Exam.Code:0905
Sub. Code: 6638

2031

B.E. (Bio-Technology) First Semester

ASP-X02: Quantum Physics

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 Unit.*

x-x-x

I. Answer the following briefly:-

a) Differentiate between Gravitational red shift and Doppler red shift.

b) Define Fermi energy. Write down the expression for Fermi-Dirac distribution function.

c) Explain the phenomenon of ultraviolet catastrophe according to the classical theory of black body radiation spectrum.

d) What are stationary states in quantum mechanics? Explain whether stationary means static in quantum mechanics.

e) What do you mean by Hermitian operator? Explain why it is necessary that operators associated with physical quantities to be Hermitian. (5x2)

UNIT - I

II. a) Calculate the fractional increase in wavelength that leads to 80 % loss of photon energy in a Compton collision.

b) Describe the Michelson-Morley experiment and explain the physical significance of negative results. (2x5)

III. a) Explain with the help of diagram how the wave nature of matter was tested by Davisson and Germer.

b) Two rockets A and B are traveling to the right and left with velocities of 0.8c and 0.6c respectively as observed by an observer on earth. What is the velocity of rocket A relative to rocket B? (2x5)

IV. a) Explain with the help of examples that how the process of measurement disturbs the system being measured.

b) Starting from Schrodinger time dependent wave equation in a potential which is independent of time obtain a time-independent Schrodinger equation. (2x5)

P.T.O.

UNIT - II

V. Discuss the Kronig-Penney model for the motion of electrons in a periodic potential. Show from E-k graph that the materials can be classified into conductors, insulators and semiconductors. (10)

VI. a) What are the basic assumptions used in classical theory of metallic conduction put forth by Drude. Explain up to what extent they succeed or fail to describe the observed phenomena.

b) A particle with mass m is in infinite square well potential with walls at x = -L/2 and x = + L/2. Obtain the wave function for the particle in ground state and first excited state. (2x5)

VII. Calculate the transmission probability of a particle of total energy E in the region $x < 0$ which is incident upon the barrier in the direction of increasing x. The barrier potential can be written as

$$V(x) = V_0 \qquad 0 < x < a$$
$$= 0 \qquad x<0 \text{ or } x>a$$

Consider the case with $E < V_0$. (10)

x-x-x