

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 Ψ 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 $\Psi = x$. 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)

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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) Coordinante 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 2×10^{-11} m suffer first order reflection from (111) crystal plane at an angle of 45° . 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
