**20CE41E3 – STRUCTURAL HEALTH MONITERING**

**(Civil Engineering)**

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| **Course Category**  | Professional Elective | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 3 - 0 - 0 |
| **Prerequisite** | None | **Sessional Evaluation**  | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Objectives** | 1. To understand basic concepts of structural health monitoring in civil engineering.
2. To interpret structural heath failure in bridge structure.
3. To overview the Non Destructive Test techniques for detecting the defects in concrete structures.
4. To understand the concept of condition survey.
5. Gain-in knowledge in quality control of concrete structures.
6. Gain-in knowledge of Rehabilitation of concrete structures.
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| **Course Outcomes** | CO1 | Understand basic concepts of structural health monitoring and analyse between system of a man and a structure with structural health monitoring. |
| CO2 | List out structural failures in bridge structure. |
| CO3 | Overview the non-destructive test techniques and methods for concrete structures. |
| CO4 | Perform condition survey for evaluation of concrete structures. |
| CO5 | Evaluate the non-destructive test techniques of concrete structures and case studies. |
| CO6 | Develop sustainable maintenance and rehabilitation of concrete structures. |
| **Course Content** | **UNIT-I****INTRODUCTION TO STRUCTURAL HEALTH MONITORING (SHM):**Definition & motivation for SHM – SHM – A way for smart materials and structures – SHM and Biomimetic – Analog between the nervous system of a man and a structurewith SHM–SHM as a part of system management – Passive and Active SHM – NDE – SHM and NDECS – Basic components of SHM – Materials for sensor design.**UNIT-II****APPLICATION OF SHM IN CIVIL ENGINEERING:** Introduction to capacitive methods – Capacitive probe for cover concrete – SHM of a bridge – Applications for external post tensioned cables – Monitoring historical buildings.**UNIT-III****NON DESTRUCTIVE TESTING OF CONCRETE STRUCTURES:** Introduction to NDT – Situations andcontexts – where NDT is needed – Classification of NDT procedures –Visual Inspection – Half-Cell electrical potential methods – Schmidt Rebound Hammer Test – Resistivitymeasurement –Electromagnetic methods – Radiographic Testing – ultrasonic testing – Infrared thermography – Ground penetrating radar – Radio isotope gauges – Other methods.**UNIT-IV****CONDITION SURVEY & NDE OF CONCRETE STRUCTURE:** Definition –Objective of condition survey – Stages of condition survey(Preliminary – Planning – Inspection and Testing stages)–Possible defects in concrete structures.**UNIT-V****QUALITY CONTROL OF CONCRETE STRUCTURES**: Definition and need – Quality control applications in concrete structures – NDT asan option for Non-Destructive Evaluation (NDE) of Concrete structures – Case studies of a few NDT procedures on concrete structures.**UNIT-VI****REHABILITATION AND RETROFITTING OF CONCRETE STRUCTURE:** Repair rehabilitation & retrofitting of structures –Damage assessment of concretestructures – Materials and methods for repairs and rehabilitation – Modeling of repaired composite structure –Structural analysis and design – Importance ofre-analysis –Execution of rehabilitation strategy – Case studies. |

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| **Textbooks and References** | **TEXTBOOKS:**1. Gandhi and Thompson,*Smart Materials and Structures*,Springer, 1992.
2. Fu Ko Chang,*Structural Health Monitoring: Current Status and Perspectives*,CRC Press 1st edition, 1998.
3. Ravi shankar.K and Krishnamoorthy.T.S, *Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures*, Allied Publishers, 2004.

**REFERENCES:**1. Shetty M.S., *Concrete Technology – Theory and Practice*”, S.Chand and Company, 2008.
2. DovKominetzky.M.S., *Design and Construction Failures*, Galgotia Publications Pvt. Ltd., 2001.
3. CPWD and Indian Buildings Congress, Hand Book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.
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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 | 2 | 2 | 1 | - | - | 2 | 1 | 2 | 2 | 2 |
| **CO2** | 2 | 1 | - | 1 | 2 | 2 | 2 | 1 | - | - | 2 | 1 | 2 | 2 | 2 |
| **CO3** | 2 | 1 | 1 | - |  - | 2 | 1 | - |  - | - | 2 | 1 | 2 | 1 | 3 |
| **CO4** | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | - |  - | 2 | 1 | -  | 1 | 2 |
| **CO5** | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | - | - | 1 | 1 | 2 | 2 | 2 |
| **CO6** | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | - | - | 1 | 1 | 2 | 2 | 2 |