Exam.Code:0906
Sub. Code: 6211

2014

B.E. (Bio-Technology)

Second Semester

APH-203: Quantum and Statistical Physics

(Common with IT & CSE)

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 Part.

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Question 1: Attempt any five.

(a) What is the role of compensating plate in Michelson –Morley experiment?
(b) Why can't we observe Compton effect with visible light?
(c) Tell whether $\psi = e^{inx}$ is an eigenfunction corresponding to the operator d^2/dx^2 or not, where n=1,2,3... Find the corresponding eigen value.
(d) How quantum theory of hydrogen atom modified Bohr's orbital model?
(e) Differentiate between symmetric and antisymmetric wave functions.
(f) Explain the concept of zero point energy for a trapped particle using uncertainity principle.
(g) Calculate the number of different ways of arranging 6 fermions in 3 phase space cells. (5x2=10)

Part A

Question 2

(a) Explain the Einstein's concept of time dilation. Deduce the necessary relation. (4)
(b) A person observes an atom moving with a velocity of 0.5c. The atom then emits a β - particle which has a velocity 0.9 c relative to the atom in the direction of its motion. What is the velocity of the β - particle as observed by the person? (2)
(c) Derive expressions for space –time Lorentz transformation equations. Show that under certain conditions, these equations become identical with Galilean transformation. (4)

Question 3

(a) Explain the energy distribution of energy in a blackbody spectrum. Give an account of the attempts made through various laws to explain the spectrum. (5)
(b) What were the various experimental observations of Photoelectric effect which could not be explained on the basis of classical theory of light? How did Einstein explain this phenomenon? (5)

Question 4

(a) Show that matter waves travel with the velocity of the particle with which it is associated. (4)
(b) Calculate the debroglie wavelength of a proton whose energy is 12.8 MeV (m_n= 1.67 x 10^{-27} kg). (2)
(c) Establish the time independent form of Schrodinger equation in operator form. (4)

Part B

Question 5

(a) Using Schrodinger equation, find out the normalized wave function for a particle confined to move along x axis in an infinitely rigid box of length L. Consider an electron in an infinitely rigid box of width 20 pico meter. Find the first excited energies of electron in eV. (5)
(b) What is the difference between a quantum and classical harmonic oscillator? Show that harmonic oscillator problem is in accordance with correspondence principle. (5)

Question 6

(a) Describe Stern Gerlach experiment, giving the importance of the results. (5)
(b) What do you mean by spin orbit coupling? Show that magnetic moment due to spin motion of electron is always one Bohr magneton. (5)

Question 7

(a) Discuss the contribution of electrons in the specific heat of solids. (3)
(b) In copper there is on e free electron per atom. Calculate the Fermi energy of free electrons in copper. Given: atomic weight of Cu= 63.5 g/mol: density of Cu= 8.94 g/cm^3. (2)
(c) Treating ideal gas as a system governed by classical statistics, derive the Maxwell Boltzmann distribution of molecular speeds. (5)

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