Exam. Code: 0931
Sub. Code: 6934

2021

B.E. (Electronics and Communication Engineering)
Seventh Semester
Departmental Elective – IV
EC-706: High Speed Semiconductor Devices and Circuits

Time allowed: 3 Hours Max. Marks: 50

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

x-x-x

Q1.
(a) Why is Schottky junction preferred over p-n junction diode for high frequency device applications?
(b) How is density of states related to energy?
(c) Define flat-band voltage and Threshold voltage for MOS capacitor.
(d) What is Quasi-equilibrium boundary condition?
(e) Sketch the C-V characteristics of MOS capacitor with an n-type substrate under low-frequency condition. Show the individual capacitance component. (5*2)

PART-A

Q2. (a) Write the expression for the probability function of electrons and holes in the donor and acceptor states. Discuss complete ionization and freeze out condition with suitable energy band diagrams.
(b) What is density of states function? Derive expression for density of states. (2*5)

Q3. (a) What is electron effective mass? Write the expression for it? (2)
(b) Prove that the concentration of holes in an intrinsic semiconductor is given by
$P= N_v \exp[-(E_f - E_v)/KT]$. (4)
(c) If $E_f = E_c$ find the probability of the state being occupied at $E= E_c + KT$ and if $E_f = E_v$ find the probability of state being occupied at $E= E_v - KT$. (4)

Q4. (a) What do you mean by carrier diffusion? Derive an expression for diffusion current density of electrons and holes. (4)
(b) Derive the Einstein relation. (4)
(c) Assume the mobility of carrier at T= 300K is $\mu = 925 cm^2/Vs$. Calculate the carrier diffusion coefficient. ($K = 1.38 \times 10^{-23}$ J/K). (2)

PART-B

Q5.
(a) A Schottky barrier contact is made from tungsten on P-type Si [$\phi_B = 0.45V$] having $N_A = 10^{16} cm^{-3}$. Determine at 300°K i) V_{bi} ; ii) W at thermal equilibrium given $\varepsilon_r = 11.8$ for Si, [Assume $N_v = 1.83 \times 10^{19} cm^{-3}$]. (5)
(b) Explain about the ohmic contact of metal semiconductor junction. (5)

Q6. Explain the construction, working principle and operation of MESFET in detail. Why MESFET is preferred over JFET for RF applications. (10)

Q7. (a) Highlight the principle difference between HBT and BJT. (5)
(b) Explain the working principle of HEMT. Also draw the band diagram formed at the heterojunction for HEMTs. (5)

x-x-x