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GOVERNMENT COLLEGE OF ENGINEERING, KANNUR.

Department of Electronics and Communication Engineering

Third Semester First Series (Retest) Examination November- 2022 (2019 Scheme)

Course code: ECT201

Course Name: SOLID STATE DEVICES

Max. Marks: 50 Duration: 90 Minutes

PART A

Answer all questions. Each question Carries 3 marks

1. What is a hole? Explain? (3 Marks)
2. How will you classify materials and on what basis? (3 Marks)
3. What is space charge neutrality equation? Explain. (3 Marks)
4. Explain the temperature dependence of mobility with the help of diagrams. (3 Marks)
5. Why mass action law is not applicable in the case of excess carriers? (3 Marks)

PART B

6. (a) What is density of states? Explain. What is the significance of effective density of states?
(b) A Si sample is doped with $3X10^{18}$phosphorous atoms/cm^3. Calculate the electron and hole concentrations in the material at 300K ($ni=1.5X10^{10}/cm^3$). Also calculate the relative position of Fermi level with respect to intrinsic energy level (Ei). (8+6 Marks)

OR

7. (a) Derive expressions for equilibrium concentrations of electrons and holes using density of states and Fermi Dirac statistics. Simplify the equations in terms of intrinsic carrier concentration. Derive mass action law.
(b) A Si sample is doped with $8X10^{17}$phosphorous atoms/cm^3 and $6X10^{17}$boron atoms/cm^3. Calculate the electron and hole concentrations in the material at 300K ($ni=1.5X10^{10}/cm^3$). Also calculate the relative position of Fermi level with respect to intrinsic energy level (Ei).

(7+7 Marks)

8. A 0.5μm thick sample of GaAs (Band gap=1.5eV) is illuminated with mono chromatic light of hν=2.0eV. The absorption coefficient α is $6X10^4$/cm. The power incident on the sample is 1mW. (i) Find the total energy absorbed by the sample per second. (ii) Find the rate of excess thermal energy given up by electrons to the lattice before recombination. (iii) Find the number of photons/s given off from recombination events, assuming perfect quantum efficiency.

(b) Explain the terms photo luminescence, cathodo luminescence, electro luminescence, fluorescence and phosphorescence. (8+6 Marks)

OR

9. (a) What is Einstein relation? Derive Einstein relation

(b) $5X10^{14}$EHP/cm^3 are created optically every microsecond in a Si sample with $n0$ = $10^{16}cm^{-3}$and τ_n=2μs. Calculate the equilibrium electron and hole concentrations and Fermi level at 300K (ni=$1.5X10^{10}/cm^3$). What is the excess carrier concentration created in the material and show the positions of quasi Fermi levels. What is the change in conductivity of the material with the creation of excess carriers (μ_n=1500cm^2/Vs ,μ_p=500cm^2/Vs).

(7+7 Marks)

10. What is Hall Effect? Explain. Derive an equation to calculate the carrier concentration from hall voltage. What is hall coefficient? (7 Marks)

OR

11. Show that there is no gradient in Fermi level when there is no current flow through a material at equilibrium. (7 Marks)