

Roll No.

(01/22-II)

5237

B.Sc. EXAMINATION

(Fifth Semester)

PHYSICS

PH-501

Quantum and Laser Physics

Time : Three Hours

Maximum Marks : 40

Note : There are nine questions in total. Q. No. 1 is compulsory and have four parts of 2 marks each. *Four* more questions are to be attempted, selecting *one* question out of two questions set from each Unit. Use of scientific (non-programmable) calculator is allowed.

1. (a) Define quantization of energy and momentum. 2
- (b) Define orthogonality and normalization

- of function. 2
- (c) Describe population inversion and laser pumping. 2
- (d) Describe optical properties of semiconductor. 2

Unit I

2. (a) Define de-Broglie Hypothesis. Explain the Davisson and Germer experiment with conclusion. 6
- (b) Calculate de-Broglie wavelength of thermal neutrons at 27°C . 2
3. (a) Explain diffraction of a beam of electrons by a slit. 5
- (b) Explain the non-existence of the electron inside the nucleus with the help of uncertainty principle. 3

Unit II

4. Find the solution of Schrödinger equation for harmonic oscillator. Write wave equation for ground state and excited states. Explain zero point energy. 8
5. (a) Discuss the solution of Schrödinger wave equation and find the reflection and transmission coefficient in case of one-dimensional step potential $E > 0$. 6
- (b) Find the lowest energy state of an electron confined in a cubical box of side 1 \AA . 2

Unit III

6. (a) Discuss Einstein's coefficients, and the possibility of light amplification. 6
- (b) Calculate the coherence length of a laser beam for which bandwidth $\Delta\nu = 3000 \text{ Hz}$. 2

7. Explain the threshold condition for laser emission, line broadening mechanism, homogeneous and inhomogeneous line broadening. 8

Unit IV

8. Discuss the principle, construction and working of semiconductor laser. 8
9. Discuss the principle, construction and working of Ruby laser. 8