21P405 (Pages: 2) Name: .....

Reg.No: .....

FOURTH SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2023

(CBCSS - PG)

(Regular/Supplementary/Improvement)

CC19P PHY4 C12 - ATOMIC AND MOLECULAR SPECTROSCOPY

(Physics)

(2019 Admission onwards)

Time : 3 Hours Maximum : 30 Weightage

Section A

Answer ***all*** questions. Each question carries 1 weightage.

1. Write a note on interaction energies of L S coupling and j-j coupling schemes.
2. Which of the following molecules will show a microwave rotational spectrum: H_2, HCl, CH_4, CH_3Cl?
3. Illustrate mutual exclusion principle with an example.
4. What is inverse Raman Effect?
5. Discuss Frank – Condon principle.
6. Outline the principle of NMR spectrum.
7. Explain the factors responsible for hyperfine structure in ESR spectra.
8. Discuss recoilless emission and absorption of gamma rays.

(8 × 1 = 8 Weightage)

Section B

Answer any ***two*** questions. Each question carries 5 weightage.

9. Describe the normal and anomalous Zeeman effect. Explain the Zeeman effect in sodium with a diagram.
10. Explain the technique of FTIR spectroscopy. What is its advantage over conventional IR technique?
11. What is Deslandre's table? Explain progressions & sequences in electronic spectroscopy of molecules.
12. Discuss the principle of Mossbauer spectroscopy. Write notes on isomer shift and magnetic hyperfine interaction in Mossbauer spectroscopy.

(2 × 5 = 10 Weightage)

Section C

Answer any ***four*** questions. Each question carries 3 weightage.

13. Evaluate the different spectroscopic terms arising due to (1) an electron in p orbital and another electron in f orbital and (2) an electron in p orbital and another electron in d orbital in j-j coupling.

14. Which of the following molecules have a microwave spectrum? Explain the reason. (a) O_2 (b) HCl (c) IF (d) F_2

15. The fundamental band for HCI is centred at 2886 cm^{-1}. Assuming that the internuclear distance is 1.276 A^0, calculate the wave number of the first two lines of each of the P and R branches of HCI.

16. Bond length of H_2 molecule is 0.7417 A^0. Determine the position of first three rotational Raman lines in the spectrum. Given, mass of H = 1.673 x 10^{-27}Kg.

17. The rotational lines of a band system of electronic vibration spectra is given by $\bar{\nu} = (24762 + 25m - 2.1m^2)cm^{-1}$, where m = ±1, ±2 etc. Deduce the values of B', B" and the position of band head.

18. An NMR signal for a compound is found to be 180 Hz downward from TMS [$(CH_3)_4$.Si] peak using a spectrometer operating at 60 MHz. Calculate its chemical shift in ppm.

19. A free electron is placed in a magnetic field of strength 1.5 T. Calculate the resonance frequency if "g" = 2.0023.

(4 × 3 = 12 Weightage)

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