K26P 1223

Reg. No. : .....

Name : .....

Second Semester M.Sc. Degree (C.B.C.S.S. – O.B.E. – Reg./Supple./Imp.) Examination, April 2026
(2023 Admission Onwards)
PHYSICS/PHYSICS WITH COMPUTATIONAL AND NANO SCIENCE SPECIALIZATION PROGRAMME
MSPHY02C11/MSPHN02C11 : Spectroscopy

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **any 5**, **each one** carries **3** marks.

1. What is Paschen-Back effect ?
2. The observed rotational spectrum of HF shows a decrease in the line separation on the high-frequency side. Why ?
3. With a neat diagram, give the normal modes of H_2O ? What are its frequencies ?
4. State and explain Franck-Condon Principle.
5. What is the basic principle of Mössbauer spectroscopy ?
6. What is chemical shift ? **(5×3=15)**

SECTION – B

Answer **any 3**, **each one** carries **6** marks.

7. Derive an expression for the Lande g-factor.
8. The fundamental band for HCl is centred at 2,886 cm^{-1}. Assuming that the internuclear distance is 1.276A°, calculate the wave number of the first two lines of each of the P and R branches of HCl.

P.T.O.

9. The first-three stokes lines in the rotational Raman spectrum of $^{16}O_2$ are separated by 14.4 cm^{-1}, 25.8 cm^{-1} and 37.4 cm^{-1} from the exciting radiation. Using the rigid rotor model obtain the value of r_0.
10. The band origin of a transition in C_2 is observed at 19,378 cm^{-1}, while the rotational fine structure indicates that the rotational constants in the excited and ground states are respectively $B' = 1.7527\ cm^{-1}$ and $B'' = 1.6326\ cm^{-1}$. Estimate the position of the band head. Which state has the larger internuclear distance ?
11. Write a note on Larmor precession and obtain an expression for Larmor Frequency. **(3×6=18)**

SECTION – C

Answer **any 3**, **each one** carries **9** marks

12. Define the Stark effect and explain the experimental setup used by stark to study this phenomenon. Illustrate how the Zeeman effect is more useful than the Stark effect.
13. Discuss the rotational spectrum of a non-rigid heterogeneous diatomic molecule and compare the spectrum with that of a rigid heterogeneous diatomic molecule.
14. Discuss vibrational and rotational fine structure of Raman spectra.
15. Discuss the rotational fine structure of electronic-vibrational transitions. Write a note on Fortrat diagram.
16. Outline the theory of NMR and ESR. Illustrate with an example. **(3×9=27)**
