OF CONCRETE:** Quality assurance for concrete – Strength – Durability and thermal properties of concrete – Cracks – Different types –Causes – Effects due to climate – Temperature – Sustained elevated temperature –Corrosion – Effects of cover thickness.**UNIT -III****MATERIALS FOR REPAIR:**–Expansive cement- Ferro cement - Special elements for accelerated strength gain-Sulphur infiltrated concrete– Fibre reinforced concrete -Types of fiber reinforced concrete – High strength concrete–High performance concrete– Vacuum concrete–– Geopolymer concrete–Reactive powder concrete–Bacterial concrete.**UNIT -IV** **PROTECTION METHODS**: Non-Destructive Testing Techniques: Radioactive Method –Nuclear Method-Magnetic Method-Electrical Method. Epoxy Injection – Shoring – Underpinning – Corrosion Protection Techniques – Corrosion Inhibitors – Corrosion Resistant Steels – Coatings to Reinforcement – Cathodic Protection.**UNIT- V****REPAIR AND DEMOLITION TECHNIQUES OF STRUCTURES**: Strengthening of Structural Elements – Repair of structures distressed due to corrosion – fire – Leakage and earthquake – Engineered demolition methods – Case studies.**UNIT -VI****CORROSION OF EMBEDDED STEEL IN CONCRETE:** Corrosion of embedded steel in concrete – Mechanism – Stages of corrosion damage – Repair of various corrosion damaged structural elements (slabs, beams, and columns).**JACKETING:** Jacketing – Column jacketing – Beam jacketing – Beam Column joint jacketing – Reinforced concrete jackets – Steel jacketing – FRP jacketing. **STRENGTHENING**: Strengthening of beam: Shear strengthening and Flexural strengthening. |
| **Text****and****Reference books** | **TEXTBOOKS:**1. Poonam I. Modi and Chirag N. Patel, *Repair and Rehabilitation of Structures*, PHI learning Pvt. Ltd, Eastern Economy Edition, 2016.
2. Denison Campbell, Allen and Harold Roper, *Concrete Structures, MaterialsMaintenance and Repair*, Longman Scientific and Technical, Illustrated edition, 1991.
3. R.T. Allenand S.C Edwards, *Repair of Concrete Structures*, Blakie and Sons, 2nd edition, 1992.

**REFERENCES:**1. M.S Dov Kominetzky, *Design and Construction Failures*, Galgotia Publications Pvt. Ltd., 2001.
2. K. Ravi Shankar and T.S KrishnaMoorthy, *Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures*, Allied Publishers, 2004.
3. M. L. Gambhir., *Concrete Technology*, McGraw Hill Publication, 5th edition 2013.
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**CO-PO Mapping**: 3-High Mapping, 2- Moderate Mapping, 1-Low Mapping, -- Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | 1 | - | 1 | 2 | 1 | 2 | 1 | - | - | 2 | 1 | - | 1 | 1 |
| **CO2** | 2 | 1 | - | 1 | 2 | 1 | 2 | 1 | - | 1 | 2 | 1 | - | 1 | - |
| **CO3** | 1 | 1 | - | - | - | - | 1 | - | - | - | 1 | 1 | - | 1 | 1 |
| **CO4** | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | - | 2 | 2 |
| **CO5** | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | - | 3 | 2 |
| **CO6** | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | - | 3 | 2 |