Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (S) Examinations (FT/WP) May 2026 (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	Outline the variation of mobility with temperature.	1	(3)
2	Derive Einstein's relation.	1	(3)
3	Draw the energy band diagram of the PNP transistor under a) zero bias b) active bias.	2	(3)
4	Explain emitter injection efficiency, base transport factor and current gain of a BJT.	2	(3)
5	Explain the threshold voltage equation of MOSFET.	3	(3)
6	What is the body effect in MOS devices?	3	(3)
7	Explain subthreshold conduction in MOSFET.	4	(3)
8	What is scaling and what is the need for scaling?	4	(3)

PART B

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

Module -1

			CO	Marks
9		With neat diagrams derive diffusion current density in a semiconductor	CO1	(9)
10	a)	An unknown semiconductor has Eg = 1.1 eV and Nc = Nv. It is doped with 10^{15} cm^{-3} donors, where the donor level is 0.2 eV below Ec. Given that E_F is 0.25 eV below Ec, calculate n_i and the concentration of electrons and holes in the semiconductor at 300 K.	CO1	(5)

	b)	Explain about generation and recombination of excess carriers	C01	(4)

Module -2

11		Derive an expression to find the width of depletion region in terms of doping concentration and contact potential for PN junction under no bias	CO2	(9)
12	a)	A Si p-n junction with cross-sectional area A = 0.001 cm^2 is formed with $Na = 10^{15}$ cm^{-3}, $Nd = 10^{17}$ cm^{-3}. Calculate: (a) Contact potential, V_0. (b) Space-charge width at equilibrium (zero bias).	CO2	(5)
	b)	Explain transistor action of BJT in detail.	CO2	(4)

Module -3

13		With neat band diagrams differentiate between accumulation, depletion and inversion regions of an ideal MOS capacitor.	CO3	(9)
14	a)	Explain the CV relation for a MOS capacitor with neat diagram	CO3	(5)
	b)	For an n-channel MOSFET with a gate oxide thickness of 10 nm, V_T = 0.6 V, and Z = 25 um, L = 1um. Calculate the drain current at VG = 5 V and VD = 0.1 V. Repeat for V_G = 3 V and V_D = 5 V. Discuss what happens for V_D = 7 V. Assume an electron channel mobility of un = 200 cm^2/V-s,Cox =3.45 x 10^{-7} F.	CO3	(4)

Module -4

15		Explain channel length modulation, DIBL and velocity saturation in detail.	CO4	(9)
16	a)	Explain in detail about the structure and working of MESFET.	CO4	(4)
	b)	Compare and contrast voltage scaling and field scaling.	CO4	(5)

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