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

PAPER ID : 0322 Roll No. | | | | | | | | | | |

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

Section – B

2. Attempt any **three** question parts : $10 \times 3 = 30$
   (a) (i) A semiconductor has $N_c = 10^{19}/cm^3$, $N_v = 5 \times 10^{18}/cm^3$ and $E_g = 2$ eV. It is doped with $10^{17}/cm^3$ donors, calculate the electron, hole and intrinsic carrier concentrations at 62.7 C. Draw energy band diagram showing the position of E_F.
   (ii) 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'.
   (b) (i) Derive the expression for the excess carrier concentration after optical excitation. Also state the resulting carrier concentration equations in terms of Quasi Fermi Levels.
   (ii) 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 $N_d = 10^{15}/cm^3$ is steadily illuminated such that $g_{op} = 10^{21}$ EHP/cm^3–s. If $\tau_n = \tau_p = 1$ μs 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.