

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

Paper ID : 2012360

Roll No.

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## 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)
- Classify semiconductors on the basis of energy band gap with the help of suitable diagram.
  - Calculate the density of GaAs, if the lattice constant of GaAs is  $5.65 \text{ \AA}$ . The atomic weights of Ga and As are 69.7 and 74.9 g/mol, respectively.
  - Differentiate between phosphorescence and florescence materials with examples.
  - What is population inversion? Write down the difference between spontaneous emission and stimulated emission for LASER action.
  - Explain the V-I characteristics of photodiode. What is the significance of 3<sup>rd</sup> and 4<sup>th</sup> 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<sup>2</sup>/v-sec and 1900 cm<sup>2</sup>/v-sec respectively. If the electrons and hole densities are each equal to 2.5 × 10<sup>13</sup> per cm<sup>3</sup>, calculate germanium resistivity and conductivity.
- 3. Discuss Transition and Diffusion capacitance in a p-n junction diode. In a p<sup>+</sup> - 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<sup>15</sup> donors/cm<sup>3</sup> 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<sup>4</sup> excess EHP in steady state.
  - ii) The sample resistivity before and after illumination.
  - iii) The percentage of conductivity due to minority carriers.
- 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.

Assume  $\mu_n = 1200 \text{ cm}^2/\text{Vs}$ ,  $\mu_p = 400 \text{ cm}^2/\text{V-s}$ ,  $T = 300 \text{ K}$ .

- 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

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

Where  $\epsilon$  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  $\text{cm}^3$  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.

