

(Following Paper ID and Roll No. to be filled in your Answer Book)

**PAPER ID : 0322**

Roll No.

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**B. Tech.****(SEMESTER-III) THEORY EXAMINATION, 2012-13****FUNDAMENTALS OF ELECTRONIC DEVICES****Time : 3 Hours ]****[ Total Marks : 100****Section – A**

1. Attempt all question parts :  $2 \times 10 = 20$
- Calculate Miller indices for a plane having intercepts at  $4a$ ,  $8b$  and  $2c$  along the three crystals axes.
  - Draw and explain the Fermi Dirac distribution function.
  - State differences between Phosphorescence and Fluorescence.
  - What are Photoconductive devices ? How their optical sensitivity can be evaluated ?
  - Why Silicon is preferred over Germanium for power rectifiers ?
  - What is contact potential ? How does it vary with the biasing ?
  - Explain briefly, the modulation doping in HEMT.
  - How does a BJT used as an Amplifier and a Switch ?
  - What is population Inversion ? State the relationship between the spontaneous emission and stimulated emission and condition for the LASER action.
  - What are Degenerate Semiconductors. Draw their energy band diagrams.

**Section – B**

2. Attempt any **three** question parts :  $10 \times 3 = 30$
- A semiconductor has  $N_c = 10^{19}/\text{cm}^3$ ,  $N_v = 5 \times 10^{18}/\text{cm}^3$  and  $E_g = 2 \text{ eV}$ . It is doped with  $10^{17}/\text{cm}^3$  donors, calculate the electron, hole and intrinsic carrier concentrations at  $62.7 \text{ C}$ . Draw energy band diagram showing the position of  $E_F$ .
    - What is the difference between the Unit cell and the Primitive cell ? Also calculate the packing fraction of a bcc lattice with lattice constant 'a'.
  - Derive the expression for the excess carrier concentration after optical excitation. Also state the resulting carrier concentration equations in terms of Quasi Fermi Levels.
    - What is Diffusion Length ? Derive its value using continuity equation.

- (c) (i) In a p+n junction reverse biased at 10 V, the capacitance is 10 pF. If the doping is doubled and reverse bias is changed to 80 V, what will be the capacitance.
- (ii) Derive the expression for the Depletion region width (W) of BJT under equilibrium conditions.
- (d) (i) Explain strong inversion in the MOSFET using relevant equations and energy band diagram.
- (ii) Explain the construction and working of the MESFET.
- (e) (i) Explain the construction of a Solar cell. What is the fill factor of a solar cell ?
- (ii) Explain the 'Transferred Electron Mechanism' in the Gunn Diode.

### Section – C

Attempt **all** questions.

**10 × 5 = 50**

3. Attempt any **two** parts :

**5 × 2 = 10**

- (a) A crystal with a simple cubic lattice has atomic radius of 2.5 Å and atomic weight 5.42. Calculate its density assuming that atoms touch each other.
- (b) Derive the expression for the equilibrium carrier concentrations ( $n_0, p_0$ ) using Fermi Dirac Distribution function.
- (c) Differentiate between the Direct semiconductor and Indirect semiconductor with relevant band diagrams.

4. Attempt any **one** parts :

**10 × 1 = 10**

- (a) An n-type Si sample with  $N_d = 10^{15}/\text{cm}^3$  is steadily illuminated such that  $g_{op} = 10^{21}$  EHP/cm<sup>3</sup>-s. If  $\tau_n = \tau_p = 1 \mu\text{s}$  for this excitation, calculate the separation in the Quasi Fermi levels, ( $F_n - F_p$ ).
- (b) What is the Diffusion of Carriers ? Derive the expression for the Diffusion current crossing a unit area. Also draw the Drift and Diffusion of electrons and holes in an electric field.

5. Attempt any **one** part :

**10 × 1 = 10**

- (a) What is time variation of Stored Charge ? Draw and explain the excess hole distribution in the n-region as a function of time during the transient.
- (b) State differences between Zener Breakdown and Avalanche Breakdown.

6. Attempt any **one** part :

**10 × 1 = 10**

- (a) Draw and explain the hole and electron flow in a p-n-p transistor. State the various currents flowing across the device.
- (b) Why MESFET is considered for the high speed applications ?

7. Attempt any **two** parts :

**5 × 2 = 10**

- (a) Explain the working principle of IMPATT diode. How does the electric field and hole construction varies with the input a-c signal.
- (b) Explain the Triggering mechanism in SCR. How does the forward characteristic vary with the gate current ?
- (c) What are Bilateral Devices ? State example and explain its construction and working.