PG (CBCS) EVEN SEMESTER EXAMINATION, 2023

PHYSICS

4th Semester

Course No. : PHYCC - 401

(Atomic and Laser Physics)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

(Answer five questions, taking one from each unit)

UNIT - I

1. (a) State Larmor theorem. Deduce the expression for Larmor frequency. 2+4=6

   (b) Show that for finite mass of the nucleus Rydberg constant.

$$R_A = \frac{R_\infty}{1 + m/\,\mathrm{AM}_p}$$

   where A is the atomic weight and M_p is one-sixteenth mass of an oxygen atom. 4

   (c) The series limit of Balmer series of H-atom spectra is 3646 Å. Find the wavelengths of the third and fourthe line of Balmer series. 4

2. Describe Stern-Gerlach experiment and explain the significance of the results. 8+6=14

UNIT - II

3. (a) Define the spin-orbit interaction energy expression for a single valence electron. 10

   (b) Derive the expression for Doppler width of spectral line. 4

4. (a) What is hyperfine structure (hfs)? Describe the theory of Back-Goudsmit effect in hfs. 2+8=10

   (b) How does it differ from Zeeman effect of hfs? 4

UNIT - III

5. (a) State and explain the selection and intensity rules of doublet fine structure. 8

   (b) Determine the intensity ratio of ^2S - ^2P and ^2P - ^2D transitions. 6

6. (a) Explain with illustration Lande internal rule for triplets under L-S coupling. 6

   (b) Find out the spectral terms for pp and p^2 electronic configrations under L-S coupling.

Why are the terms not same in both the configuration? 6+2=8

UNIT - IV

7. (a) Explain the Paschen-Back effect using vector atom model and derive the expression for energy shift. 10

   (b) Point out some basic differences between Paschen Back and Zeeman effects. 4

8. Explain Hartree's SCF method for many electron atom. How is the total energy calculated by this method. 9+5=14

UNIT - V

9. (a) Using detailed energy level diagram of a He-Ne laser explain its working principle. 10

   (b) What are the basic criteria of lasing? 4

10. (a) Write the basic properties of laser beam. 2

    (b) Define Einstein A and B co-efficients. Derive the relations between A and B (Einstein relations). 6+6=12

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