VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)
DEPARTMENT OF PHYSICS
Open Elective Course

FUNDAMENTALS OF SMART MATERIALS AND APPLICATIONS
B.E. III SEMESTER

L : T : P	Credits	CIE Marks	SEE Marks	SEE Duration	Course Code
02: 0: 0	02	40	60	3 hours	U24OE310PH

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	1
CO2	3	-	-	-	-	-	-	-	-	-	-	1
CO3	3	3	-	-	-	-	-	-	-	-	-	1
CO4	3	-	-	-	-	-	-	-	-	-	-	1
CO5	2	-	-	-	-	-	-	-	-	-	-	1

Course Objectives	Course Outcomes	BTL
The student will be able to	**the student should at least be able:**	
1. To introduce various types of smart materials used in engineering.	1. Identify various smart materials and their significant applications.	2
2. Grasp the concepts of piezo and ferroelectric materials.	2. Summarize various properties and applications of peizo and ferroelectric materials.	3
3. Learn fundamentals of pyro and thermoelectric materials	3. Apply fundamental principles of pyro and thermoelectricity in relevant fields of engineering.	3
4. Gain knowledge on shape memory alloys	4. Explain types of shape memory alloys and their properties and applications	2

UNIT I: INTRODUCTION TO SMART MATERIALS (6 hours)

Characteristics of metals, polymers and ceramics. Introduction to smart materials, need for smart materials, Classification of smart materials, Components of a smart System, Applications of smart material, role of smart materials in developing intelligent systems and adaptive structures.

UNIT II: PIEZO AND FERRO ELECTRIC MATERIALS (8 hours)

Piezo electric effect and inverse piezoelectric effect, Piezo electric materials, Structure of Quartz crystal, piezoelectric oscillator, Magnetostriction, Magnetostriction oscillator, piezo-electric sensors, applications of Piezo-electric materials. Characteristics and properties of ferroelectric materials, Curie-Weiss law, applications of Ferro electric materials.

UNIT III: PYRO AND THERMO-ELECTRIC MATERIALS (6 hours)

Pyro electricity: pyro electric effect, pyro electric materials, pyro-electric detector.
Thermoelectricity: thermoelectric effect, Seebeck effect, Peltier effect, thermocouple, Principle and working of thermoelectric generator and Thermoelectric cooler, applications of thermoelectric materials

UNIT IV: SHAPE MEMORY MATERIALS (8 hours)

Introduction to shape memory alloys (SMA)- Shape Memory Effect (SME), Austenite, Martensite phases, Properties and characteristics SMAs, one-way and two-way shape memory effects, Properties of Ni-Ti shape memory alloy, Cu-based shape memory alloys, and their applications, Applications of SMAs.

Learning Resources:

1. Mukesh V. Gandhi, Brian S Smart Materials and Structures, Thompson, Springer, May- 1992
2. D. Patranabis, Sensors and Transducers, PHI Learning Pvt. Ltd., 2022
3. Nachiketa Tiwari, Bishakh Bhattacharya, Smart Material, Adaptive Structures & Intelligent Mechanical Systems

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