August/September 2022

B.Tech.- II SEMESTER

B.Tech(CSE(AIML)/CE/CE(DS)/CSE/IT/CE(DS)/CSE)

Physics (Semiconductor Physics) (BSC-101D/BSCH-101D)

Time: 3 Hours **Max. Marks:75**

Instructions
1. *It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.*
2. *Answer any four questions from Part -B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*
4. *The candidate is required to attempt the question paper in the language as per his/her medium of instructions.*

PART -A

Q1 (a) What are the basic assumptions of classical free electron theory? (1.5)

(b) Explain density of state. Write its applications. (1.5)

(c) Distinguish Direct and indirect bandgaps semiconductors. (1.5)

(d) What is Fermi level and Fermi energy? (1.5)

(e) What is meant by effective mass of electron? (1.5)

(f) What is hall mobility? (1.5)

(g) Explain the Quantum wells, wires, and dots. (1.5)

(h) Define Photovoltaic effect and write its applications. (1.5)

(i) Distinguish Ohmic and Schottky contacts. (1.5)

(j) What is the physical significance of E-K diagram? (1.5)

PART -B

Q2 (a) Derive an expression for density of energy states. Obtain an expression for Fermi energy in metals at $T = 0$ K. (10)

(b) In a solid, consider the energy level lying 0.01 eV below Fermi level. What is the probability of this level not being occupied by an electron? (5)

Q3 (a) Explain formation of energy bands in solids on the basis of band theory of solids. (5)

(b) Write any two techniques of synthesis and characterization of quantum dots. (10)

Q4 Define energy level and energy band. Explain with proper diagrams, how on the basis of band theory, solids are classified as conductors, insulators and semiconductors. (15)

Q5 (a) How to measure the band gap of a semiconductor through UV-Vis spectroscopy? (5)

(b) Explain the 'Kronig-Penny' model of solids and show that it leads to energy band siructure of solids. (10)

Q6 (a) Draw the Density of states curve for 2D, 1d and 0D dimensions and also give examples of 2D, 1d and 0D structures. (10)

(b) Find the temperature at which there is 1% probability that a state with energy 2 eV is occupied. Given that Fermi energy is 1.5 eV. (5)

Q7 Explain in details the Four-point probe and vander Pauw methos to measure the resistivity of semiconductor materials with formulas and diagrams. Also write the merits and demerits of both methods. (15)

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