Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third Semester B.Tech Degree (S,FE) Examination December 2022 (2015 scheme)

Course Code: EC203

Course Name: SOLID STATE DEVICES (EC, AE)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Derive the expression $n_0p_0 = ni^2$ from fundamentals. (7)

b) A silicon sample is doped with $5x10^{16}$ As atoms/cm3 and $2x10^{16}$ Boron atoms/cm3. Determine the electron and hole concentration at room temperature and draw the position of fermi level. (8)

2 a) With suitable assumptions, derive Einstein's relation for mobility of electrons in a semiconductor (7)

b) Prove that under steady state carrier injection, the injected excess carrier concentration is an exponentially decreasing function of distance. **(8)**

3 a) Derive an expression for drift current density. (8)

b) With necessary diagram derive the continuity equation of electrons and holes (7)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Derive the ideal diode equation and list the assumptions (10)

b) A p+n Si diode has $N_A=10^{17}cm^{-3}$ and $N_D=10^{15}cm^{-3}$, area of cross section $A=10^{-3}$ cm^2 and the lifetime in n and p regions be 1 μs at 300K. Determine the ideal diode current for applied voltage of 0.1 V. Given $Dp = 10cm^2/s$, $Dn = 36cm^2/s$. (5)

5 a) Derive the expressions for i) Contact potential ii) transition region width iii) maximum value of electric field. (9)

b) Illustrate with diagram the working of a tunnel diode. Explain its characteristic curve. (6)

6 a) Derive the expression for junction capacitance and storage capacitance of a PN junction diode. (8)

b) With suitable energy band diagrams, explain Schottky contact. (7)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Derive the expression for terminal currents of a transistor. (10)

b) Plot and explain the distribution of minority carriers of a PNP transistor in saturation mode of operation. (5)

c) Explain base width modulation and its effects. (5)

8 a) Derive the expression for drain current at linear region and saturation for a MOSFET. (10)

b) Draw and explain the drain characteristics of an n-channel MOSFET. (5)

c) With diagram explain the principle of operation of FinFET. (5)

9 a) Derive the expression for capacitance of MOS system. Also draw the C-V Characteristics of an Ideal MOS capacitor and explain. (10)

b) Explain the terms emitter injection efficiency and base transport factor of a BJT. (5)

c) The current components in a transistor are In_E =2.712 x 10^{-6} A, Ip_E =0.678 mA, In_C=9.4x10^{-15}A and Ip_C =0.6779mA. Determine emitter injection efficiency(γ), base transport factor(α_T) and short circuit common base current gain(α). (5)

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