



COLLEGE OF ENGINEERING & TECHNOLOGY

Department: Electronics and Communications Engineering

Course Title: Electronic Devices I I

Course Code: EC332

Cairo Branch

Sheet 2

I. Indicate whether each of the following statements is true or false (give reasons):

1. The P-Channel MOSFET is the transistor with P-Substrate.
2. Threshold voltage is the minimum voltage needed to be applied between Drain and source terminals to induce a channel.
3. For N-Channel MOSFET when the voltage applied between gate and source is greater than threshold voltage the transistor is on.
4. When the voltage applied between drain and source terminals is less than the over drive voltage then the transistor is in triode mode.
5. The channel of n-MOS transistor starts to taper when the voltage applied between drain and source terminals exceed the over drives voltage.
6. Saturation region is the region in which the relation between the transistor current and the voltage applied between the drain and gate terminals is linear.
7. For P-Channel transistor the source and drain areas are heavily doped by donor atoms.

II. Complete the following table:

#	Channel Type	V_T	V_S	V_G	V_D	Mode
a	N	1	0	3	2.1	
b	N	2	-2	2	-0.1	
c	P	-2	0	-1	-3	
d	P	-1	2	0	-1	
e		2	-3	0		Saturation
f		-2	3	0	-1	
g		-2	3		-3	Cutoff

III- For an n-Channel enhancement MOSFET having $\mu_n C_{ox} = 20 \mu A/V^2$, $W/L = 10$, and $V_t = 1 \text{ v}$ is operated with $V_S = 0 \text{ v}$ and $V_G = 2 \text{ v}$.

- a- For What Range of values of V_D on the drain the transistor will operate in triode mode?
- b- What current flows for : i- $V_{DS} = 2V$ ii- $V_{DS} = 1V$ iii- $V_{DS} = 0.5 V$.
- c- What is the value of r_{DS} for V_{DS} relatively small ?
- d- What is the value of V_{DS} that makes r_{DS} increase beyond its very low-voltage value by 10%?

IV - An n-MOS device operating with a small Drain-source voltage serves as a resistor. If the maximum voltage if the supply available is 1.8 V, What is the minimum on resistance that can be achieved with $W=L=20$, $V_t = 0.4 \text{ v}$?

V- It is possible to define an “intrinsic time Constant” for a MOSFET operating as a resistor $\tau = R_{on} C_{GS}$ where $C_{GS} = WLC_{ox}$:

- a- Find expression for τ .
- b- Explain what the circuit designer must do to minimize the time constant.