

**5 SEM TDC PHY M 3**

**2 0 1 4**

( 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 :  $2 \times 5 = 10$

(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.

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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  $H_{\alpha}$ -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

( 4 )

- (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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