

M. Tech.

MICROELECTRONICS TECHNOLOGY

SUBJECT CODE : EC - 521 (Elective - IV)Paper ID : [E0578]

[Note : Please fill subject code and paper ID on OMR]

Time : 03 Hours

Maximum Marks : 100

Instruction to Candidates:

- 1) Attempt any **Five** questions.
- 2) All questions carry equal marks.

- Q1)** Derive the current equation for an enhancement mode NMOS transistor in saturation. Describe the each term involved. How does the equation get modified for PMOS transistor? Is the same equation valid for depletion transistors?
- Q2)** (a) Derive an expression for the Logic Threshold voltage of a E/D NMOS inverter.
(b) If $V_{TD} = -3.5$ V, $V_{TN} = 1$ V in a depletion-load NMOS inverter and supply voltage is 5 V. Determine the inverter ratio K for a symmetric switching point.
- Q3)** (a) Describe with illustrations, the p-well CMOS' fabrication process to show how a CMOS inverter is fabricated.
(b) Draw the stick diagram of a 2-input XOR gate circuit in 2-metal single poly CMOS technology.
- Q4)** (a) Find τ_{PHL} for a load of 1 pF driven by a 20-k Ω resistive-load inverter circuit, where $\mu_n \cdot C_{ox} = 25$ μ A/V², W/L = 10, $V_{T0} = 0.7$ V. Assume input to be ideal rectangular pulse switching between 0 V and 3.3 V.
(b) What are Super Buffers? Explain.
- Q5)** (a) What is sheet resistance of a material? A particular layer of MOS circuit has a resistivity $\rho = 1$ Ω cm. A section of this layer is 55 μ m long and 5 μ m wide and has a thickness of 1 μ m. Calculate the resistance, R from one end of this section to the other along the length in terms of sheet resistance R_o . What is the value of R_o ? What is the absolute value of R?

(b) Discuss the capacitive model of a MOSFET.

Q6) (a) What do you understand by Constant-Voltage and Constant-Field Scaling? How do the various performance parameters scale in both of these theories?

(b) Calculate the approximate (i) dynamic and (ii) short-circuit power dissipated in a chip (with 10,000 equivalent inverters) operating with a V_{DD} of 5 V at 100 MHz with an internal switched capacitance of 300 pF. The average rise/fall time is 200 ps. Assume $|V_{Tn}| = |V_{Tp}| = 1$ V, $\beta_n = \beta_p = 60 \mu\text{A}/\text{V}^2$.

Q7) Do the modular design of an n-bit gray to binary code converter. Evolve the schematic of a cell. Use this cell to design a 3-bit converter.

Q8) Write short notes on any two of the following :

(a) Limits of scaling in MOS circuits.

(b) Latch-up in CMOS.

(c) Channel length modulation.

