23ME801 Smart Materials and Shape memory alloys 4-0-0-4

Course objective

1. To study various types of smart materials used in engineering application
2. Analyse, interpret and study the processing of smart materials.
3. Assess which methods of characterisation are appropriate for different material combinations
4. Get knowledge of the use of smart materials as sensors and actuators.

Course outcome

After successful completion of the course, Students will be able to:

S.No.	Course Outcomes	Knowledge level [Bloom's Taxonomy]
CO01	**Describe** the properties and applications of smart materials	Understand
CO02	**Analyse** the manufacturing route for smart materials	Evaluate
CO03	**Study** the properties, types and fabrication of shape memory alloys	Understand
CO04	**Discuss** the application of shape memory alloys in various industries	Analyze
CO05	**Understand** the properties and application of Electro-rheological and Magneto Rheological Fluids	Apply

Syllabus

Overview of smart materials, Traditional v/s Smart systems, Smart sensors and actuators, Smart materials for sensing and actuating, Direct effect and converse effect, Smart actuators.

Piezoelectric materials, piezoceramic actuator, Constitutive relationship, Piezo ceramic polymers and composites, Bio morphs, and piezo stacks.

Magnetostriction, magnetostrictive materials, Butterfly curve, applications. Active smart polymers, classification of electro-active polymers, Comparison of EEAPS and IEAP applications, IPMC – actuators.

Shape memory effect (SME), alloys with SME, one–way SME, Pseudo elasticity, two–way SME, Applications of SMA, Nitinol, Copper-based SMA, and Iron-based SMA. Other SMA materials. Phenomenology of shape memory alloys, Manufacturing of SMA, Mechanical and thermal characterisation of shape memory alloys.

Electro-rheological Fluids, Magneto Rheological Fluids. Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials, Self-Healing Polymers, Intelligent System Design, Emergent System Design

References:

(a) Brian Culshaw, Smart Structures and Materials, Artech House, 2000

(b) Gauenzi, P., Smart Structures, Wiley, 2009

(c) Cady, W. G., Piezoelectricity, Dover Publication

(d) Antonio Concilio, Vincenza Antonucci, Ferdinando Auricchio, Leonardo Lecce, Elio Sacco., Shape memory alloy engineering for aerospace, structural, and bio-medical applications, Second edition, 2021.

Evaluation Pattern

Component	Weightage	Remarks
Cumulative Internal Examination [CIE] (70%)		
First Assessment Examination	15	
Second Assessment Examination	15	
Continuous Assessment (CA) - Theory	20	
Semester End Examination [SEE] (30%)		
End semester exam	50	
Note: Project/term papers may be given wherever it is applicable as a part of the CA		