



Menoufia University

Faculty of Electronic Engineering
2nd year. 1st Term Exam.

Very large scale Integrated Circuit Technology
First Paper Time allowed: 1.5 hours



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ANSWER ALL QUESTIONS:

1. a) Explain wafer pure Silicon three steps method of production?
b) What are the fabrication four processes of Poly silicon self-align gate NMOS Tr.? (use color in your explication)

- 2- An n-channel MOS transistor has the following properties:
 - Substrate Doping Concentration, $N_A = 2 \times 10^{16} \text{ cm}^{-3}$
 - Metal Gate Fermi Potential, $\phi_{FM} = 0.6 \text{ V}$
 - Oxide Concentration, $N_{ox} = 10^{10} \text{ cm}^{-2}$
 - Free Space Permittivity = $8.85 \times 10^{-14} \text{ F/cm}^{-1}$
 - Permittivity of Silicon, $\epsilon_{Si} = 11.7$
 - Permittivity of Silicon Dioxide, $\epsilon_{ox} = 3.97$
 - Oxide Layer Thickness, $t_{ox} = 50 \times 10^{-7}$
 - The transistor $W = 20 \mu\text{m}$ and $L = 0.5 \mu\text{m}$
 - The mobility is $500 \text{ cm}^2/\text{V}$
 - a) Determine the threshold voltage, V_{tn0} , of the transistor with no source-body bias if $q = 1.6 \times 10^{-19} \text{ C}$, $n_i = 1.5 \times 10^{10}$ and $kT/q = 26 \text{ mV}$ @ 300°K .
 - b) Calculate the drain current for an NMOS transistor operating with $V_{GS} = 5 \text{ V}$ and $V_{DS} = 3 \text{ V}$ if $V_{TN} = 1 \text{ V}$ and $K_n = 1 \text{ mA/V}^2$. What is the W/L ratio of this device if $K_n^2 = 40 \mu\text{A/V}^2$? What is W if $L = 0.35 \mu\text{m}$?

- 3- Design a resistive load inverter with $R = 1 \text{ k}\Omega$, Such that $V_{OL} = 0.6 \text{ V}$.

When nMOS drive transistor has the following parameters: $V_{DD} = 5.0 \text{ V}$, $V_{tn0} = 1.0 \text{ V}$, $\gamma = 0.0 \text{ V}^{0.5}$, $\lambda = 0.0 \text{ V}^{-1}$, $k' = 22 \mu\text{A/V}^2$.

- a) Determine the request aspect ratio, W/L .
- b) Determine V_{OH} , V_{IL} . (Draw Drain current Characteristic curve of NMOS with Load Line to know the operation points of your calculated voltage)
- c) Determine noise Margins NML and NMH. If $V_{IH} = 2.45 \text{ V}$
- d) Draw layout and Stick diagram, for $W/L = 4$ and $R_{sheet} \text{ poly} = 0.2 \text{ k}\Omega$

