Name: **Enrolment No:**	

UPES

End Semester Examination, May 2025

Course: Smart Materials **Semester: VIII**
Program: B. Tech MECHANICAL **Time : 03 hrs.**
Course Code: MEMA4010 **Max. Marks: 100**

Instructions:
Answer all questions.
Read each question carefully before answering.
Provide clear explanations where necessary.
Use diagrams or sketches to support your answers when appropriate.

ANY ACT OF DISHONESTY WILL RESULT IN AN 'F' GRADE.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Describe your understanding of the term 'rheology' in the context of ER and MR fluids.	**4**	**CO2**
Q 2	Shape Memory alloy phenomenon occurs due to the _____ phase transformation between the _____ and _____ phases, which is triggered by changes in _____ or _____. The specific temperature range at which this transformation occurs is determined by the alloy.	**4**	**CO1**
Q 3	Explain the meaning of the term 'Smart' as it relates to Smart Materials. Also, mention any four types of smart materials and provide one application for each.	**4**	**CO1**
Q 4	Describe the working principle behind ER and MR fluids. Which is more effective for large-scale vibration damping: ER fluids or MR fluids? Justify your answer.	**4**	**CO2**
Q 5	Explain the compression mode, transverse mode, and shear mode in piezoelectricity, including diagrams, and discuss their significance.	**4**	**CO2**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	Discuss in detail the phase transformation mechanism in Shape Memory Alloys (SMAs), accompanied by clear schematic representations.	**10**	**CO2**
Q 7	Explain the complete working principle and mechanism of a quartz crystal in electronic watches, including the design of the quartz tuning	**10**	**CO3**

	fork oscillator, frequency division circuitry, and timekeeping display mechanism.		
Q 8	Describe your understanding of the term “dielectric constant” Explain the significance of the dielectric constant in electrical and electronic systems. Provide examples of how the dielectric constant influences the performance and functionality of materials and devices in various applications. Additionally, discuss the importance of considering dielectric constants in material selection for specific engineering purposes.	**10**	**CO3**
Q 9	Explain the key features of Electro Active Polymers (EAP) microgels and discuss how these properties enhance their performance and suitability for various applications.	**10**	**CO2**
SECTION-C (2Qx20M=40 Marks)			
Q 10	Design and propose a concept for an innovative smart textile using smart polymers. Explain the selection of materials, working mechanism, potential applications, advantages, challenges, and future prospects of your design.	**20**	**CO4**
Q 11	Define LCST AND UCST. Discuss in detail the concepts of LCST) and (UCST) for smart polymers. Compare their behavior, give examples, describe mechanisms, and explain their application in drug delivery system OR Describe the poling process in piezoelectric materials in detail, highlighting its significance, the steps involved, and its effect on the performance of piezoelectric devices. Provide examples of applications where the poling process plays a crucial role.	**20**	**CO3**