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

Paper ID :131302 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. III) THEORY EXAMINATION. 2015-16

FUNDAMENTAL OF ELECTRONIC DEVICES

[Time:3 hours] **[Total Marks:100]**

Section-A

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

   (a) Differentiate Zener and avalanche mechanism on the basis of doping, voltage and required depletion region width and ionization effect.

   (b) Si sample is doped with 10^{20} As atoms/cm^3. What is equilibrium concentration of holes at 300 K? Where is E_f relative to E_i? Draw the energy band diagram to show the position of E_i and E_f. Take $n_i = 1.5\times10^{10}$ cm^{-3}.

   (c) What is indirect band gap semiconductors.

   (d) What is lattice scattering.

(e) How high electron mobility channel is created in HEMT?

(f) Which semiconductor parameters are measured from Hall effect.

(g) State the principle of Invariance of Fermi level.

(h) What is superiority of metal semiconductor diode over conventional diode?

(i) Why 3rd quadrant is preferred for photo detectors?

(j) What is figure of merit of photodiode?

Section-B

Attempt **any five** questions from this section: (5x10=50)

2. Calculate packing fraction and formation (with FCC) of Si-unit cell. Also describe the energy band splitting in Si crystal formation.

3. Discuss the temperature dependence of Fermi-Dirac distribution function for semiconductor materials. Derive the thermal equilibrium concentration of electron.

4. Describe diffusion of carriers and derive the current equation resulting due to this phenomenon. Also, derive the Einstein relation.

5. A semiconductor sample is exposed to a photonic excitation for a long time($t<0$). Under low level injection, derive the equation governing the decay of excess carrier and life time of carrier if the excitation is removed at $t=0$.

6. Derive the expression of contact potential for PN homojunction diode. Boron is implanted into an n-type Si sample ($N_d=10^{16}cm^{-3}$), forming an abrupt junction of square cross section with area=2×10^{-3} cm^2. Assume acceptor concentration in p-type region is $N_a=4\times10^{18}$ cm^{-3}. Calculate V_0 Q^+, E_0 and depletion region extension on either side of junction at RT. (Given $n_i=1.5\times10^{10}$ cm^{-3}, $\varepsilon_r=11.8$, $\varepsilon_0=8.85\times10^{-14}$ F/cm and KT=0.0259 eV at RT).

7. Describe in detail the operation of n-channel enhancement MOSFET. Draw is physical structure and I-V characteristic.

8. With the help of neat diagram describe the operation of Impact ionization avalanche transit time diode.

9. Deduce the conditions of lasing. Describe the operation of semiconductor LASER.

Section-C

Attempt **any two** question in this section : (2×15=30)

10. Mention ideally desired characteristics of (parameters) area, doping, lifetime and width of base region in BJT. With the help of neat diagram showing the various current components of a PNP BJT, describe emitter injection efficiency, base transport factor and collector to base amplification ratio. Describe how the base current controls the operation of BJT.

11. Derive the ideal diode equation. Discuss the majority carrier flow mechanism in neutral regions.

12. With the help two transistor analogy explain the operation of PNPN diode. Also describe various turn-on mechanisms used in SCR.

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