

Mid-West University
Examinations Management Office
Surkhet, Nepal
End Semester Examinations -2078

Bachelor level/ B.Sc /5th Semester
Time: 3 hrs

Full Marks : 100
Pass Marks : 50

Subject : Physics of Atoms & Molecules Electromagnetism (PHY 453)

Candidates are required to give their answer in their own words as far as Practicable. The figures in the Margin indicate full marks.

Group – A

1. Answer in short any **EIGHT** questions [8x 2= 16]
- What property of electron produces spin angular momentum?
 - Define space quantization of electron.
 - State and explain Pauli's exclusion principle.
 - Why molecules show band spectrum? Explain.
 - Differentiate between L-S and j-j coupling.
 - Show that Raman Effect is a two-step process.
 - What special property produces the laser light during stimulated emission?
 - State selection rule for different quantum numbers.
 - Write short note on Stark effect.

Group – B

2. Answer in brief any **SIX** questions [6x6= 36]
- Define magnetic moment. Also express the magnetic moment in terms of angular moment. Signify the result.
 - State and explain Stern-Gerlach experiment.
 - Define fine and hyperfine structure of atom. Also explain the fine structure of hydrogen atom.
 - Define population inversion and optical pumping. Also explain about the working of four level lasers.
 - What is Zeeman Effect? Also discuss about anomalous Zeeman Effect.
 - State and proof the Mosley's laws.
 - Show that the vibrational energy levels are equally spaced.

---Group – C

3. Derive an expression about the total magnetic moment of an electron. [9]
4. What do you mean by X-ray spectra? Also discuss about continuous and characteristics X-ray spectra. [9]

OR

What is Raman Effect? Explain about the quantum theory of Raman Effect. Also discuss in brief about the significance of Raman Effect.

5. Determine the maximum separation of a beam of hydrogen atoms that moves a distance of 20 cm with a speed of 2×10^5 m/s perpendicular to a magnetic field whose gradient is 2×10^2 T/m. Neglect the magnetic moment of proton. (Given, $\mu_B = 9.27 \times 10^{-24}$ J/T, $m_p = 1.67 \times 10^{-27}$ kg) [6]
6. An atom in the state $^2P_{3/2}$ is located in an external magnetic field of 1.0 kg. In terms of vector model, find the angular velocity of precession of the total angular momentum of the atom. [6]
7. Find the wavelength of K_α line in Copper (Z = 29) if the wavelength of K_α line in iron is known to be 193 pm. [6]

OR

For hydrogen molecule the inter-nuclear distance is $0.74 \text{ \AA}$, mass of hydrogen atom is 1.6738×10^{-27} kg, calculate the rotational energy levels in electron volts.

8. An X-ray beam of wavelength $0.97 \text{ \AA}$ is obtained in the third order after reflection 60° from the crystal plane. Another beam is obtained in the first order after reflection at 30° from the same crystal plane. Find the wavelength of second X-ray beam. [6]
9. Consider an atom with electronic configuration $1s^2 2s^2 2p^1$ and find possible values of l, s & j. Also find the magnitude of angular momenta L, S & J. [6]

THE END