PG Even Semester (CBCS) Exam., May—2018

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, selecting **one** from each Unit

UNIT—I

1. *(a)* Calculate the wavelength difference between the first Balmer line of hydrogen atom and that of deuterium. Given R 109737 cm $^{-1}$. — 5

   (b) Explain Stern-Gerlach experiment and discuss the importance of the results obtained. — 9

2. *(a)* Explain Sommerfeld's elliptical model. Discuss whether this model could explain the fine structure of hydrogen spectral line. — 12

   (b) How many different wavelengths would appear in the spectrum of hydrogen atom initially in the n 5 state? — 2

UNIT—II

3. *(a)* Calculate the spin-orbit interaction energy for a single non-penetrating valence electron. — 10

   (b) Two levels in an atom, whose nuclear spin is 3, have the designations $^2D_{3/2}$ and $^2P_{1/2}$. Find the expected number of components in the hyperfine structure of the corresponding spectral line. — 4

4. *(a)* Describe the theory of Back-Goudsmit effect and show how it leads to the determination of nuclear spin. — 10

   (b) Explain Lamb shift. — 4

(3)

UNIT—III

5. Find out the spectral terms for the dd and d^2 electronic configurations under L-S coupling. Comment why the terms for these two electronic configurations are not same.

12+2=14

6. (a) Discuss Landé interval rule. 4

(b) What are normal and inverted multiplets? 2

(c) Describe the salient features of spectra of alkali atoms. 8

UNIT—IV

7. Explain Hartree's SCF method. How is the total energy of an atom calculated by this method? Write its limitations. 9+3+2=14

8. (a) What is Stark effect? Discuss the weak-field Stark effect in hydrogen. 2+6=8

(b) Discuss the Zeeman pattern of a line due to $^2D_{3/2}$ $^2P_{1/2}$ transition. 6

(4)

UNIT—V

9. Write short notes on the following : 7×2=14

(a) 3-level laser

(b) Optical resonators

10. (a) What are the characteristics of laser light? 2

(b) Discuss briefly the applications of lasers. 4

(c) Discuss the working principle of a semiconducting laser. 8

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