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Reg. No. : .....

Name : .....

Third Semester M.Sc. Degree Examination, JUNE 2022.

Physics with Specialization in Nano Science/Space Physics

PHSP 532/ PHNS 532 : 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 not photoelectron spectroscopy.
2. Briefly explain Paschen back effect.
3. What are the factors affecting the intensity of rotational spectral lines.
4. What do you meant by Fermi Resonance.
5. Explain pre-dissociation.
6. Write a short note on CARS.
7. Explain chemical shift in NMR spectroscopy.
8. Explain the recoil emission and absorption of Mossbauer spectroscopy.

(5 × 3 = 15 Marks)

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PART – B

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

9. Explain Normal and Anomalous Zeeman effect.

OR

10. Explain (a) molecular point group (b) Matrix representation of symmetry operators and (c) reducible and irreducible representation.

11. Explain the rotational fine structure of electronic vibrational transitions and Fortrat diagram.

OR

12. Discuss the diatomic vibrating rotator and explain the breakdown of born openheimer approximation.

13. Explain nonlinear Raman effect with three nonlinear Raman spectroscopic phenomena.

OR

14. Explain the recoil emission and absorption in Mossbauer spectroscopy and chemical isomer shift.

(3 × 15 = 45 Marks)

PART – C

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

15. Consider an atom placed in a magnetic field of 1.0 webber/m^2 which has l = 2. Calculate the rate of precession and torque on the atom, given that the magnetic moment makes an angle of 450°.

16. Explain great orthogonality theorem.

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17. What is the average period of rotation of HCl molecule if it is in the *j=1* state. The inter nuclear distance of HCl is 0.1274 nm. Given the mass of hydrogen and chlorine atoms are 1.673×10^{-27} kg and 58.06×10^{-27} Kg respectively.

18. The fundamental and first overtone transitions of $^{14}N^{16}O$ are centered at 1876.06 cm^{-1} and 3724.20 cm^{-1} respectively. Evaluate the equilibrium vibrational frequency, the anharmonicity constant, zero point energy and force constant of the molecule.

19. Calculate the NMR of F^{19} nucleus when it is placed in a magnetic field of 1.0T. given that $g_I = 5.256$ and $\mu N = 5.0504 \times 10^{-27}$ JT^{-1}.

20. In the rotational Raman spectra of MCI the displacements from the exciting line are represented by $\Delta v = \pm$ (62.4+41.6 J) cm^{-1}. Calculate the moment of inertia of HCl molecule.

(3 × 5 = 15 Marks)

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