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

Paper ID : 2012360 Roll No. | | | | | | | | | |

B.TECH

Regular theory Examination(Odd Sem - III), 2016-17

FUNDAMENTAL OF ELECTRONIC DEVICES

Time : 3 Hours *Max. Marks : 100*

Section - A

1 Attempt all parts. All parts carry equal marks. Write answer of each part in short. (10×2=20)

a) Classify semiconductors on the basis of energy band gap with the help of suitable diagram.

b) Calculate the density of GaAs, if the lattice constant of GaAs is 5.65 A^{o}. The atomic weights of Ga and As are 69.7 and 74.9 g/mol, respectively.

c) Differentiate between phosphorescence and florescence materials with examples.

d) What is population inversion? Write down the difference between spontaneous emission and stimulated emission for LASER action.

e) Explain the V-I characteristics of photodiode. What is the significance of 3^{rd} and 4^{th} quadrant operation of photodiode?

f) What is Fermi level? How does it depend on temperature?

g) What is the physical significance of diffusion length? How is it related with mobility of the carrier?

h) What do you mean by reverse recovery transient? State the significance of storage delay time.

i) What are degenerate semi-conductors? Draw their energy band diagrams.

j) Calculate the maximum packing fraction of fcc lattice.

Section - B

Note: Attempt any five questions from this section

(5×10=50)

2. a) What do you mean by mobility of a carrier? How does it depend on temperature, doping concentrations and high field? Explain.

   b) Mobilities of electrons and holes in a sample of intrinsic germanium at room temperature are 3900 cm^2/v-sec and 1900 cm^2/v-sec respectively. If the electrons and hole densities are each equal to 2.5×10^{13} per cm^3, calculate germanium resistivity and conductivity.

3. Discuss Transition and Diffusion capacitance in a p-n junction diode. In a p^+ - n junction reverse biased at 10V, the capacitance is 10pF. If the doping is doubled and reverse bias voltage is changed to 80V, what will be the capacitance?

4. a) A silicon sample is doped with 10^{15} donors/cm^3 and has a hole life time of 0.5 μsec. Assuming all the donors to be ionized, determine :

   i) The photo generation rate, which will produce 4×10^4 excess EHP in steady state.

   ii) The sample resistivity before and after illumination.

   iii) The percentage of conductivity due to minority carriers.

   Assume μ_n = 1200 cm^2/Vs, μ_p = 400 cm^2/V-s, T = 300 K.

   b) What do you mean by drift and diffusion of carriers? Find total current density generated due to both of these transport mechanisms of carriers.

5. Using suitable diagrams, describe the principle and operation of a Tunnel diode. Also discuss its V-I characteristics.

6. Draw and explain the hole and electron flow in a p-n-p Common Base BJT. State various currents flowing across the device along with characteristics curves.

7. Show that the total depletion width in a p-n junction at thermal equilibrium condition can be given by

$$W = \sqrt{\frac{2\varepsilon V_0}{q}\left(\frac{1}{N_a} + \frac{1}{N_d}\right)}$$

Where ε is the permittivity of semiconductor, V_0 is the built-in potential of the junction, N_a is the acceptor

concentration in the p-type material, N_d is the donor concentration in the n-type material and q is the electronic charge.

8. Derive an expression for diode current in an ideal p-n junction diode.

9. What is Hall effect? Derive the relation between Hall voltage and carrier concentration.

Section - C

Note: Attempt any two questions from this section **(2×15=30)**

10. Write the special features of MESFET. Explain the working of normally-off and normally-on MESFETS with its characteristics.

11. a) Derive the expression for the equilibrium carrier concentration for holes using Fermi Dirac distribution function.

    b) A Si doped with 10^{17} per cm^3 Boron atoms has fermi level 0.36 eV above valence band at 300K. What is the density of states in valence band?

12. Write short notes on :

    a) LED materials.

    b) GUNN Diode.

    c) IMPATT Diode.