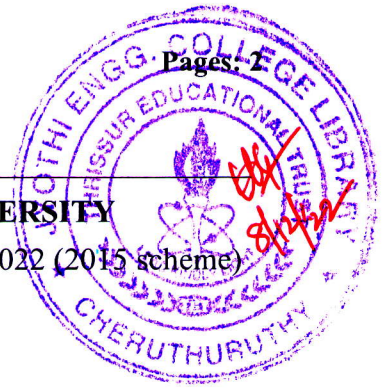


Reg No.: _____

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 $n_{0p0} = n_i^2$ from fundamentals. (7)
- b) A silicon sample is doped with 5×10^{16} As atoms/cm³ and 2×10^{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 $N_A = 10^{17} \text{cm}^{-3}$ and $N_D = 10^{15} \text{cm}^{-3}$, area of cross section $A = 10^{-3} \text{cm}^2$ and the lifetime in n and p regions be $1 \mu\text{s}$ at 300K. Determine the ideal diode current for applied voltage of 0.1 V. Given $D_p = 10 \text{cm}^2/\text{s}$, $D_n = 36 \text{cm}^2/\text{s}$. (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 $I_{E1} = 2.712 \times 10^{-6} \text{ A}$, $I_{E2} = 0.678 \text{ mA}$, $I_{C1} = 9.4 \times 10^{-15} \text{ A}$ and $I_{C2} = 0.6779 \text{ mA}$. Determine emitter injection efficiency (γ), base transport factor (α_T) and short circuit common base current gain (α).
