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Reg. No. : .....

Name : .....

Third Semester M.Sc. Degree Examination, February 2024

Physics with Specialization in Nano Science / Physics with Specialization in Space Physics

PHSP 532/PHNS 532 : ATOMIC AND MOLECULAR SPECTROSCOPY

(2020 Admission Onwards)

Time : 3 Hours Max. Marks : 75

PART – A

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

1. Write a short note on symmetry elements.
2. What is Paschen-Back effect?
3. Explain Stark effect.
4. Comment on 'hot bands' in IR spectra.
5. What is isotope effect?
6. Define chemical shift.
7. Explain Franck-Condon principle.
8. Briefly explain stimulated Raman scattering.

(5 × 3 =

PART – B

Answer any **three** questions. **Each** question carries **15** marks.

9. (a) Explain Fermi Resonance.

   (b) Discuss the rotational fine structure of electronic transitions. Comment of Fortrat parabola.

OR

10. (a) Obtain an expression for the vibration levels of a diatomic molecule.

    (b) Discuss the effect of isotopic substitution on the spectra.

11. (a) Explain Paschen bach effect.

    (b) Explain molecular point-groups.

OR

12. (a) Explain photo electron spectroscopy.

    (b) Explain Zeeman effect.

13. (a) Explain the principle and resonance condition of NMR.

    (b) Explain isomer shift in Mossbauer spectroscopy.

OR

14. (a) Explain the working principle of Raman spectrometer.

    (b) Write classical and quantum mechanical theories of Raman effect.

(3 × 15 = 4

PART – C

Answer any **three** questions. **Each** question carries **5** marks.

15. Draw the normal Zeeman pattern for the 1F3 → 1D2 transition.

16. Explain Great orthogonality theorem.

17. Explain the L-S and J-J coupling schemes in a strong magnetic field with the help of a vector model.

18. Explain the classification of molecules as linear, spherical top, symmetric top and asymmetric top.

19. An NMR signal for a compound is found to be 180 Hz downward From TMS peak using a spectrometer operating at 60 MHz. Calculate its chemical shift in ppm.

20. Calculate the recoil velocity of a free Mossbauer nucleus of mass $1.67*10^{-25}$ kg (equivalent at. Wt. 100) when emitting a γ-ray of wavelength 0.1mm. What is the doppler shift of the γ-ray frequency to an outside observer?

($3 \times 5 = 15$ Marks)
