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Reg. No. : .....

Name : .....

Third Semester B.Tech. Degree Examination, November 2013
(2008 Scheme)
08.302 : SOLID STATE DEVICES (TA)

Time : 3 Hours Max. Marks : 100

PART – A

Answer **all** questions. **Each** question carries **4** marks.

1. Derive the continuity equation for holes and electrons in a semi conductor.
2. With neat diagram explain the Fermi-Dirac distribution applied to semi conductors.
3. A GaAs sample is doped so that the electron-hole components of currents are equal in an applied electric field. Calculate the equilibrium electron-hole concentrations, the net doping and the sample resistivity at 300 K

   $\mu_n = 8500\ cm^2/Vs$ $\mu_p = 400\ cm^2/Vs$ $n_i = 1.79\times10^6 cm^{-3}$.
4. With neat diagram distinguish between direct and indirect band semiconductor.
5. Derive the junction capacitance of a linearly graded junction.
6. Explain with neat diagram Avalanche Breakdown.
7. An n channel Si JFET has Nd $=10^{16}\ cm^{-3}$ Na $= 10^{19} cm^{-3}$ and a $=1\ \mu m$. Determine the

   a) built in voltage

   b) pinch off voltage.
8. What is a punched through diode ? What are its advantage ?
9. Explain the C-V characteristics of ideal MOS system.
10. Explain the principle of operation of JFET.

P.T.O.

PART – B

Answer **any two** questions from **each** Module. **Each** question carries **10** marks.

Module – I

11. State and derive Einstein's relation.
12. Explain Hall effect. Explain the procedure to measure majority carrier concentration and mobility of a semi conductor specimen.
13. Intrinsic Ge sample at room temperature has resistivity of 50 Ω cm. The sample is doped to the extend of 6×10^{13} As atoms/cm^3 and 10^{14} Boron atoms per cm^3. Find the conduction current density if an electric field of 4V/cm is applied across the sample $\mu_n = 3800\,cm^2/Vs$ $\mu_p = 1800\,cm^2/Vs$.

Module – II

14. Derive expressions for injection efficiency transport factor, α and β of a p-n-p transistor operating in the active region in terms of the doping and dimensions of the different regions of the transistor.
15. Define the figure of merit of a BJT. Derive the expression for the same.
16. a) Explain the principle of operation of Schottky diode and derive the current equation.
    b) An ideal Silicon abrupt p-n junction has $N_A = 10^{16}$, $N_D = 10^{14}$ Cm^{-3}. $\tau_n = \tau_p = 0.1\mu s$ $A = 10^{-3}\,cm^2$, $D_p = 10\,cm^2/s$. $D_n = 24\,cm^2/s$. Determine the dynamic forward resistance of the diode at 300 K with forward voltages of
    a) 0.5 v b) 0.6 V.

Module – III

17. Explain the principle of operation of an SCR.
18. a) An n channel Si JFET has $N_A = 10^{19}\,cm^{-3}$ $N_D = 10^{15}\,cm^{-3}$ and $a = 4\,\mu m$. Determine at 300 K
    a) pinch-off voltage
    b) the gate bias required to make the thickness of the undepleted channel equal to 1 μm with $V_{DS} = 0$.
    b) Define the threshold voltage of ideal MOS capacitor.
19. Explain the structure and principle of operation of depletion mode MOSFET. Derive expression for drain current.