

Roll No.

(09/23-II)

5237

B. Sc. EXAMINATION

(Fifth Semester)

PHYSICS

PH-501

Quantum and Laser Physics

Time : Three Hours

Maximum Marks : 40

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. 1 is compulsory. All questions carry equal marks.

1. (a) Define matter waves. 2
- (b) What conditions a wave function must satisfy ? 2
- (c) What is meant by penetration depth ? 1

- (d) What is the need of resonance condition for laser action ? 2
- (e) Which type of pumping is used in He-Ne Laser ? 1

Unit I

2. (a) What are de Broglie waves ? Give an expression for de-Broglie wavelength of a particle in terms of its Kinetic energy. 4
- (b) Derive zero point energy of Linear Harmonic oscillator using Heisenberg's uncertainty principle. 4
3. (a) Derive three dimensional time independent Schrödinger wave equation. 4
- (b) Prove that two eigen functions corresponding to two different energy eigen values are orthogonal to each other. 4

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Unit II

4. Define step potential. Derive reflection and transmission coefficient for $E < V_0$ using Schrödinger's ~~wave~~ equation. Prove that $T + R = 1$. 8
5. Define one dimensional Potential barrier. Derive reflection and transmission coefficient and explain phenomena of transmission for $E > V_0$. 8

Unit III

6. (a) Explain ^{Directionality} and monochromaticity of laser. 5
- (b) Find the intensity of laser beam of 10 mW and diameter 2.5 mm. Assume that the intensity to be uniform throughout the beam. 3
7. (a) Differentiate between homogeneous and non-homogeneous broadening. Explain natural broadening. 4

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- b) Calculate the coherence length of a laser beam having band width $\Delta\nu = 2500$ Hz. 4

Unit IV

8. Explain Principle, construction and working of He-Ne Laser with energy level diagram. 8
9. (a) What are the main features of semiconductor laser? Explain its construction and working. 6
- (b) Give some applications of laser in industry. 2

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