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Reg. No. : .....

Name : .....

Third Semester B.Tech. Degree Examination, December 2012
(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. How does Fermi-level position vary with doping of the semiconductor ?
2. Distinguish between direct and indirect band semiconductors.
3. Find the (E, K) relationship for a free electron and relate it to the electron mass.
4. An abrupt Si p-n junction has $N_a = 10^{17}$ cm^{-3} on the p side and $N_d = 10^{16}$ cm^{-3} on the n side. At 300 K, calculate the Fermi-levels, draw an equilibrium band diagram and find contact potential V_0 from the diagram.
5. What are the differences between Zener break down and avalanche break down ?
6. What is diffusion capacitance ? How is it related to forward current ?
7. Define injection efficiency and transport factor for a BJT. How are they related to α and β ?
8. An n channel Si JFET has $N_d = 10^{15}$ cm^{-3}, $N_a = 10^{18}$ cm^{-3} and a = 2 μm. Determine built in voltage and pinch off voltage.
9. What is meant by body effect ?
10. Explain the principle of operation of SCR. **(10×4=40 Marks)**

P.T.O.

PART – B

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

Module – I

11. a) Explain Hall effect.

    b) A sample of silicon is doped with 10^{17} phosphorous atoms/cm^3. Find its resistivity. What will be the Hall voltage if the sample is 100 μm thick if current through the sample is 1 mA and the perpendicular magnetic field B_Z = 1 kG.

12. State and derive Einstein relation.

13. An abrupt silicon p-n junction has $N_a = 10^{17}$ cm^{-3} on the p side $N_d = 10^{15}$ cm^{-3} on the n side. The area of cross section of the diode is 10^{-4} cm^2. The relative permittivity of Si is 11.8. Determine the following at 300 K (a) the built -in voltage (b) the depletion layer width W_o, X_{no} and X_{po}, (c) the maximum electric field, (d) the charge on one side of depletion layer.

Module – II

14. Plot the minority carrier distribution in the base region of the p-n-p transistor with a forward bias applied to the emitter base junction under the following conditions (a) collector shorted to base (b) collector shorted to emitter (c) collector terminal is kept open. Which of these configurations as a diode gives best performance ?

15. A Si p-n junction at 300 K has $N_a = 10^{16}$ cm^{-3} and $N_d = 10^{15}$ cm^{-3}, $Z_n = Z_p = 0.1$ μs. A = 10^{-3} cm^2. At 300 K determine (a) Junction capacitance at zero bias G_o (b) The junction capacitance at $V_a = -4$ V (c) The storage capacitance at $V_a = 0.4$ V.

16. Derive expression for (a) Built in potential (b) Depletion layer capacitance of a linearly graded p-n junction.

Module – III

17. a) Draw the drain characteristics of JFET and explain.

    b) An n channel Si JFET has $N_a = 10^{18}\ cm^{-3}$, $N_d = 10^{13}\ cm^{-3}$ and $a = 3\mu m$. Determine at 300 K (a) pinch off voltage (b) the gate bias required to make thickness of undepleted channel width equal to $1\mu m$ with $V_{DS} = 0$.

18. An n channel Si JFET has $N_a = 10^{18}\ cm^{-3}$, $N_d = 5 \times 10^{15}\ cm^{-3}$, $L = 28\mu m$, $Z = 300\mu m$, $a = 1.3\mu m$. Assume $\mu_n = 1350\ cm^2/vs$. Determine (a) built in voltage (b) pinch off voltage (c) the channel conductance (d) drain current at $V_{GS} = 0$, $V_{DS} = 4$ V (e) g_m at $V_{GS} = -2$ V.

19. a) A MOS capacitor with silicon substrate of doping $N_A = 5 \times 10^{16}\ cm^{-3}$ has oxide thickness of 100 A°. Calculate the applied voltage, the electric field intensity at the interface and the depletion layer width (i) to make semiconductor surface intrinsic (ii) for strong inversion.

    b) Define threshold voltage of ideal MOS capacitor. **(6×10=60 Marks)**
