Time: 3 Hours **Marks: 80**

Instructions:

1. Assume suitable **data** if necessary.
2. Question **No.1 is Compulsory**.
3. Solve any **Three** Questions from **Q.2 to Q.6**.
4. Figures to Right Indicates **Marks**.

Q1) Solve **any Four.** (20 Marks)

a. Explain voltage transfer characteristics (VTC) of CMOS inverter.
b. Implement a 2x1 multiplexer using CMOS transmission gates (TG).
c. Explain 1T DRAM cell.
d. Draw 4x4 NAND- based ROM array (using Transistor) memory for following table,

R1	R2	R3	R4	C1	C2	C3	C4
1	0	0	0	1	1	0	1
0	1	0	0	1	0	0	1
0	0	1	0	1	0	1	0
0	0	0	1	1	0	0	1

e. Explain short channel effects in VLSI.
f. Define Channel Pinch-off with condition and Write drain current equations for Linear and Saturation region.

Q2) Solve the following. (20 Marks)

a. Compare the two technology scaling methods, namely, (i) the constant electric-field scaling and (ii) the constant power-supply voltage scaling. In particular, show analytically by using equations how the **oxide capacitance, drain current in saturation, and power dissipation** are affected in terms of the scaling factor, S.
b. Consider a CMOS inverter circuit with V_{DD}= 3.3 V, k_n = 200 µA/V ^{2}, k_p = 80 µA/V ^{2} V_{thn}= 0.6 V, V_{thp}= -0.7 V, k_r = 2.5. Calculate the critical voltages *(V_{OL}, V_{OH}, V_{IL}, V_{IH})* on the VTC and find the noise margins of the circuit.

Q3) Solve the following. (20 Marks)

a. Draw and explain 6T-SRAM Memory.
b. Explain steps for fabrication process of a CMOS transistor with neat diagram.

Q4) Solve the following. (20 Marks)

a. Draw an RTL of 4-bit Ripple Carry Adder (RCA) and Carry Save Adder (CSA).
b. Implement a following function using Static CMOS, Pseudo NMOS, Dynamic CMOS and Domino Logic.

$$Y = A.B$$

5) Solve the following. (20 Marks)

a. Draw a CMOS Logic and Physical layout for 2-input NAND Gate.
b. Draw and explain 3T-DRAM memory.

Q6) Solve the following. (20 Marks)

a. Implement using CMOS Logic 1-bit Full adder and D latch using Transmission Gates (TG).
b. Write a short note on Clock Generation, Distribution and ESD Protection.

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