Exam.Code:0975
Sub. Code: 7421

1129

M. Tech. (Micro-Electronics)
First Semester
MIC-101: Semiconductor Device Physics

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Section.

X-X-X

1) Attempt all questions (5*2=10)

i. What is fermi-Direc distribution function?
ii. Define diffusion current with its equation.
iii. what is early effect?
iv. Calculate the silicon diode current for the forward bias voltage of 0.6 V at 25° C, if the reverse saturation current is 10μA.
v. Difference between MOSFET and JFET?

Section-I

2) (A) Design a semiconductor resistor of resistance 10KΩ which is to be operated at 300k .The resistor should be able to handle a current density of 50 A/cm^2 when a potential of 5V is applied across it. Given that the semiconductor material has been initially doped with a concentration of N_d=5*10^{15}cm^{-3}and acceptors are to be added to form a compensated p-type material.

(B) Explain the electron and hole concentration in conduction band and valence band respectively for a extrinsic semiconductor. Figures and assumptions must be clearly notified.

3) a) What is Ebers-Moll Model for BJT.

b) For an abrupt Si p-n junction with N_A=9*10^{16} cm^{-3} and N_D =8*10^{15}cm^{-3}.Calculate the following. Given that T=300K V_T=25.8mv and n_i=10^{10}cm^{-3}.

a) Built in potential (b) depletion width ,V_a=0v (c) the junction capacitance per unit area when V_a=-3v (d) total depletion width when V_a=-3v (e) the maximum electric field in the depletion region when V_a=-3v.

4) Explain the importance of continuity equations in bipolar transistor modeling and also derive the V-I characteristics of reverse and forward bias pn junction by using continuity equation.

Section-II

5) Mathematically derive the I-V characteristics of n-type JFET. Also find out the small signal parameters such drain conductance and transconductance of the same.

6) Explain following second order effects in BJTs operations.

i) Effect of non uniform doping in base region
ii) High injection in collector region
iii) Heavy doping effects in emitter region

7) Show the formation of accumulation layer, positive space charge region and inversion layer for the MOS structure using an n-type semiconductor with the help of a suitable band diagram. Also explain the threshold voltage for a MOS.

X-X-X