Reg. No ..... Name **23P4004**

MSc DEGREE END SEMESTER EXAMINATION : MARCH 2023

SEMESTER 4 : PHYSICS

COURSE : **21P4PHYT13 : ATOMIC AND MOLECULAR PHYSICS**

(For Regular - 2021 Admission)

Duration : Three Hours Max. Weights: 30

PART A

Answer any 8 questions **Weight: 1**

1. Discuss the conditions under which band heads are degraded towards violet or red in electronic spectrum. (An, CO 3)
2. Briefly explain the fine structure of sodium D lines. (U, CO 1)
3. Explain the formation of auger electrons in SEM technique (U, CO 5)
4. What is the effect of nuclear magnetic field on the Mossbauer spectrum? (An, CO 4)
5. State the conditions for a vibration to be Raman active. (An, CO 3)
6. What is the Spin - Spin interaction in NMR? (A)
7. Write a short note on Small angle X-ray scattering. (E)
8. List the reasons for hyperfine structure in atomic spectra. (U, CO 1)
9. Explain zero point energy (R, CO 2)
10. Explain Morse function. (U, CO 2)

(1 x 8 = 8)

PART B

Answer any 6 questions **Weights: 2**

11. Evaluate Lande's g factor for $^2F_{7/2}$ state. (A, CO 1)
12. If the bond length of H_2 is 0.075nm, what would be the positions of the first three rotational Raman lines in the spectrum? ($H^1 = 1.673 \times 10^{-27}$kg) (A, CO 3)
13. Explain how size, shape and orientation of polarizability ellipsoid changes when H_2O molecule vibrates. (A, CO 3)
14. The fundamental band of $^{14}N^{16}O$ is centered at 1876cm^{-1} and the first overtone at 3724cm^{-1}. Calculate the equilibrium oscillation frequency, anharmonicity constant and the force constant. (A, CO 2)
15. Calculate the frequency for proton resonance at1.5T. Compare this with the vibrational frequency in H_2, being4390cm-1. (A, CO 4)
16. Draw the vector diagram for *L S* coupling in a *pd* electron system (A, CO 1)
17. Explain the relaxation process in NMR. What are the applications of NMR? (An, CO 4)
18. What are the essential components of an X-Ray diffraction equipment? Explain. (E, CO 5)

(2 x 6 = 12)

PART C

Answer any 2 questions **Weights: 5**

19. Derive the expression for spin orbit interaction energy. Draw the doublet formation in 2F energy state. (A, CO 1)
20. Give the details of specimen interaction in SEM technique (E, CO 5)

21. Explain the rotation vibration spectra of a polyatomic linear molecule having perpendicular vibrations. (U, CO 2)

22. Explain inverse Raman effect, hyper Raman effect, and stimulated Raman effect. (R, CO 3)

(5 x 2 = 10)

OBE: Questions to Course Outcome Mapping

CO	Course Outcome Description	CL	Questions	Total Wt.
CO 1	To apply the principles of atomic spectroscopy in the study of material science	A	2, 8, 11, 16, 19	11
CO 2	Analyse the microwave and infra red spectrum in the material science study	An	9, 10, 14, 21	9
CO 3	Analyse the given Raman & UV - Visible spectra in the material science study	An	1, 5, 12, 13, 22	11
CO 4	To understand about the NMR, ESR & Mossbauer technique of material identification	U	4, 15, 17	5
CO 5	Understand about the advanced spectroscopic techniques	U	3, 18, 20	8

Cognitive Level (CL): Cr - CREATE; E - EVALUATE; An - ANALYZE; A - APPLY; U - UNDERSTAND; R - REMEMBER;