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**Reg. No. : .....**

**Name : .....**

**Third Semester M.Sc. Degree Examination, March 2022**

**Physics**

**PH 232 – ATOMIC AND MOLECULAR SPECTROSCOPY**

**(2020 Admission)**

Time : 3 Hours Max. Marks : 75

PART – A

Answer **any five** questions. Each question carries **3** marks.

1. Write a short note Auger electron spectroscopy.
2. Briefly explain stark effect.
3. Discuss the breakdown of Born-Oppenheimer approximation.
4. Explain Frank Condon principle.
5. Explain the effect of isotopic substitution in rotational spectra.
6. Explain stimulated Raman scattering.
7. Explain isomer shift in Mossbauer spectroscopy.
8. Explain the relaxation process in NMR.

**(5 × 3 = 15 Marks)**

PART – B

Answer **all** questions. Each question carries **15** marks.

9. Explain LS and JJ coupling schemes and Explain Paschen back effect.

OR

10. Explain symmetry operations and symmetry elements of a molecule.

**P.T.O.**

11. Explain

    (a) The fundamental vibrations and symmetry of polyatomic molecules with examples and

    (b) Fourier Transform spectroscopy.

OR

12. Discuss the rotational spectra of symmetric top molecules and explain information derived from rotational spectra.

13. Explain the quantum theory of Raman effect and Explain the structure determination from IR and Raman spectroscopy.

OR

14. Explain

    (a) NMR with the resonance condition and relaxation process.

    (b) Discuss NMR imaging.

**($3 \times 15 = 45$ Marks)**

PART – C

Answer **any three** of the following questions. Each question carries **5** marks.

15. Determine the normal Zeeman effect of the cadmium red line of $6438 \times 10^{-10}$ m when the atoms are placed in a magnetic field of 0.009 T.

16. Explain matrix representation of symmetry operations.

17. The rotational constant for HCl is found to be 10.5909 $cm^{-1}$. What are the B values for $H^{37}$ Cl and $D^{35}$ Cl.

18. The fundamental and first overtone transitions of CO are centered at 2143.3 $cm^{-1}$ and 4260.0 $cm^{-1}$ respectively. Evaluate the equilibrium vibrational frequency, the anharmonicity constant, and force constant of the molecule.

19. The first rotational Raman line of $H^2$ appears at 346 $cm^{-1}$ from the exciting Line. Calculate the bond length $H_2$ molecule. Given mass of H = $1.673 \times 10^{27}$ kg.

20. Calculate the Doppler velocity corresponding to the natural line width of the gamma ray emission from 14.4 KeV excited state of $^{57}Fe$ nucleus having a half-life of $9.8 \times 10^{-8}$ s.

**($3 \times 5 = 15$ Marks)**

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