M 21812

Reg. No. : .....

Name : .....

Third Semester B.Tech. (Reg./Sup./Imp.) (Including Part Time) Degree Examination, November 2012
(2007 Admn. Onwards)
PT2K6/2K6 EC/AEI 304 : SOLID STATE DEVICES

Time: 3 Hours Max. Marks: 100

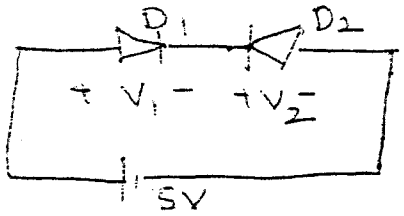
Instruction: *Answer* ***all*** *questions.*

I. 1) A Ge sample is doped with 10^{17} Boron atoms per cm^3. Determine the carrier concentrations and fermilevel position at room temperature. ni for Ge = 10^{13} cm^3 at room temperature.

2) Explain the effect of temperature on intrinsic carrier concentration.

3) With energy band diagram explain zener break down.

4) Two identical Si diodes D_1 and D_2 with $\eta = 1$ are connected back-to-back as shown in fig. The reverse saturation current I_s of diode is 10^{-8}A and break down voltage V_{Br} is 50V. Calculate the voltages V_1 and V_2 dropped across the diodes D_1 and D_2 assuming $\frac{kT}{q} = 26$ mV.



5) The following parameters are given for a p-n-p transistor. $I_{pE} = 10$mA, $I_{nE} = 0.02$ mA, $I_{pC} = 9.99$ mA, $I_{nC} = 0.002$ mA. Determine γ, α_T, α, β, I_C.

6) With neat diagram define delay time, rise time, fall time for a switching transistor.

7) What is the difference between enhancement and depletion mode MOSFETs ?

8) What is meant by channel length modulation in MOSFET ? **(8×5)**

P.T.O.

II. 1) Derive continuity equation. **15**

OR

2) Derive $n_0 = n_i\, e^{(E_f - E_i)/kT}$

$P_0 = n_i\, e^{(E_i - E_f)/kT}$. **15**

III. 3) 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 that acceptor concentration in the P-type region is $N_a = 4 \times 10^{18}$ cm^{-3}. Calculate V_0, x_{no}, x_{po}, Q_+ and ε_0 for this junction at equilibrium (book).

Sketch $\varepsilon(x)$ and charge density to scale. Assume $\frac{kT}{q} = 0.0259$

$n_i^2 = 2.25 \times 10^{20}$ cm^{-3} $\in = 11.8 \times 8.85 \times 10^{-14}$. **15**

OR

4) a) With neat diagram explain the working and characteristics of tunnel diode. **10**

b) Explain the working of varactor diode. **5**

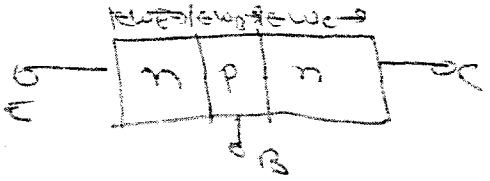
IV. 5) a) For a typical n-p-n transistor shown in fig. below following data are available at 300 k

a) $W_e = 20\ \mu$m, collector doping = 5×10^{18} cm^{-3}

b) $W_E = 1\ \mu$m, emitter doping = 10^{19} cm^{-3}

c) base doping = 5×10^{15} cm^{-3}

d) minority carrier life time in the base region $\tau_n = 0.5\ \mu$S.



Under punch through condition $V_{BC} = 10$ V + V_0 where V_0 is the built in potential of the base collector region, emitter junction efficiency can be assumed as 1. Evaluate W_B and current gain α. **10**

Given $q = 1.6 \times 10^{-19}$C

$D_n = 30$ cm^2/S

$\in_r \in_0 = 10^{-12}$ F/cm

$n_i = 1.5 \times 10^{10}$ cm^3

b) Define injection efficiency and transport factor of a BJT. How are they related to α and β ? 5

OR

6) Briefly explain the following : 15
   a) Hetero junction bipolar transistor
   b) Effect of base norrowing in BJT
   c) Punch through effect.

V. 7) With neat diagram explain the construction, working and characteristics of enhancement mode MOSFET. 15

OR

8) Give the simplified cross sectional view of JFET. Explain pinch off and saturation and effect of negative gate bias and I_D vs V_G characteristics. 15