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

PAPER ID : 1248 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. III) ODD SEMESTER THEORY EXAMINATION 2013-14

ELECTRONIC DEVICES

Time : 3 Hours *Total Marks : 100*

Note :– Attempt all Sections.

SECTION–A

1. Attempt all parts : (2×10=20)

(a) What do you mean by Effective Mass ? How does it depend on Energy Band ?

(b) Draw and explain Fermi Dirac distribution function.

(c) What is Punch through in diode ?

(d) What is Contact Potential and how does it vary with the Biasing ?

(e) State difference between Phosphorescence and Fluorescence.

(f) Explain carrier life time. How direct recombination life time differs from indirect recombination life time ?

(g) Write down the maximum power delivered by solar cell.

(h) Draw V-I characteristics of Photodiode and what is the significance of 3rd and 4th quadrant operation of Photodiode ?

(i) What is Population Inversion Layer in LASER ? Write down the difference between stimulated emission and spontaneous emission.

(j) How a BJT is used as an amplifier and a switch ?

SECTION–B

2. Attempt any **three** parts : **(3×10=30)**

(a) (i) What is mobility and discuss its dependency on temperature and doping concentration.

(ii) Derive the expression for the equilibrium carrier concentration (n_0, p_0) using Fermi Dirac Distribution Function.

(b) (i) What is Diffusion Length ? Derive its value using continuity equation.

(ii) Discuss the relationship between Photoconductivity and Mobility of carriers.

(c) (i) Differentiate between Zener and Avalanche Breakdown.

(ii) Derive the expression for electron current in n type material of a forward Biased PN junction.

(d) (i) Write the special features of MESFET. Differentiate between MOSFET and MESFET.

(ii) Differentiate between Rectifying contacts and Non Rectifying contacts with the help of Band Diagram.

(e) (i) Explain different components of current flow through the structure of a N-P-N transistor with the help of current flow diagram.

(ii) What is Photo Detector ? Explain the operation of p-i-n photodetector. What are the suitable materials of it ? How can it be made more sensitive to low level intensity of light ?

SECTION–C

Note :– Attempt **all** questions. **(5×10=50)**

3. Attempt any **two** parts :

   (a) Discuss temperature dependency of carrier Concentration.

   (b) A semiconductor has $\mu_c = 10^{19}/cm^3$, $\mu_v = 0.5 \times 10^{19}/cm^3$ and $E_g = 2$ eV. It is doped with $10^{17}/cm^3$ donors. Calculate e^- and hole and intrinsic carrier concentration at 62.7°C. Draw its energy band diagram showing the position of E_F.

   (c) What is Hall Effect ? Derive the expression for Hall Angle.

4. Attempt any **two** parts :

   (a) What is Quasi Fermi Level ? An n type Si sample with $\mu_d = 10^{15}/cm^3$ 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 Level $(F_n - F_p)$.

   (b) Write short notes on :

      (i) Cathodoluminesence

      (ii) Electroluminesence.

   (c) What do you mean by diffusion of carriers ? Derive expression for Diffusion Current. Draw drift and diffusion of electron and hole in an applied electric field.

5. Attempt any **two** parts :

   (a) Derive the expression for Penetration depth X_n and X_p in N and P Region respectively for a PN jn diode. Also derive an expression for depletion region width.

   (b) What is time variation of Stored Charge ? Draw and explain the excess hole distribution in n region as a function of time during the transient.

(c) An abrupt Si P-N junction has $\mu_a = 10^{18}cm^{-3}$ on one side and $\mu = 5 \times 10^{15}cm^{-3}$ on the other side.

(i) Calculate Fermi Level Position at 300 K in P and N Regions.

(ii) Draw an equilibrium band diagram for the junction and determine the contact potential V_o from the diagram.

6. Attempt any **two** parts :

(a) What is the difference between Homojunction and Heterojunction ? Explain Heterojunction with the help of ideal band diagram.

(b) For a MOSFET. Given that $L_{min} = 0.4$ µm, $t_{ox} = 8$ nm, $\mu_n = 450$ cm²/V-s and $V_t = 0.7$ V. Find out C_{ox}, K'_n. For a MOSFET with W/L = 8 µm/0.8 µm, calculate the value of V_{GS} and V_{DSmin} needed to operate a transistor in saturation region with a DC current $I_D = 100$ µA.

(c) Explain the operation of enhancement type MOSFET and discuss its Drain and Transfer characteristics.

7. Attempt any **two** parts :

(a) Explain Ebers-Moll Model of BJT.

(b) Write a short note on semiconductor LASER.

(c) What is Base Width Modulation and Early effect in BJT ?