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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 $\langle p_x \rangle$ 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

$\Psi(x) = 2x \quad 0<x<1$

$= 0$ 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 cm^3 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)**

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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 $(NNi)^{1/2}$ 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

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