Course Code: D2515703

BONAM VENKATA CHALAMAYYA INSTITUTE OF TECHNOLOGY & SCIENCE

(AUTONOMOUS)

I – M.Tech I - Semester Regular Examinations (BR25), Feb - 2026

MOS DEVICE PHYSICS

Time: 3 hours | Max. Marks: 60

Answer any Five Questions One Question from One UNIT
ALL the Questions Carry Equal Marks

		Marks	CO	BL
	UNIT-I			
1.a)	Explain the three modes of operation (Accumulation, Depletion, and Inversion) for an ideal p-type MOS capacitor.	6M	CO1	L2
b)	Apply the Depletion Approximation to solve the 1D Poisson's equation for a MOS capacitor. Derive expressions for the surface potential (ϕ_s), electric field, and depletion region width (W_{dep}). Discuss the accurate solution of Poisson's Equation in a MOS structure.	6M	CO1	L3
	OR			
2.a)	Define and derive the Threshold Voltage (V_T) for an ideal MOS capacitor. How do factors like substrate doping concentration (N_A or N_D) and oxide thickness (t_{ox}) affect the threshold voltage?	6M	CO1	L3
b)	Explain low frequency and high frequency C-V characteristics of a MOS capacitor with diagrams.	6M	CO1	L2
	UNIT-II			
3.a)	Describe subthreshold conduction in MOSFETs and explain the concept of subthreshold slope.	6M	CO2	L2
b)	Derive the drain current (I_D) equation for an n-channel MOSFET using the drift-diffusion model.	6M	CO2	L4
	OR			
4.a)	Describe the physical origin of current flow when $V_{GS}<V_T$. Derive the expression for sub-threshold swing (S).	6M	CO2	L4
b)	Identify the various Intrinsic Resistances in a MOSFET and explain their impact on the high-frequency performance of the device.	6M	CO2	L3
	UNIT-III			
5.a)	Write short notes on single transistor latch effect and the ZRAM device.	6M	CO3	L2
b)	Discuss the evolution of Bulk vs. SOI FETs as outlined in the International Technology Roadmap for Semiconductors (ITRS).	6M	CO3	L2
	OR			
6.a)	Explain the structure of PDSOI and FDSOI MOSFETs with neat diagrams.	6M	CO3	L2
b)	Detailed explanation of the Floating Body Effect in SOI devices. How does it lead to history-dependent behaviour and parasitic bipolar action?	6M	CO3	L4
	UNIT-IV			
7.a)	Write short notes on quantum transport effects in nanoscale transistors.	6M	CO4	L2
b)	Explain the fundamental differences between diffusive, quasi-ballistic, and ballistic transport regimes in nanoscale transistors.	6M	CO4	L2
	OR			

		Marks	CO	BL
8.a)	Explain the Boltzmann Transport Equation (BTE) and the relaxation-time approximation in the context of semi-classical transport theory.	6M	CO4	L2
b)	Describe quasi-ballistic transport and its relevance to nanoscale transistor operation.	6M	CO4	L2
	UNIT-V	**Marks**	**CO**	**BL**
9.a)	Compare the scaling potential of Planar, FinFET, and Gate-All-Around (GAA) architectures.	6M	CO5	L4
b)	Explain strain engineered channel materials used in advanced MOSFETs.	6M	CO5	L2
	OR			
10.a)	Write short notes on FinFET structure and advantages over bulk MOSFETs.	6M	CO5	L2
b)	Analyse the potential distribution in a symmetric Double-Gate MOSFET. Use Poisson's equation to explain the "volume inversion" effect and how it leads to improved drive current and reduced leakage.	6M	CO5	L4

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