TM243969P

Reg. No :.....

Name :.....

MASTER'S DEGREE (C.S.S) EXAMINATION, NOVEMBER 2024

2023 ADMISSIONS REGULAR

SEMESTER III - CORE COURSE

PH3C11TM20 - Atomic and Molecular Physics

Time : 3 Hours **Maximum Weight : 30**

Part A

I. Answer any Eight questions. Each question carries 1 weight **(8x1=8)**

1. Explain the selection rules and intensity rules in atomic spectroscopy.
2. State and explain Hund's rule and Lande's interval rule.
3. Explain the physical significance of Lorentz unit and evaluate it in a magnetic field of flux density 2 Tesla.
4. Sketch the allowed transitions between the rotational energy levels in a rigid and a non-rigid rotator.
5. Briefly discuss the influence of rotation on the infra-red spectra of polyatomic symmetric top molecules.
6. Apply Rule of Mutual exclusion principle and illustrate Raman spectrum of chloroform.
7. Explain Bohr- Oppenheim approximation.
8. Explain the interaction between magnetic field and nuclear spin.
9. Distinguish between paramagnetic and diamagnetic materials.
10. Explain quadrupole effects in Mossbauer spectroscopy.

Part B

II. Answer any Six questions. Each question carries 2 weight **(6x2=12)**

11. Derive an expression for the spin - orbit interaction energy of electron.
12. Draw the anomalous Zeeman pattern of Sodium D1 and D2 line.
13. Given that the spacing of the lines in the microwave spectrum of $^{27}Al^{1}H$ is constant at $12.604cm^{-1}$, calculate the moment of inertia and bond length of the molecule. (m(^{27}Al) = 26.9815amu).
14. The position of lines in the fundamental band of CO is given by $\bar{\nu} = 2143.3 + 3.813m - 0.0175m^2 cm^{-1}$. Calculate the wavenumbers of the first two lines in the P and R branches and the values of B_0 and B_1.
15. Explain the principles of Hyper Raman effect and discuss its experimental techniques.
16. With a schematic representation, explain the significance of Fortrat parabola.
17. With necessary theory, explain Magnetic Resonance imaging.
18. A stationary nucleus of mass 24 amu emits a gamma photon of energy 7 MeV. Calculate the recoil energy of the nucleus.

Part C

III. Answer any Two questions. Each question carries 5 weight **(2x5=10)**

19. Explain different types of coupling and derive the interaction energy in each case.
20. Explain the rotational spectrum of polyatomic molecules.
21. Discuss the quantum and classical theory of Raman effect. Explain how Raman activity is shown by the vibration of water molecule.
22. Discuss the basic principle and instrumentation of Mossbauer spectroscopy. Illustrate various applications of Mossbauer spectroscopy.