SHIV NADAR UNIVERSITY

GRADUATE COURSE DESCRIPTION

I. **COURSE TITLE: Structural Health Monitoring**

II. **COURSE CODE:** CED625

III. **COURSE CREDITS (L:T:P):** 2:0:1

IV. **TOTAL CONTACT HOURS/ BATCH/WEEK (L:T:P):** 2:0:1(2Hr)

V. **COURSE TYPE: Elective**

VI. **PREREQUISITE/S (IF ANY):** None

VII. **SCHOOL/ DEPARTMENT:** SOE / Civil

VIII. **DISCIPLINES TO WHICH THE COURSE MAY BE OF INTEREST:**
Civil Engineering/Mechanical Engineering

IX. **COURSE OBJECTIVE**

The purpose of the course is to convey the main ideas behind Structural Health Monitoring (SHM), with a particular emphasis on the data-based approach (although some aspects of model-based SHM will be covered). The course will mainly concentrate on vibration-based SHM, but will also cover aspects of wave-based SHM including traditional non-destructive evaluation methods like Acoustic Emissions. The course will be largely self-contained in terms of its mathematical content, but will assume a good familiarity with the sort of mathematics covered in an undergraduate engineering programme e.g. matrix analysis, Fourier analysis and linear differential equations.

X. **LEARNING OUTCOME**

- To make the student familiar with the state of-the art in structural health monitoring
- (SHM), both in theory and practice.
- To impart working practical skills in SHM.
- To prepare the student undertake further R&D studies in SHM.

XI. **COURSE CONTENT:**

(Theory Component)

Unit-1: Concept of Structural Health Monitoring

Introduction of structural damages and failure, Brief review conventional NDTs, Discussion on merits and demerits NDTs in practice. Structural Health Monitoring. Techniques used in present structural health monitoring practice. Advantage of SHM over the conventional NDTs. Discussion on case studies of engineered structure implanted with SHM. Hardware and software requirement for any SHM system.

Unit-2: Smart systems
Definition of smart system/structures, Smart materials-piezoelectricity, shape memory effects, Magneto-rheology, and bio-inspired sensors Active and passive smart materials, working principles of smart sensors in various SHM technique.
Unit-3 Component of SHM
Structure, Sensor, Data acquisition system, data transfer and storage mechanism, data management, data interpretation and diagnosis. System Identification and damage quantification using modal curvature concept Structural model update Structural condition assessment Prediction of remaining service life.
Unit-4: Techniques for SHM
State of Art in SHM/NDE, Global SHM technique, Local SHM technique, Electro-Mechanical Impedance technique. Wave propagation technique. Suitability of stated techniques in current practice in bridges and tall buildings
Lab Component

Assessment of Health of Structure, Investigation Management, SHM Procedures.
Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.
Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Data Acquisition Systems, Remote Structural Health Monitoring.

XII. TEXTBOOK:

1. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
2. Piezoelectric Materials: Applications to SHM, Energy Harvesting and Biomedicine, Suresh Bhalla, (Wiley Publication; Published. 1st Edition, 2017), ISSN 978-93-8546-246-7.
3. Other readings materials will be assigned from multiple sources throughout the course of the class.

XIII. ASSESSMENT SCHEME:

ASSESSMENT SCHEME: Class Participation (15%), Research Project (35%), Mid-Term Examination (20%), and Final Examination (30%)

Class Participation – Reading material will be assigned for each class. Students must come to class prepared to contribute thoughtfully to a discussion of the assigned reading.

Research Project –Students are required to propose and do a research project on a SHM related topic of their choice. The deliverable is class presentations and a research report.