



GUJARAT TECHNOLOGICAL UNIVERSITY

Programme Name: Master of Engineering

Level: PG

Subject Code: ME02000241

Course / Subject Name : Structural Health Monitoring

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite:	Concrete technology, Structural Analysis and Design of RCC structures, Repairs and Rehabilitation of Structures
Rationale:	Recent structural failures and the increased deterioration of the civil infrastructure, calls for the technology that can help to preserve structural integrity thereby assuring the public safety. Structural Health Monitoring (SHM) is one such proactive approach/technology that helps to assess the in-service performance of the structures located in earthquake zones or remote areas, using a variety of measurement techniques. SHM helps to enhance safety, reduces maintenance costs and contributes to overall resilience and sustainability of infrastructure. SHM plays a predominant role in catering to the need of monitoring of innovative designs and materials & better management of existing structures. The proper diagnosis through SHM helps to suggest the most appropriate retrofitting techniques to localize damages at their first occurrence.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
01	Identify and define all the terms and fundamental concepts associated with Structural health monitoring.
02	Comprehend the significance of SHM in ensuring safety, reliability and longevity of structures.
03	Develop a knowhow of the SHM technologies and their applications across the different types of the structures.
04	Know the advancements in field of SHM monitoring technologies.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR		C	Theory		Tutorial / Practical	
			ESE (E)		PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150



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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Need for Structural Assessment: <ul style="list-style-type: none">⇒ Introduction to health assessment of structures, structural damages & failures.⇒ Principles of structural assessment.⇒ Classification & levels of assessment.⇒ Damage detection techniques⇒ Current scenario of infrastructure through case studies	08	25
2.	Introduction to SHM: <ul style="list-style-type: none">⇒ Introduction to global infrastructure crisis.⇒ Definition & Motivation for SHM.⇒ SHM versus Non-destructive evaluation.⇒ SHM & biomimetics -Parallelism between medical activities and SHM.⇒ Concept of smart materials & smart structures with SHM.⇒ System components & categories of SHM.⇒ Classification of SHM systems.⇒ Methodologies and monitoring principles.⇒ Local & global Techniques for SHM.⇒ Advantages and applications of SHM through case studies.	12	30
3.	Monitoring techniques of SHM: <ul style="list-style-type: none">⇒ Static field testing: Behavior tests, Diagnostic tests, Proof tests.⇒ Sensors- Types, application and measurement techniques – Piezometer, Seepage monitoring, Strain gauge, Inclinometer, Tilt meter, Load cell, Pressure cell, Crack meter, Accelerometer, Anemometer, Temperature sensors, Corrosion monitoring system.⇒ Dynamic Field Testing: Stress history tests, Ambient vibration tests, Dynamic Load Allowance tests, Pull back (anchored cable tests)⇒ Periodic Monitoring: Field testing, tests to determine changes in structure⇒ Continuous monitoring: Active & Passive Monitoring	12	25
4.	Advancements in SHM: <ul style="list-style-type: none">⇒ Application of SHM using Machine learning & IoT's.	10	20



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	<p>⇒ Advanced techniques such as Web based data monitoring, Laser scanning, Automatic 3D deformation monitoring systems</p> <p>⇒ Overview of SHM of key infrastructures such as Bridges, Tunnels, Dams, Geotechnical monitoring, High rise buildings, Nuclear power plants</p> <p>⇒ Future of SHM</p>		
	Total	45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	30	30	10	5	5

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Structural Health Monitoring, Daniel Balageas, Peter Fritzen, Alfredo Guemes, John Wiley & Sons, 2006.
2. Health Monitoring of Structural Materials and Components_Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
3. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.
4. Structural Health Monitoring with Wafer Active Sensors, Victor Giurgutiu, Academic Press Inc, 2007..

(b) Open source software and website:

1. [NPTEL :: Ocean Engineering - NOC:Structural Health Monitoring](#)
2. <https://research.csiro.au/data61/structural-health-monitoring>
2. <https://beanair.com/conditioning-monitoring-system.html>
3. <https://www.hindawi.com/journals/ace/2010/724962/>
4. https://www.ndt.net/events/NDTCanada2014/app/content/Slides/40_Tamutus.pdf
5. https://cpwd.gov.in/Units/FinalDraftHandbook_Apr2007.pdf



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Suggested Course Practical List: NA

Suggested Project List:

1. Students in a group of 2 to prepare presentation on ‘Case studies of damage detection using SHM technologies’.
2. Students in a group of 2 to prepare presentation on ‘Case studies on application of SHM in critical/key infrastructures’.
3. Students in a group of 2 to download and thoroughly study high end technical journal papers on SHM and prepare a lucid presentation of the same.

List of Laboratory/Learning Resources Required:

Suggested Activities for Students: If any
