END TERM EXAMINATION

SECOND SEMESTER [B.TECH] JUNE 2024

Paper Code: BS-106 **Subject: Applied Physics-II**

Time: 3 Hours **Maximum Marks: 60**

Note: Attempt five questions in all including Q.No.1 which is compulsory. Select one question from each unit. Assume missing data.

Q1 Answer the following questions: - **(4x5=20)**
- a) Explain how the wave nature of particles give rise to uncertainty principle.
- b) For an electron in one- dimensional box of width 2 A°· calculate the separation between the lowest two levels in eV.
- c) A Bose-Einstein gas has two particles in the ith state whose degeneracy is three. Find the number of independent ways of selecting the particle in the state.
- d) Draw sketch illustrating (011), (123), (111) and (001) planes in cubic unit cell.
- e) What are Brillouin zones?

UNIT-I

Q2 a) What do you mean by the dual nature of matter and wave? Describe an experiment to support it. **(5)**

b) Set up Schrodinger equation for a free quantum particle. Discuss the properties of wave function. **(3)**

c) Calculate the expectation value $<p_x>$ of the momentum of a particle trapped inside a one-dimensional box. **(2)**

Q3 a) What is potential barrier and tunnel effect? Calculate the transmission probability for rectangular barrier for the condition of $E < V_0$, where E is the total energy of the particle. **(7)**

b) A particle constrained to move along the x-axis is described by the wave function
$\Psi(x) = 2x$ $0 < x < 1$
$= 0$ elsewhere
Calculate the probability of finding the particle within the interval (0, 0 , 4). **(3)**

UNIT-II

Q4 a) Distinguish between quantum and classical statistics. **(3)**

b) How many photons are present in 100 cm³ of radiation in thermal equilibrium at 1000 K.? **(3)**

c) Which type of statistics shall be applicable for a gas of (i) photons, (ii) electrons? Justify your answer. **(4)**

Q5 a) Show that the Fermi energy E_F of electrons in a metal at T = 0 is given by,

$$E_F = \frac{h^2}{2m}\left(\frac{3n}{8h}\right)^{\frac{2}{3}}$$

where symbols have their usual meanings. **(6)**

b) Fermi energy for Gold is 5.54 eV. Calculate the Fermi temperature, given Boltz's man constant $1.38 \times 10^{-3} JK^{-1}$. **(2)**

c) How white/black dwarfs explain the concept of dying star? **(2)**

UNIT-III

Q6 a) Find the Miller indices of a plane that makes an intercept of 3A°, 4A° and 5A° on the coordinate axes of an orthorhombic crystal with a: b: c = 1: 2: 5. Find the equation of the plane. **(6)**

b) Using Bragg's equation, argue that greater is the angle of diffraction, greater is the accuracy in determining the lattice parameter. **(4)**

Q7 a) Differentiate the term amorphous and crystalline and amorphous solids. Write down seven crystal system with their lattice parameters. **(3)**

b) Show that the number of Frenkel defects in equilibrium at a given temperature is proportional to $(NN_i)^{1/2}$ where N be number of atoms and Ni be the interstitial atoms. **(5)**

c) If X- rays of wavelength 0.5A° are diffracted at an angle of 5° in the first order, what is the spacing between the adjacent planes of the crystal? At what angle will second maximum occur? **(2)**

UNIT-IV

Q8 a) What are Bloch functions? Explain the origin of allowed and forbidden energy bands for electrons in solids. What is the number of orbitals in an energy bands? https://www.ggsipuonline.com **(6)**

b) In an intrinsic semiconductor (Eg = 0.676 eV), m_e= 0.09 m and m_h= 0.36 m. Calculate the concentration of intrinsic charge careers at 300 K. **(2)**

c) What do you understand by effective mass of an electron? Explain its significance. **(2)**

Q9 Write short note on **(2x5=10)**
a) Zener Breakdown
b) Tunnel diode
c) LED
d) Fermi energy
e) PN-Junction diode