END TERM EXAMINATION

SECOND SEMESTER [B.TECH] JULY 2023

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

Time: 3 Hours ***Maximum Marks: 75***

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

Q1 Answer the following questions:- **(3x5=15)**

(a) An eigen function of an operator $\frac{d^2}{dx^2}$, *is* $\Psi = e^{ax}$. Find the corresponding Eigen value.

(b) Show that Wien's law is a special case of Planck's radiation law.

(c) Lattice constant of a cubic lattice is 'a'. Calculate spacing between (011), (101), (112), (111) and (100) planes.

(d) Explain why semiconductor acts as insulator at 0K?

(e) The wave function of a particle is $\Psi = A\cos^2 x \; for \; interval - \pi/2$. Find the value of A.

UNIT-I

Q2 (a) What do you mean by particle in a box? Show that the energy of an electron in the box varied as the square of the natural numbers. **(3+7=10)**

(b) Prove quantum mechanically that particle will not exist in a box if its energy is zero. **(3)**

(c) Differentiate between $\Psi \; and \; |\Psi^2|$ **(2)**

Q3 (a) Distinguish between phase and group velocity. Show that the de-Broglie wave group associated with moving particle travels with same velocity as the particle. **(3+7=10)**

(b) What is the physical significance of wave function? **(3)**

(c) The particle trapped in one dimensional box of length L is described by a wave function Ψ= x. Normalise the wave function between a and b. **(2)**

UNIT-II

Q4 (a) State Planck's formula for Black body radiation and derive it from BE statistics. **(8)**

(b) If the Sun has a surface temperature of 5700K, what is the wavelength of maximum intensity of solar radiation? **(4)**

(c) Define Stefan's law. **(3)**

Q5 (a) An electron gas obeys the Maxwell-Boltzman statistics. Calculate average thermal energy (in eV) of an electron in the system at 300 K. **(4)**

(b) Distinguish between a Boson and Fermions. **(3)**

(c) What is the relative population of the first two single particle energy levels of a system of distinguishable particles if the energies of the levels is $\epsilon_0 = 0 \; and \; \epsilon_1 = kT$? **(4)**

(d) Discuss the Fermi-Direct distribution with the help of the distribution function; explain the concept of Fermi level and Fermi energy. **(4)**

P.T.O.

UNIT-III

Q6 (a) Why do we use X-ray to study crystal structure? **(3)**
(b) State Bragg's law? How is it applied? **(3)**
(c) Write short notes on: **(9)**

i. Point defects
ii. Frenkel defects
iii. Schottky defects

Q7 (a) Define the following:- **(2+2+2+2=8)**
(i) Unit Cell
(ii) Space Lattice
(iii) Coordiante number
(iv) Miller indices

(b) Deduce Miller indices for the plane having intercepts a, b and c at -2, ∞, -2. Also draw the plane. **(4)**

(c) X- rays of wavelength 2 $x10^{-11}$ m suffer first order reflection from (111) crystal plane at an angle of 45^0. What is the inter atomic spacing of the crystal? **(3)**

UNIT-IV

Q8 (a) Distinguish between intrinsic and extrinsic semiconductors. **(4)**
(b) Explain Kronig-Penney model for the motion of electron in a periodic potential. **(7)**
(c) Differentiate conductor, insulator and semiconductor using energy-band diagram. **(4)**

Q9 (a) Show that the Fermi energy lies midway between the conduction band and valence band for intrinsic semiconductor. **(6)**
(b) Write short notes on:- **(3+3+3=9)**
(i) Zener diode
(ii) PN junction diode
(iii) Photodiode

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