Name: **Enrolment No:**	

UPES

End Semester Examination, May 2025

Course: Shape Memory and Smart Materials **Semester: VIII**

Program: B. Tech AMNT **Time : 03 hrs.**

Course Code: MECH4053 **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 what you understand by the term 'Smart' in Smart Materials. List any four types of smart materials along with one application each.	**4**	**CO2**
Q 2	Explain your understanding of the term 'rheology' in relation to ER and MR fluids.	**4**	**CO2**
Q 3	Explain the significance of high d_{33} and g_{33}	**4**	**CO1**
Q 4	Describe the compression mode, transverse mode, and shear mode in piezoelectricity with diagrams, and explain their significance.	**4**	**CO2**
Q 5	Define hysteresis loss and discuss the methods used to minimize hysteresis and associated energy losses	**4**	**CO2**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	Which is more effective for large-scale vibration damping: ER fluids or MR fluids? Justify your answer.	**10**	**CO4**
Q 7	Explain the complete working principle and mechanism of a quartz crystal in electronic watches, including the design of the quartz tuning fork oscillator, frequency division circuitry, and timekeeping display mechanism.	**10**	**CO3**
Q 8	Identify the key piezoelectric constants essential for selecting a material in an energy harvesting system, sonar and ultrasound applications. Justify your selection.	**10**	**CO3**

Q 9	Discuss the **IMPORTANCE** of spontaneous polarization, remnant polarization, and coercivity in the design of piezoelectric and ferroelectric devices with a neat diagram.	**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 applications 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**