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B.M.S COLLEGE FOR WOMEN
BENGALURU – 560004

V SEMESTER END EXAMINATION – JAN/FEB - 2024

B.Sc. - PHYSICS – ELEMENTS OF ATOMIC, MOLECULAR AND LASER PHYSICS
(NEP Scheme 2021-22 Onwards)

Course Code: PHY5DSC06

Duration: 2 ½ Hours

QP Code: 5021

Max. Marks: 60

Instructions: Answer any FOUR questions from each part.

PART-A

I. Answer any FOUR questions out of SIX. Each question carries 8 marks. (4X8=32)

1. a. Derive an expression for radius of orbit of an electron in hydrogen atom.
b. Describe Franck-Hertz experiment. (4+4)
2. Briefly explain the different quantum numbers associated with an atom. (8)
3. a. What is Zeeman effect? Compare anomalous and normal Zeeman effect.
b. Derive an expression for Bohr magneton. (4+4)
4. a. Derive an expression for rotational energies of a diatomic molecule.
b. What is Born Oppenheimer approximation? (6+2)
5. a. What is Raman scattering? Differentiate Raman scattering and Rayleigh scattering.
b. Explain the construction and working of He-Ne laser. (3+5)
6. a. Derive the expressions for Einstein's coefficients A and B.
b. Mention any three applications of laser. (5+3)

PART-B

II. Answer any FOUR problems out of SIX. Each question carries 5 marks. (4X5=20)

7. Find the wavelength of the light emitted when hydrogen atom undergoes transition from 5th orbit to 3rd orbit. Given ionisation potential of atom is 13.6 eV.
8. In a normal Zeeman effect, the sodium 422.6 nm line splits into three components separated by 0.025nm in a magnetic field of 3T. Calculate the value of specific charge of electron.
9. In Stern-Gerlach experiment silver atoms travel a distance of 0.1m in a non-homogeneous magnetic field of gradient 55 Tm⁻¹. If the velocity of silver atom is 450ms⁻¹. Calculate the separation between the 2 traces on the photographic plate. Given $\mu_B = 9.2 \times 10^{-24} \text{ JT}^{-1}$, mass of silver atom = $1.79 \times 10^{-25} \text{ kg}$.

10. The force constant of CO molecule is 187 Nm^{-1} . Find the frequency of vibration of CO molecule and spacing between the vibrational levels. Given mass of C = $1.99 \times 10^{-26} \text{ kg}$ and O = $2.66 \times 10^{-26} \text{ kg}$.
11. In an experimental study of Raman effect using mercury radiation of 546.1 nm, stokes of wavelength 554.6 nm was observed. Find Raman shift and wavelength corresponding to anti-stokes line.
12. A laser beam is focused on a surface area of 0.5 mm diameter. If the power of laser source is 5mW and wavelength is 6328 \AA . Calculate intensity of the photons emitted.

PART-C

III. Answer any FOUR questions out of SIX. Each question carries 2 marks.

(4X2=8)

13. Can principal quantum number be zero? Explain.
14. Atomic magnetic moments are measured in terms of Bohr magneton. Justify.
15. What is Stark effect?
16. Can there be a transition from $J=1$ to $J=3$ of rotational energy levels. Why?
17. Do homo nuclear diatomic molecules exhibit rotation or vibration spectra? Explain.
18. Why population inversion is necessary in a laser?
