2023BEE-012

ABV-INDIAN INSTITUTE OF INFORMATION TECHNOLOGY & MANAGEMENT GWALIOR

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Major Theory Exam (2024-2025)

Duration: 2:00 Hours | **BEE Semester - III** | **Date: 27/09/2024**
Max. Marks: 30 | **Faculty: Dr. Alok Kumar Kamal** | **Time: 4:00 - 6:00 PM**

Important Instructions:

- **This is a closed book, closed notes examination.**
- **All sections are compulsory.**
- **Calculators are allowed.**

Section A

1) State the wave-particle duality principle and state the relationship between momentum and wavelength. **[1]**

2) What is the physical meaning of Schrodinger's wave equation? **[1]**

3) Plot the distribution of Effective density of states w.r.t energy and fermi level for n-type silicon semiconductor at 250 ^{0}K. **[1]**

4) What is the energy band gap (E_g) for silicon at 0 ^{0}K and why it is different from E_g at 300 ^{0}K. **[1]**

5) Discuss how intrinsic carrier concentration is related with diode leakage current (I_0). **[1]**

6) Two possible conduction bands are shown in the E v/s k diagram given in Fig. 1. State which band will result in the heavier electron effective mass: state why. **[1]**

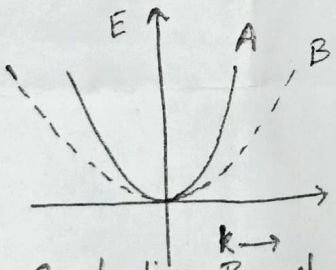

Fig. 1 Conduction Band

7) You have GaAs and Silicon. Which one will u choose for designing a photo detector, support your answer with proper explanation. **[1]**

8) Differentiate between drift and diffusion current. Further, write a relation which shows dependency of drift current with diffusion current. **[1]**

9) Why drift velocity saturates with increase in Electric field. Explain with the help of plot. **[1]**

10) Discuss excess carrier generation using photo ionization. **[1]**

Dr. Alok Kumar Kamal

Section B

1) A simplified E v/s k diagram for an electron in the conduction band is given in Fig. 2. The value of "a" is 10^{-10} m. determine the relative effective mass m^*/m_0. **[5]**

Given: $E = Ak^2+Ec$, A is constant

$m_0 = 9.10\times10^{-31}$ kg, $h = 6.626\times10^{-34}$ m^2kg/s

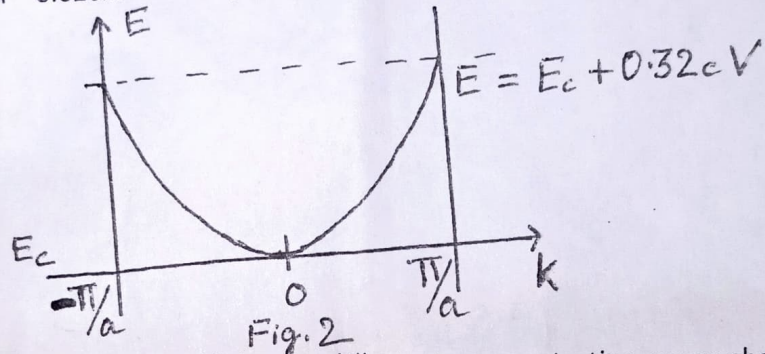

Fig. 2

2) Discuss P^+N junction under thermal equilibrium, and illustrate concentration, space charge, electric field and potential profile plot, with proper explanation. **[5]**

3) Derive the diode current equation. Additionally, discuss log (I_f) v/s voltage characteristics of diode. **[5]**

4) How is Zener breakdown different from avalanche breakdown discuss w.r.t a) type of mechanism, b) doping, and c) increase in temperature. Also derive total current in reverse biased due to SRH generation. **[5]**