

18A9

B. Tech. EXAMINATION, 2021

(First Semester)

(C Scheme) (Main & Re-appear)

CSE

PHY109C

SEMICONDUCTOR PHYSICS

Time : 2½ Hours]

[Maximum Marks : 75

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt *Four* questions in all. All questions carry equal marks.

1. (a) Considering a solid with infinite rows of rectangular potential wells separated by barrier of width b , discuss the origin of band in it.
(b) Explain the concept of negative effective mass in semiconductor using energy band of solids.
2. (a) Prove that in one dimension the average kinetic energy of the electron is one-third of Fermi energy.
(b) Show that the sum of occupancy probabilities of two states, whose energies are equally spaced above and below the Fermi energy level, is unity.
(c) Differentiate between direct and indirect semiconductor.
3. (a) Prove that the carrier concentration of electron in conduction band for n -type of semiconductor depends upon the ionization energy of the donor atom.

- (b) Discuss, how barrier height is determined in Schottky metal semiconductor contact ?
4. (a) In direct recombination the minority carriers recombine with majority carriers and decays exponentially with time constant τ_p . Justify.
- (b) Mobility's of electron and holes in a sample of intrinsic germanium at 300K are $0.36 \text{ m}^2\text{V}^{-1}\text{s}^{-1}$ and $0.17 \text{ m}^2\text{V}^{-1}\text{s}^{-1}$ respectively. If the conductivity of the specimen is $2.12 \Omega^{-1}\text{m}^{-1}$, determine the forbidden energy gap of the material.
5. (a) Prove that the transition rate between two energy states is proportional to the square of the matrix element of perturbation connecting these states.
- (b) Discuss the various types of bound state of an electron and an electron hole, which is a electrically neutral quasiparticle, that occur in semiconductor.
6. (a) Derive the expression of joint density of states in semiconductor. How is singularity of joint density of states obtained ?
- (b) Discuss the factors on which the ratio of spontaneous and stimulated emission depends.
7. (a) Prove that the total density of states of quantum well is in the form of step function.
- (b) Explain how UV-Spectroscopy can be used to determine optical bandgap of a semiconductor.
8. (a) Discuss, how hot-point probe method can be used to differentiate between n -type and p -type of semiconductor.
- (b) Compare the van der Pauw measurement method and four-point probe method to determine resistivity of the material.
9. (a) Differentiate between photon and phonons.
- (b) Photovoltaic effect can be used to store energy. Justify.

- (c) Determine the relationship between diffusion coefficient and mobility of charge carrier in a semiconductor.
- (d) How are pn -junction and metal semiconductor junction different from each other ?
- (e) Explain an experimental technique used to study the surface topography and crystallography of low dimensional system.
- (f) Discuss the band alignment in pn , nn and pp heterojunctions under thermal equilibrium.