M.Sc. II (Physics) (CBCS Pattern) Third Semester **PSCPHYT11-3 - Paper-XI : Atomic and Molecular Physics-I (Elective)**

P. Pages : 2 Time : Three Hours		2 GUG/W/18/1130 aree Hours * 3 4 0 3 * Max. Marks : 5	GUG/W/18/11300 Max. Marks : 80	
	Not	es : 1. All questions are compulsory.	_	
1.		Either		
	a)	Explain the spectra of Helium atom and explain why the ground state of He atom is very low lying.	6	
	b)	Explain the spectrum of alkali atom.	4	
	c)	What is spin-spin and spin-lattice relaxation in NMR. Explain the chemical shift in NMR.	6	
		OR		
	e)	Explain the Mossbauer effect of y-rays. Describe its experimental techniques.	8	
	f)	Explain the chemical shift in Mossbauer effect.	4	
	g)	Explain the magnetic hyperfine interaction.	4	
2.		Either		
	a)	Explain the principle of E.S.R. Write the experimental technique.	8	
	b)	Explain the normal and anomalous Zeeman effect.	8	
		OR		
	e)	What is spontaneous and stimulated emission. Obtain the relation between Einstein A & B coefficients.	8	
	f)	Explain the construction and working of ruby laser.	8	
3.		Either.		
	a)	What are molecular spectrum. Discuss various types of molecular spectrum.	6	
	b)	Show that the rotational energy of a diatomic molecule E is related to angular momentum L through the relation $E = \frac{L^2}{L^2}$ Where u is reduced mass and n is interrupted distance.	6	
		$E = \frac{1}{2\mu r^2}$, where μ is reduced mass and r is internuclear distance		

c) The J = 0 to J = 1 absorption line in CO occurs it a frequencies 1.153×10 "Hz. Calculate the moment of inertia and bond length. (Given : Mass of ${}_{6}C^{12}$ and ${}_{8}O^{16}$ atoms are 1.99×10^{-26} kg and 2.66×10^{-26} kg respectively).

OR

4

e)	Explain Raman effect. Describe the experimental set-up to study it. Outline the theory of Raman effect.	10
f)	Explain.i) Symmetric top.ii) Asymmetric top molecules.	4
g)	In an experiment in the study of Raman effect using mercury green radiation of wavelength 546.1nm a stokes line of wavelength 554.3nm was observed find the Raman Shift. (Given : $C = 3x10^8 \text{ m/s}$).	2
	Either.	
a)	Explain electronic spectra of diatomic molecule in details.	6
b)	State and explain Franck-Condon principle.	6
c)	The value of \overline{V}_e and X_e for lower and upper state of CO are 2170.21cm ⁻¹ , 0.0062 and 1515.61cm ⁻¹ , 0.0114 respectively the (0, 0) transition is observed at 64746.66 cm ⁻¹ . Calculate the energy difference of the two electronic state.	4
e)	Describe in details rotational fine structure of electronic-vibration spectra for diatonic	8

- e) Describe in details rotational fine structure of electronic-vibration spectra for diatonic **8** molecule (B' < B'') with proper band diagrams for R-branch, P-branch, Q- branch and complete spectrum.
- f) Plotting the for that parabola for B' < B". Obtain the equation for band head.
 g) State Born-Oppenheimer approximation and dissociation energy.
 Answers all the following.
 - a) Write a note on NMR.
 b) Explain the terms LS and JJ coupling.
 c) Explain classical theory of Raman effect.
 d) Describe the salient features of molecular electronic spectra.

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