Name: **Enrolment No:**	

UPES

End Semester Examination, May 2023

Course: MATERIALS CHARACTERIZATION-I **Semester: IV**

Program: B. Tech (AM & NT) **Time : 03 hrs.**

Course Code: MEMA2007 **Max. Marks: 100**

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	What is the difference between transmission electron microscopy (TEM) and scanning electron microscopy (SEM)?	**4**	**CO3**
Q 2	How do X-rays interact with matter, and how can this interaction be used for materials analysis?	**4**	**CO2**
Q 3	What are some of the challenges associated with sample preparation for electron microscopy, and how can these be addressed?	**4**	**CO4**
Q 4	What is scanning probe microscopy, and how is it used to study surface properties of materials?	**4**	**CO1**
Q 5	What are the key challenges and limitations associated with AFM-based techniques, and what are some potential future directions for AFM research?	**4**	**CO5**
SECTION B **(4Qx10M= 40 Marks)**			
Q 6	Draw and explain schematic of SAED pattern in TEM obtained from crystalline, amorphous and poly crystalline samples.	**10**	**CO5**
Q 7	How does electron optics differ from other forms of optics, such as optical or X-ray optics?	**10**	**CO3**
Q 8	What is Scanning transmission electron microscopy (STEM)? How its is different from Scanning tunneling microscopy (STM)? Elaborate advantages of STEM?	**10**	**CO6**
Q 9	Explain various electron specimen interactions taking place in SEM. Elaborate interaction volume dependencies on atomic number (Z) and Incident electron energy. **OR** Elaborate basic image contrast formation mechanism in TEM and various factor affecting it.	**10**	**CO4** **CO4**

SECTION-C (2Qx20M=40 Marks)			
Q 10	What are the underlying principles of X-ray diffraction and crystallography? What is Bragg's law, and how is it used to interpret X-ray diffraction patterns to determine unit cell parameters? How do X-rays interact with matter, and how can this interaction be leveraged for materials analysis?	**20**	**CO2, CO5**
Q 11	What are the different types of microscopy techniques available for materials characterization, and how do they differ in terms of resolution, sample preparation requirements, and other key parameters? How can these techniques be used to study the microstructure and behavior of materials at different length scales, from the atomic to the macroscopic level? **OR** What are the different modes of AFM operation, and how are they used to study different properties of materials? Describe the operation of tapping mode, contact mode, and other AFM techniques, and discuss the advantages and limitations of each mode.	**20**	**CO1** **CO1**