VIT

Vellore Institute of Technology

Continuous Assessment Test – I

Programme Name & Branch: B.Tech – ECE

Course Code & Name: ECE1006 – Semiconductor Devices and Circuits

Class Number: VL2019205004767, 4770, 4766, 4768, 4771

Slot: C1+TC1

Time: 09:30 A.M – 11:00 A.M

Date of Exam: 31/01/2020

Max. Marks: 50 Marks

General Instructions: Use the below mentioning constant values if it is not specified in the questions

Constants Silicon: $n_i = 1.5\times10^{10}$ cm^{-3}, $E_g = 1.1$eV, relative permittivity $\varepsilon_r = 11.8$, $\mu_n = 1350$ cm^2/V-s, $\mu_p = 480$ cm^2/V-s, $D_n = 35$ cm^2/V-s, $D_p = 12.5$ cm^2/V-s. Others: kT=0.026 eV at 300K, Boltzmann's constant $k = 8.66\times10^{-5}$ eV/K, $\varepsilon_0 = 8.854\times10^{-14}$ F/cm, $q = 1.6\times10^{-19}$ C

S.No.	Question	Marks
1.	a) In a solid, consider the energy levels lying 0.01 eV and 0.03eV below Fermi level. What is the probability of these energy levels are not being occupied by an electron at T=300K? b) For a P-type Silicon, What must be N_a at T=300 K, if the electron concentration drops below the intrinsic level by a factor of 10^{6}?	10
2.	A Silicon sample is doped with Arsenic with number density $N_d = 8\times10^{16}$ cm^{-3} and as well as Boron with number density $N_a = 3\times10^{16}$ cm^{-3}. Find Electron concentration, hole concentration and position of fermi level at 300K. Show fermi level on suitable band diagram.	10
3.	A p$^+$N junction has $N_a = 10^{20}$ cm^{-3} and $N_d = 10^{17}$cm^{-3}. (a) What is its built in potential, W_{dep}? (b) A Si p–n junction is formed from p-material doped with 10^{27} acceptors/m^3 and n-material doped with 1.2×10^{21} donors/m^3. Find the thermal voltage and barrier voltage at 30°C.	10
4	A silicon crystal having a cross-sectional area of 0.001 cm^2 and a length of 10μm is connected at its end to a 10V battery. A current of 100mA is required at 300K. Calculate (a) the required resistance, (b) the required conductivity, (c) the density of donor atoms to be added to achieve this conductivity, and (d) the concentration of acceptor atoms to be added to form a compensated p-type material with the conductivity from part (b) if the initial donor concentration is $N_d = 10^{15}$ cm^{-3}. Given $\mu_n = 1350$ cm^2/V.s and $\mu_p = 480$ cm^2/V.s	10
5.	(a) A silicon PN junction at T = 300 K is doped at $N_d = 10^{17}$ cm^{-3} and $N_a = 10^{18}$ cm^{-3}. The junction capacitance is to be $C_j = 0.9$ pF when a reverse bias voltage of $V_R = 4$ V is applied. Find the zero – biased junction capacitance C_{j0}. (b) Find the change in diode voltage drop if the current changes from 0.1 mA to 10 mA.	6