Q1. Distinguish between direct and indirect bad-gap semiconductors with the aid of band diagrams. (4)

Q2. Discuss LCAO model for constructing the band diagram for a two-atom material. (3)

Q3. What is Fermi distribution function for electrons and describe how it varies with respect to temperature. (3)

Q4. Hall measurements are made on p-type semiconductor of 500 μm wide and 20 μm thick. The Hall contacts are displaced 2 μm with respect to each other in the direction of the current of 3 μA. The voltage between the Hall contacts with a magnetic field 10 KG pointing out of the plane of the sample is 3.2 mV. When the magnetic field is reversed, the voltage changes to -2.8 mV. What is the hole concentration and mobility? (4)

Q5. What is the effect of high electric fields on electrons? (3)

Q6. How long does it take an average electron to drift 1μm in pure Si at an electric field of 100V / cm? Compare it with the result when electric field is 10^5 V/cm. (3)

Q7. Let 10^{13} Electron hole pairs/Cm^3 are created optically every microsecond in Si sample with $n_o = 10^{14}$ and /cm^3 and $\tau_n = \tau_p = 2$ μSec. Calculate minority charge carrier density from equilibrium to steady-state condition. Calculate the energy separation from intrinsic Fermi –level to electron Quasi Fermi level. (4)

Q8. Describe an experiment for measuring the effect of recombination and trapping on carrier generation, upon the optical excitation of semiconductor. (4)

Q9. What are the factors that are to be considered for choosing a photoconductor for an application? (2)

Q10. in a very long p-type Si bar with the cross-sectional area 0.5 cm^2 and $N_a = 10^{17}$ / cm^3, we inject holes such that the steady state hole concentration is 5×10^{16} / cm^3 at x = 0. What is steady state separation between F_p and E_I at x = 1000 Å ? What is the hole current there? How much is the excess stored hole charge. Let $\mu_p = 500$ cm^2/ V-S and $\tau_p = 10^{-10}$ Sec. (4)

Q11. Describe an experiment to minority charge carrier parameters such as mobility and diffusion constant. (3)

Q12. Explain the effects caused by the gradients in the quasi-Fermi levels. (3)

Q13. An abrupt Si P-N junction has $N_a = 10^{18}$ /cm^3 on one side $N_d = 5 \times 10^{15}$ /cm^3 on other side. (3)

i) Calculate the Fermi level positions at 300K in the p- and n-regions.
ii) Draw an equilibrium band diagram for the junction and calculate contact potential.

Q14. Describe variation Quasi -fermi levels in forward and also reverse bias PN junctions. (5)

Q15. Describe majority and minority charge carrier currents in forward biased PN Junction. (2)