Roll No. .....

(12/24)

5237

B. Sc. EXAMINATION

(Fifth Semester)

(For Batch 2011 & Onwards)

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. Scientific calculator is allowed for numerical calculations.

1. (a) What do you mean by wave-particle duality ? 1

   (b) Comment on zero point energy. 2

(c) Define penetration and tunneling coefficients. 1

(d) Differentiate between meta stable states and excited states. 2

(e) Differentiate between spatial and temporal coherence. 2

Unit I

2. (a) Find the expectation value of the position and momentum of a particle whose normalized wave function is $\psi(x) = Ne^{-(x^2/a^2)-ikx}$. 4

(b) Describe de-Broglie matter waves and establish the correspondence between particle concepts and wave concepts. 4

3. (a) What do you mean by group velocity and phase velocity ? Derive the relation between them. 5

(b) Calculate the stopping potential for the photo electrons emitted by a gold cathode for wavelength 9.7×10^{-6} m and work function of gold is 4.78 eV. 3

Unit II

4. (a) Apply Schrödinger equation to one dimensional linear harmonic oscillator and obtain the recursion relation. 4

(b) Discuss the behaviour of a free particle in one dimensional box and show that eigen values are discrete. 4

5. Solve the Schrödinger equation for a particle having $E > V_0$ in a potential barrier and calculate reflection and transmission coefficients and give their significance also. 8

Unit III

6. Describe kinetics of optical absorption and prove that for a non-degenerate case absorption atomic cross section is equal to the emission atomic cross-section. 8

7. (a) What do you mean by line broadening mechanism and explain collision broadening with line shape function. 5

(b) For an ordinary source, the coherence time $\tau_c = 5 \times 10^{-9} s$. Calculate The degree of non-monochromaticity for wavelength of 500 nm. 3

Unit IV

8. What do you mean by solid state laser and explain the principle, construction and working of a Ruby laser ? 8

9. (a) Explain, how does a semiconductor laser differ from other lasers. Discuss the principle construction and working of semiconductor laser. 6

(b) Describe the role of laser in the field of medicine. 2