

- N.B. :** (1) Question No. 1 is compulsory.
 (2) Solve any four out of remaining six questions.
 (3) Assume suitable data wherever necessary.

1. (a) Explain various types of integrated circuit capacitors and their structures as implemented in silicon crystal. 10
 (b) Cite the merits and demerits of MOS integrated circuits. 5
 (c) Define LSI, MSI and ULSI circuits. 5
2. (a) Calculate the threshold voltage V_T for a polysilicon n-channel MOS transistor with substrate doping density $N_A = 10^{16} \text{ cm}^{-3}$, polysilicon gate doping density $N_D = 2 \times 10^{20} \text{ cm}^{-3}$, $t_{ox} = 500 \text{ \AA}$, oxide interface fixed charge density $N_{ox} = 4 \times 10^{10} \text{ cm}^{-2}$, substrate bias potential $V_{SB} = 0$ and $\phi_F(\text{gate}) = 0.55 \text{ V}$. 10
 (b) Explain different short-channel effects in MOS transistor. 10
3. (a) Draw circuit diagram and stick diagram of NMOS 2- I/P NAND gate with depletion mode pull up. Assume inverter ratio of 4:1 is desired. Draw its physical layout. 10
 (b) Explain the need of design rules and explain significance of λ -based design rules. 10
4. (a) Discuss different scaling technologies present in VLSI. Write down their advantages and disadvantages. 10
 (b) Discuss different parasitic effects in MOS transistors. 10
5. (a) What do you mean by lithography ? 10
 Explain different types of photolithography in brief.
 (b) Differentiate between diffusion and ion-implantation technique. 10
6. (a) Describe different fabrication steps of CMOS inverter. Also sketch the masking steps in cross-sectional view. 10
 (b) What is epitaxy ? Explain any one process in detail. 10
7. Write short notes on any two : 20
 (a) MOSFET Operation
 (b) MOSFET Capacitances
 (c) BJT Fabrication.