



VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)  
DEPARTMENT OF PHYSICS  
Open elective Course  
SMART MATERIALS AND APPLICATIONS

L : T : P	Credits	CIE		SEE		Course Code
		Marks	Exam Duration	Marks	Exam Duration	
02 : 0 : 0	02	40	90 min	60	3 hours	U23OE310PH
CIE	Assignments (02)	Quizzes (02)	Internal Exams (02)		Total CIE Marks	
Ave. Marks	05	05	30		40	

Course Objectives	Course Outcomes	BTL
<p><b>The student will be able to</b></p> <ol style="list-style-type: none"> <li>1. grasp the concepts of piezo and ferro electric materials</li> <li>2. Learn fundamentals of pyro and thermo electric materials</li> <li>3. gain knowledge on shape memory alloys</li> <li>4. acquire fundamental knowledge on chromic materials</li> </ol>	<p><b>the student should at least be able:</b></p> <ol style="list-style-type: none"> <li>1. summarize various properties and applications of piezo and ferro electric materials</li> <li>2. apply fundamental principles of pyro and thermo electricity in relevant fields of engineering</li> <li>3. Explain types of shape memory alloys and their properties and applications</li> <li>4. Outline the importance of chromic materials in engineering fields.</li> </ol>	<p>2</p> <p>3</p> <p>3</p> <p>2</p>

**UNIT I: PIEZO AND FERRO 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 ferro-electric materials, Curie-Weiss law, applications of Ferro electric materials

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

**Pyroelectricity:** 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 III: 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.

**UNIT-IV: (6 hours)**

Electro-chromaticity, Electro-chromic materials, Electro-chromic sensors and devices.

Photo-chromaticity, Photo-chromic materials, Photo-chromic sensors and devices.

Thermo-chromaticity, thermo-chromic materials, thermo-chromic sensors and devices.

Smart fluids: Magneto-rheological and Electro-rheological fluids.

**Learning Resources:**

1. K. Otsuka and C M Wayman, Shape memory materials, Cambridge university press, 1998.
2. T W Duerig, K N Melton, D Stockel, C M Wayman, Engineering aspects of shape memory alloys, Butterworth-Heinemann, 1990
3. A.K. Sawhney, A Course in Electronic Measurements and Instrumentation, Dhanpat Rai & Sons, 2015
4. D. Patranabis, Sensors and Transducers, PHI Learning Pvt. Ltd., 2013

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