

PG Even Semester (CBCS) Exam., May—2017

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) What is spatial quantization? Draw the space quantization diagram for the orbit with $l = 3$. 3
- (b) Discuss unquantized states and origin of continuous spectra in H-atom. 5
- (c) Derive the quantum condition $\frac{k}{n} = \frac{b}{a}$ of Sommerfeld elliptical orbits. 6

2. (a) Calculate the wavelength difference between the first Balmer line of hydrogen and that of tritium. Given,
 $R = 109737 \text{ cm}^{-1}$. 7
- (b) Using Bohr's model, considering infinite nuclear mass, explain the hydrogen line spectra. Also discuss the effect of finite nuclear mass on the hydrogen line spectra. 7

UNIT—II

3. (a) Derive the expression for spin-orbit interaction energy. Illustrate and compare the results of spin-orbit interaction for 2P , 2D and 2F states. 7+3+2=12
- (b) What is Lamb shift? 2
4. (a) What is hyperfine structure of atomic spectral lines? Discuss the Beck-Goudsmit effect in hyperfine structure. 2+10=12
- (b) Find the components in hyperfine structure of $^2D_{5/2}$, when $I = 9/2$. 2

(3)

UNIT—III

5. (a) Derive the spectral terms for p^3 and p^4 electronic configuration under LS coupling. 10
- (b) Find the spectral terms for sp -configuration under jj coupling scheme. 4
6. (a) Describe the salient features of alkali spectra. 5
- (b) State Lande interval rule. Illustrate the rule for a 3D term. Does the rule apply to both LS and jj coupling scheme? $3+4+2=9$

UNIT—IV

7. (a) Distinguish between Zeeman and Paschen-Back effect. 4
- (b) Explain the anomalous Zeeman effect considering $^2P_{3/2}$ $^2S_{1/2}$ transition as an example. $6+2=8$
- (c) What is Moseley's law? 2
8. What is Stark effect? Explain the weak field Stark effect in hydrogen atom using the classical vector model. How does it differ from strong field Stark effect (in hydrogen)? $2+8+4=14$

(4)

UNIT—V

9. Write short notes on any *two* of the following : $7 \times 2 = 14$
- (a) Applications of lasers
- (b) Free electron laser
- (c) He-Ne Laser
10. (a) What are Einstein A and B coefficients? Derive Einstein relation (relation between A and B). 7
- (b) Explain with suitable diagram the working principle of 3-level and 4-level lasers. 7
