Exam.Code:0905
Sub. Code: 33259

2076
B.E., First Semester
ASP-X02: Quantum Physics
(Common with CSE, IT)

Time allowed: 3 Hours Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Section.

x-x-x

Question 1: Attempt *any five* of the following:-

(a) What is ultraviolet catastrophe? How it depicts the failure of classical physics.

(b) What are inertial and non inertial frames of reference?

(c) Is gravitational red shift apparent for most of the stars?

(d) Why a particle cannot be at rest in the infinitely deep potential well?

(e) Determine whether the wavefunction $\psi = Ne^{ax}$ is an eigenfunction of the momentum operator or not. If yes, find the corresponding eigen value.

(f) Find the probability of an energy level lying 0.02eV below Fermi level being occupied at 300 K.

(g) Find the total energy of an electron having momentum of 2 MeV/c. (5x2)

Section - A

Question 2:

(a) Using the postulates of special theory of relativity, obtain Lorentz transformations for space and time coordinates of an event.

(b) What was the theoretical background of the Michelson Morley experiment? How are the negative results of the experiment interpreted? (2x5)

Question 3:

(a) What is photoelectric effect? What are its important experimental findings? How Einstein explain these using Quantum theory of light.

(b) What are matter waves? Show that matter waves travel with the velocity of the body. Find the phase and group velocities of matter waves associated with an electron whose kinetic energy is 0.99c. (2x5)

P.T.O.

Question 4:

(a) Obtain the time independent form of Schrodinger equation from first principles What are the properties of a well behaved wave function?

(b) A particle is moving along x-direction and is described by a wavefunction $\psi(x) = Ae^{iax}$ in a region $0 \leq x \leq L$. Normalize the wavefunction and determine the probability of finding it in the region $0.45\ L \leq x \leq 0.55\ L$. (6,4)

Section - B

Question 5:

(a) Obtain the normalized wavefunction and energies for a particle trapped in a one dimensional infinitely rigid box of length L.

(b) By solving Schrodinger equation, find out the reflection and transmission coefficients for an electron incident on a potential step V_0, when energy of electron $E > V_0$. What happens when $E < V_0$? (2x5)

Question 6:

(a) How a quantum mechanical harmonic oscillator behaves differently from a classical oscillator. Also prove that harmonic oscillator problem is in accordance with correspondence principle.

(b) Discuss the variation of Fermi Dirac distribution function with temperature. (2x5)

Question 7:

(a) Give basic postulates of free electron theory and tell what modifications have been considered in Kronig Penney (K-P) Model to remove the failures of classical free electron theory. Also explain the formation of energy bands in solids using Kronig Penney Model.

(b) What is effective mass? How the effective mass of an electron varies with wave vector k. (6,4)

x-x-x