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Total No. of Pages : 02

Total No. of Questions : 18

B.Tech. Only for CSE/IT (2018 Batch) (Sem.–1)

SEMI-CONDUCTOR PHYSICS

Subject Code : BTPH-104-18

Paper ID : [75360]

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION - B & C. have FOUR questions each.**
3. **Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.**
4. **Select atleast TWO questions from SECTION - B & C.**

SECTION-A

Write briefly :

1. Draw the density of states, g(E) vs E diagram for 2-D and 3-D systems.
2. Differentiate between metals, semiconductors and insulators. Also draw the band diagrams for each.
3. Briefly explain : "*For LED applications we need direct band gap materials*".
4. Briefly explain : "*Semiconductors have higher mobility as compared with metals*".
5. List 4 direct bandgap semiconductors and their main applications.
6. What are photovoltaic devices?
7. List main features of Kronig-Penny model.
8. What is Hall effect?
9. Briefly explain : "*Contact resistance becomes significant for semiconductors*".
10. Draw the schematic for the hot-point probe measurement and briefly explain its basic principle.

SECTION-B

11. Explain in detail (with diagrams) the origin of the bandgap in solids using the Bloch's theorem for particles in periodic potential. (8)

12. Determine the value of Fermi temperature, Fermi velocity, Fermi momentum and electrical conductivity for Sodium (Fermi energy, E_F = 3.1 eV, Electron density, n= $2.5 \times 10^{28}/m^3$, mobility, $\mu = 5.8 \times 10^{-3}$ m^2/Vs). (e = 1.6×10^{-19} C, electron mass, m = 9.1×10^{-31} kg, 1 eV = 1.6×10^{-19} J Boltzmann constant, k = 1.3808×10^{-23} J/K) (8)

13. Explain (with diagrams) the origin of depletion region and built in potential for a p-n junction diode. Give the expressions for the built-in potential and depletion region width. Also sketch the variation of the electric field and charge density across the barrier region. (8)

14. a) Explain the difference in recombination process in direct and indirect band gap semiconductors. And explain its effect on the charge carrier life time and luminescent properties for a semiconductor.

    b) Differentiate between ohmic contact and schottky junction for metal- semiconductor junction. (5 + 3)

SECTION-C

15. a) Explain (using suitable diagrams) various possible absorption transitions in a semiconductor.

    b) List and briefly explain salient features of a semiconductor laser. (4 + 4)

16. a) Write short notes on :

    i) Phonon density of states

    ii) Excitons

    b) Briefly explain the concept of population inversion and its significance for lasers. (3 × 2 + 2)

17. a) List and briefly explain (with suitable diagram) one method for determination of :

    i) Resistivity for a semiconductor.

    ii) Sign of charge carrier in a semiconductor.

    b) List various parameters which can be extracted from l-V curve for a diode. (3 × 2 + 2)

18. a) Explain the origin of capacitance in a p-n junction. Briefly explain the parameters which can be determined from the capacitance measurement of a p-n junction.

    b) Compare van der Paw method with 4-probe method for resistivity measurement.(5 + 3)