Name: **Enrolment No:**	

UPES

End Semester Examination, May 2024

Course: Materials Characterization II **Semester: VI**

Program: BTech Advanced Materials and Nanotechnology **Time : 03 hrs.**

Course Code: MEMA3011 **Max. Marks: 100**

Instructions:

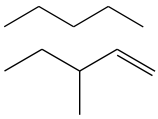
1. **Read all questions carefully and attempt questions of one section in one place.**
2. **In Section B, Q6, and in Section C, Q 10 have internal choice questions.**
3. **Use of the calculator is allowed.**

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Discuss Hook's law in the case of AFM.	**4**	**CO1**
Q 2	How does AFM overcome the limitations of STM?	**4**	**CO1**
Q 3	Elaborate on the following equation: $\beta_{Total} = \beta_{sample} + \beta_{instrument}$	**4**	**CO3**
Q 4	Describe the working principle behind Xray Fluorescence Spectroscopy.	**4**	**CO3**
Q 5	Define i) Singlet and triplet states ii) Fluorescence and Phosphorescence	**(2+2)**	**CO2**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Derive and explain the equation for Beer-Lambert's Law. **OR** i) After analyzing an unknown sample using UV-Visible spectroscopy, you observe an absorbance of 0.30, assuming the pathlength to be 1 cm, and concentration of the sample to be 2.5 M, what is the molar absorption coefficient of the unknown sample? ii) A solution of thickness 3 cm transmits 40% of light. Calculate the concentration of the solution given that the molar absorption coefficient is 4000 $dm^3mol^{-1}cm^{-1}$.	**10** **OR** **(5+5)**	**CO2**

Q 7	i) What are symmetry elements? Briefly mention the different types of symmetry operations. ii) Describe the following operation of $TiCl_4$: 	**(8+2)**	**CO2**
Q 8	Identify the role of quantum mechanics in spectroscopy.	**10**	**CO2**
Q 9	Schematically show the instrumentation behind AAS and AES.	**10**	**CO3**
	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	i) In ^{1}H-NMR, why is $CDCl_3$ used and not $CHCl_3$ as a solvent? ii) List the different types of NMR available. iii) How many ^{1}H-NMR signals will you observe for the following molecules, and why? a)  pentane b) 3-methylpent-1-ene  c) cyclopenta-1,3-diene  d) benzene **OR** i) Describe Rayleigh and Raman scattering. ii) A sample was excited by 435 nm wavelength light, the first Raman line was observed at 448 nm. Calculate the Raman shift. iii) For exciting line at λ = 600 nm, the stokes line for the substance falls at λ = 615 nm. What will be the nearest λ value for the anti-stokes line for the same material?	**(5+5+(4 ×2.5))**	**CO3**
Q 11	Discuss the instrumentation of STM and AFM in detail.	**(20)**	**CO1**