

# **STRUCTURAL HEALTH MONITORING**

## **(Professional Elective-I)**

**Course Code: 22CE2251**

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### **Course Outcomes:**

At the end of the course, The students will be able to:

CO1 Understand the fundamentals of structural dynamic

CO2 Analyze the need and challenges of Structural Health Monitoring (SHM).

CO3 Describe various methods of damage detection

CO4 Apply the Structural Health Monitoring technique for building.

CO5 Apply the Structural Health Monitoring techniques for bridge.

### **UNIT-I**

**(10 Lectures)**

**Non-Destructive Evaluations :** - Concrete strength assessment –Rebound hammer test – Ultrasonic pulse velocity tests, penetration resistance, pullout tests, core sampling and testing, chemical tests – carbonation, chloride, content and corrosion problem.

Learning outcomes:

1. Understand the procedure for strength assessment test (L1)
2. Understand the procedure for chemical attack tests (L2)

### **UNIT-II**

**(10 Lectures)**

#### **INTRODUCTION TO STRUCTURAL HEALTH MONITORING:**

Factors affecting the health of structures, SHM scheme, various steps in SHM, damage diagnostic methods, challenges in SHM, Experimental modal analysis, operational modal analysis and combined methods

Learning outcomes:

1. Factors affecting SHM and schemes for SHM (L1)
2. Understand the challenges in SHM (L2)
3. Experimental modal analysis and operational modal analysis (L3)

### **UNIT-III**

**(10 Lectures)**

#### **METHODS OF DAMAGE DETECTION:**

Vibration Control & SHM Damage Diagnostic methods based on vibration response, Method based on modal frequency/shape/damping, Curvature and flexibility method, Modal strain energy method, Sensitivity method, Baseline-free method.

Learning outcomes:

1. Learn the damage detection methods based on vibration (L1)

2. Apply the various techniques for damage detection in structures (L2)

#### **UNIT-IV**

**(10 Lectures)**

##### **HEALTH MONITORING SYSTEMS OF BUILDING STRUCTURES:**

Numerical modeling– Use of sensors – Data acquisition techniques – Data Processing – Diagnostic techniques – Wireless sensor network – Rehabilitation techniques.

Learning outcomes:

1. Learn the numerical modeling of buildings (L1)
2. Understand sensors in SHM and data acquisition techniques (L2)

#### **UNIT-V**

**(10 Lectures)**

##### **HEALTH MONITORING OF BRIDGES:**

Measurement of Parameters, Sensors/Transducers technologies, Measurement & Health monitoring Techniques: Vibration signal analysis, Strain gage based Instrumentation, Destructive & Non-destructive testing, Load Test, etc

Learning outcomes:

1. Evaluate the measuring parameters (L1)
2. Understand health monitoring techniques (L2)
3. Understand the suitability of various instruments used to extract the parameters (L3)

##### **Text books:**

1. Charles R Farrar, and Keith Worden, *Structural Health Monitoring: A Machine Learning Perspective*, John Wiley & Sons, first edition, 2012-2013.
2. Nagayama, T. and Spencer Jr, B.F., 2007, *Structural health monitoring using smart sensors*, Newmark Structural Engineering Laboratory. University of Illinois at Urbana-Champaign.

##### **References**

1. Glisic, B. and Inaudi, D., 2008, *Fibre optic methods for structural health monitoring*, John Wiley & Sons.
2. Do, R., 2014, *Passive and active sensing technologies for structural health monitoring*, University of California, San Diego.