5 SEM TDC PHY M 3

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(November)

PHYSICS

(Major)

Course : 503

(**Atomic and Molecular Physics**)

Full Marks : 60

Pass Marks : 24

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Answer the following as directed :   1×5=5

   (a) What are the three magnetic quantum numbers required to explain the splitting of spectral lines in a magnetic field?

   (b) Stimulated emission and spontaneous emission, both are essential for laser action.

                                (State true or false)

   (c) Zeeman effect is only a weak field effect.

                                (State true or false)

(d) Write two drawbacks of Sommerfeld's atom model.

(e) Write two examples of solid laser.

2. Answer any *five* of the following : 2×5=10

(a) Explain the terms stimulated emission and spontaneous emission.

(b) The term symbol for a particular state is $^2P_{3/2}$. What are the values of l, s and j?

(c) Distinguish between Stokes and anti-Stokes lines.

(d) How is He-Ne laser superior to a ruby laser?

(e) Define Larmor precession.

(f) Find the wavelength of spectral line corresponding to a transition in hydrogen atom from $n = 4$ state to $n = 2$ state.

(g) Describe Stern-Gerlach experiment.

3. State the modifications introduced by Sommerfeld in Bohr's atomic model.

Or

Describe the different types of coupling in atom.

4. What do you mean by fine structure of spectral lines? Discuss the fine structure of H_α-line. 2+4=6

5. Describe the experimental arrangement for studying the Zeeman effect. Discuss the Zeeman pattern of sodium D-lines. 4+3=7

Or

Describe an expression for Lande's splitting factor. Distinguish between normal and anomalous Zeeman effect. 4+3=7

6. Explain the vibration-rotation spectrum. What are P and R branches? 4+3=7

Or

What is Raman effect? Describe the classical theory of Raman effect. 2+5=7

7. Describe the theory and construction of ruby laser. Write down two main features of ruby laser. 5+2=7

Or

(a) Discuss the essential requirements for producing a laser action. 2

(b) Why is two-level system not appropriate for laser action? What is the importance of metastable state? 1+2=3

(c) What do you mean by pumping process? How many types of pumping processes are employed? 2

8. Write short notes on (any *four*) : 3×4=12

    (a) Einstein's coefficients

    (b) Gyromagnetic ratio

    (c) Ammonia beam maser

    (d) Vector atom model

    (e) Bohr's correspondence principle

    (f) Lande's *g*-factor

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