Name:

**Enrolment No:** 



## UPES End Semester Examination, December 2024

Course: Molecular Spectroscopy & Diffraction Methods Program: M.Sc. Chemistry Course Code: CHEM8047 Semester: III Time : 03 hrs. Max. Marks: 100

Instructions: Scientific Calculator is allowed.

SECTION A								
(5Qx4M=20Marks)								
S. No.		Marks	СО					
Q 1	The term symbol for an atomic state is quoted as ${}^{4}D_{5/2}$ . What are the values of <i>L</i> , <i>S</i> and <i>J</i> for this state.	4	CO1					
Q 2	Compare Zeeman effect and Stark effect.	4	C01					
Q 3	Categorize the following into IR and/or Raman active molecules. a) CO <sub>2</sub> b) SO <sub>2</sub>	4	CO2					
Q 4	Demonstrate the following planes in a cubic crystal: a) 001 b) 111 c) 211 d) 202	4	CO2					
Q 5	Microwave spectra of the molecule containing C-H bond showed the lines at 15.612 cm <sup>-1</sup> , 31.224 cm <sup>-1</sup> , 46.830 cm <sup>-1</sup> , 62.440 cm <sup>-1</sup> , 78.06 cm <sup>-1</sup> . Calculate the moment of inertia of the C-H bond.	4	CO3					
SECTION B								
(4Qx10M= 40 Marks)								
Q 6	<ul> <li>Explain which of the following transitions are allowed and which ones are forbidden by selection rules for hydrogen like atoms. Give reasons.</li> <li>a) 3s → 2p</li> <li>b) 3d → 4s</li> <li>c) 1s → 2p</li> <li>d) 2p → 3d</li> <li>e) 3s → 4s</li> </ul>	10	CO1					
Q 7	Discuss X-ray diffraction method for determining crystal structure.	10	CO2					

Q 8	Describe Spectrum. Find the structure bands						
	cm <sup>-1</sup>	IR band	Raman peak	Polarization	10	CO3	
	589	Strong	Very weak	Polarized			
	1286	Very strong (PR contours)	Very strong	Polarized			
	2224	Very strong (PR contours)	Strong	-			
Q 9	Demonstra						
	a) SO2	2	b) H <sub>2</sub> O		10	CO3	
SECTION-C (2Qx20M=40 Marks)							
Q 10	<ul><li>a) Derive</li><li>vibrati</li><li>b) Explai</li><li>spectru</li></ul>	the following expression of a diatomic molec n the following terms: im ii) Rayleigh scatteri	10 + 10	CO2			
Q 11	a) Discu b) State of CC	ss the crystal structure the rule of mutual excl $D_2$ .					
		10 + 10	CO3				
	a) Elabor b) The fir be at 3	10 1 10					