

GSQ/D-21

1069

PHYSICS

(Quantum and Laser Physics)

Paper-IX

Group No. : PH-501

Time : Three Hours]

[Maximum Marks : 40

Note : Attempt *five* questions in all, Question no 1 is Compulsory. Select *one* question from each unit. All questions carry equal marks. Non-programmable calculator is allowed.

Compulsory Question

1. (a) Calculate the de-Broglie wavelength for 28.8 eV neutron of mass 1.67×10^{-27} kg. (2)
- (b) What is zero point energy of an harmonic oscillator ? (2)
- (c) What is coherent length in laser ? (2)
- (d) What do you mean by spiking of laser ? (2)

UNIT-I

2. (a) What are de-Broglie waves? Develop expression for de-Broglie wavelength of particle. (4)
- (b) Calculate the size of the atom with the help of Heisenberg's uncertainty principle. (4)
3. (a) Define the terms group and phase velocity. What is relation between them. (4)

- (b) Develop time independent Schrödinger wave equation for a non-relativistic particle. (4)

UNIT-II

4. Write down Schrödinger wave equation for a free particle inside a rigid wall of infinite potentials. Find out its eigen values and functions. Plot the normalized wave function for first two energy levels. (8)
5. What is tunneling through a barrier? Derive an expression for reflection and transmission through a barrier when $E > V_0$. (8)

UNIT-III

6. (a) Explain the concept of temporal coherence and monochromaticity for laser. (5)
- (b) For an ordinary source, coherence time is 10^{-10} s. Find out the degree of non-monochromaticity $\lambda_0 = 6000 \text{ \AA}$. (3)
7. Derive Fuchbauer-Landenburg formula connecting absorption coefficient with energy level of population. (8)

UNIT-IV

8. Discuss with a suitable diagrams the principle, construction and working of a He-Ne gas laser. (8)
9. Describe with the help of suitable diagrams the main features and condition of lasing action of a semiconductor. (8)