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Reg. No. : .....

Name : .....

Third Semester B.Tech. Degree Examination, December 2015
(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. Distinguish between the energy bands diagrams of metals, semi conductors and insulators.
2. Derive the expression for the majority carrier concentration in a semiconductor in terms of Hall voltage.
3. Derive an expression for the effect of diffusion and recombination in terms of the diffusion equations.
4. Explain the different breakdown mechanisms in the abrupt PN junctions.
5. Compute the contact potential Vo of a Si abrupt P-n junction with $N_D = 10^{15}$ cm^{-3} and $N_A = 10^{17}$ cm^{-3} at (a) 300 k (b) 450 k.
6. What is meant by Kirk effect in BJT ?
7. What are the effects of base width modulation on the parameters and characteristics of a BJT ?
8. Derive an expression for the drain current of a JFET.
9. Explain the effect of velocity saturation in MOSFETs.
10. What are the parameters on which the threshold voltage of a MOSFET depend ?

P.T.O.

PART – B

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

Module – I

11. The fermi level in a silicon sample at 300k is located at 0.3eV below the bottom of the conduction band. The effective densities of states $Nc = 3.22 \times 10^{19}$ cm^{-3} and $Nv = 1.83 \times 10^{19}$ cm^{-3}. Determine
    a) The electron and hole concentrations at 300 k
    b) The intrinsic carrier concentration at 300 k.

12. Draw the energy band diagram of a P-n junction a) under equilibrium b) forward bias c) reverse bias. Show the variation of quasi fermi level if exist.

13. An abrupt silicon P-n junction has $Na = 10^{17}$ cm^{-3} on the P side $Nd = 10^{15}$ 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) built in voltage (b) depletion layer width W_o, X_{no} and X_{po} (c) the maximum electric field (d) the change on one side of depletion layer.

Module – II

14. Draw the Ebers Moll model of a pnp BJT and write the Ebers Moll equations. Explain the terms involved ?

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

16. A Si abrupt P-n junction has $N_A = 3 \times 10^{18}$ cm^{-3} on the p side and an area of 1.6×10^{-3} cm^2. The junction capacitance is 18PF at reverse bias of 3.2V and 12 PF at 8.2 V. Calculate the build in voltage and donor concentration on the n-side.

Module – III

17. An n channel silicone JFET has $N_D = 5 \times 10^{16}$ cm^{-3} $N_A = 10^{18}$ cm^{-3} a = 0.5 μm. Determine at 300 k (a) V_O (b) V_D (Sat) for $V_{GS} = -3V$ (c) V_{GS} for V_D (Sat) = I V (d) width of undepleted channel if $V_{GS} = -2V$, $V_{DS} = 0$.

18. With neat diagram explain the principles of operation of UJT. What is intrinsic stand off ratio ? Draw the equivalent circuit of UJT.

19. a) Explain channel length modulation and body effect in a MUSFET.
    b) With a two transistor equivalent model, describe the operation of an SCR.
