Printed Pages: 1/2

Subject Code* EEC-201

Roll No

B.TECH.
Year: 2nd Semester: IV
MINOR TEST (EXAMINATION): 2025-26
Semiconductor Devices and Applications

Time: 2 Hr. **Max. Marks: 30**

Note- Answer all questions

			Marks	CO	BL	PO	PI Cod
Q1.		Attempt any **Three** parts of the following. **(Unit-1 & Unit-2)**					
	a)	Define effective mass of an electron. Derive the expression of effective mass using the E–k relation.	4	1	2, 3		
	b)	Using the relation $\mu \propto T^{-m}$, discuss how the mobility of charge carriers changes with temperature within the range of 100K to 400K.	4	2	2, 3, 4		
	c)	Derive the expression for the width of the depletion region W of an open-circuited P–N. junction in terms of V_0, N_A, N_D, and permittivity ε.	4	1	3, 4		
	d)	Consider a silicon pn junction at T = 300 K with a p-type doping concentration of $N_a = 2 \times 10^{17}$ cm^3. Determine the n-type doping concentration such that the maximum electric field is $E_{max} = 2.5 \times 10^5$ V/cm at a reverse-biased voltage of $V_R = 25$ V.	4	1	3, 4, 5		
Q2.		Attempt any **Three** parts of the following. **(Unit 1)**					
	a)	State and explain Maxwell–Boltzmann approximation. Mention its validity condition. Assuming the Boltzmann approximation applies, write the equations for n0 and p0 in terms of the Fermi energy.	3	1	3, 4, 5		
	b)	State and explain the mass-action law. show how to calculate the minority carrier concentration in an **n-type** semiconductor if the donor concentration (N_D) is known.	3	1	2, 3, 4, 5		
	c)	Consider a gallium arsenide sample at T=300 K with doping concentrations of N_a=0 and N_d=10^{16} cm^3. Assume complete ionization and assume electron and hole mobilities given in Table. Calculate the drift current density if the applied electric field is E=10V/cm.	3	2	2, 3, 4		

	μ_n (cm^2/V-s)	μ_p (cm^2/V-s)
Silicon	1350	480
Gallium arsenide	8500	400
Germanium	3900	1900

	d)	Explain n-type and p-type semiconductors and the role of donor and acceptor impurities.	3	1	2, 3	
Q3.		Attempt any **Three** parts of the following.				
	a)	Sketch the depletion region charge profile, electric field profile E(x), electrostatic potential $\phi(x)$, across the depletion region of an abrupt P–N junction at equilibrium.	3	2	2, 3, 4	
	b)	Discuss the effect of doping concentration on the width of the depletion region in a P–N junction diode with the diagram.	3	2	3, 4, 5	
	c)	Derive the expression for maximum electric field intensity E_{max} in the depletion region of an open-circuited P–N junction and show its relationship with V0 and W.	3	2	3, 4	
	d)	A silicon diode indicates forward current of 2mA and 10mA when forward voltage are 0.6V and 0.7V respectively. Estimate the operating temperature of the diode junction.	3	2	3, 4, 5	

BL – Bloom's Taxonomy Levels (1- Remembering, 2- Understanding, 3 – Applying, 4 – Analysing, 5– Evaluating, 6 - Creating)

CO – Course Outcomes

PO – Program Outcomes (As per Examination Reform Policy by AICTE Page No. 15)

PI Code – Performance Indicator Code