Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (R) (FT/WP) Examination November 2025 (2024 Scheme)

Course Code: PCECT302

Course Name: SOLID STATE DEVICES

Max. Marks: 60 Duration: 2 hours 30 minutes

PART A

		(Answer all questions. Each question carries 3 marks)	CO	Marks
1		Distinguish between lattice scattering and ionized impurity scattering	CO2	(3)
2		For a semiconductor under thermal equilibrium, effective densities of states in the conduction band and valence bands are given as $N_c = 10^{19} cm^{-3}$ and $N_v = 5x10^{18}$ cm^{-3}, Energy band gap is 2 eV. Calculate the intrinsic carrier concentration at 300K.	CO1	(3)
3		Define base width modulation and its impact on collector and base currents	CO3	(3)
4		Draw and explain current components in a p-n-p transistor	CO3	(3)
5		Distinguish between electron affinity and work function	CO4	(3)
6		Differentiate Ohmic and rectifying contacts	CO4	(3)
7		Define Sub threshold conduction in MOSFET	CO5	(3)
8		Explain the need for scaling?	CO5	(3)

PART B

(Answer any one full question from each module, each question carries 9 marks)

Module -1

9	a)	Illustrate the Generation and recombination mechanisms of excess carriers in semiconductors.	CO1	6
	b)	An n-type Si sample with $N_D = 10^{15} cm^{-3}$ is steadily illuminated such that $g_{op} = 10^{21}$ EHP/cm^3s. If $\tau_n = \tau_p = 1\mu s$ for this excitation, calculate the separation in the quasi-Fermi levels ($E_{Fn} - E_{Fp}$).	CO1	3

10	a)	Derive the expression for diffusion current density with suitable sketch.	CO2	9

Module -2

11	a)	Derive the expression for the built-in potential of a PN junction under thermal equilibrium.	CO3	5
	b)	An abrupt silicon PN junction has $N_A=10^{17}$ cm^{-3} on the p-side and $N_D=10^{15}$ cm^{-3} on the n-side. The relative permittivity of Si is 11.8. 1. Calculate the built-in voltage (V_0). 2. Width of depletion region (W)	CO3	4
12	a)	Derive the ideal diode equation with a neat sketch.	CO3	9

Module -3

13	a)	Draw and explain the C-V Characteristics of an Ideal MOS capacitor	CO4	6
	b)	Derive the expression for the threshold voltage of MOS Capacitor.	C04	3
14	a)	Draw and explain the energy band diagrams, of an ideal MOS capacitor under equilibrium, and inversion conditions.	CO4	5
	b)	An nMOS transistor has W/L= 4/2, gate oxide thickness 40 A^0, Mobility of electrons 180 cm^2/Vsec. The threshold voltage is 0.4 V, relative permittivity of gate oxide ϵ_{ox} =3.9. Calculate the drain current when i) V_{gs} = 1.5 V, V_{ds} = 1.8 V ii) V_{gs} = 1.5 V, V_{ds} = 0.3 V	CO4	4

Module -4

15	a)	Explain drain induced barrier lowering	CO5	3
	b)	Distinguish between constant voltage scaling and constant field scaling	CO5	6
16	a)	Draw and explain the structure and working of Fin FET.	CO5	6
	b)	Explain channel length modulation of MOSFET	C05	3

***