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Reg. No. : .....

Name : .....

Third Semester M.Sc. Degree Examination, July 2023

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

SECTION – A

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

1. What is isomer shift?
2. Explain the principle of NMR.
3. Explain the factors responsible for the hyperfine structure in ESR spectra.
4. Why homonuclear diatomic molecules do not show rotational spectra?
5. What is known as finger print region of IR?
6. Explain Stark effect.
7. What are the different ways in which the orbital and spin momentum can be coupled in a two electron system?
8. Explain Pauli's exclusion principle.

(5 × 3 = 15 Marks)

P.T.O.

SECTION – B

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

9. (a) Explain the principle of ESR.

   (b) Outline the basic requirements of an ESR spectrometer.

OR

10. (a) Explain the theory of Raman scattering. Why anti-Stokes lines are less intense than Stokes lines?

    (b) Write a brief note on Mossbauer sources and absorbers.

11. (a) Describe Paschen-Back effect.

    (b) Explain anomalous Zeeman effect in detail.

OR

12. (a) Explain X–ray fluorescence spectroscopy.

    (b) What is molecular point groups? Explain the characteristic table of C_{2v} and C_{3v} point groups.

13. (a) Deduce rotational energy levels of diatomic molecule by treating it as a rigid rotator.

    (b) Obtain the frequency of rotational spectral lines.

OR

14. Discuss the influence of rotation on the spectra of :

    (a) linear molecules.

    (b) symmetric top molecules.

(3 × 15 = 45 Marks)

SECTION – C

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

15. 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 0.1 nm. What is the Doppler shift of the γ-ray frequency to an outside observer?

16. Electron spin resonance is observed for atomic hydrogen with an instrument operating at 9.5 GHz. If the g value for the electron in the hydrogen atom is 2.0026, what is the magnetic field applied? Bohr magnetron $\mu_B = 9.274 \times 10^{-24} JT^{-1}$.

17. Give an account on Fortrat parabola.

18. Explain FTIR Spectroscopy.

19. A state is denoted as $^4D_{5/2}$. What are its values of L, S and J? What is the minimum number of electrons which could give rise to this? Suggest a possible electronic configuration.

20. Illustrate, with an energy level diagram. Pachen Bach effect for the D2 line of sodium.

(3 × 5 = 15 Marks)
