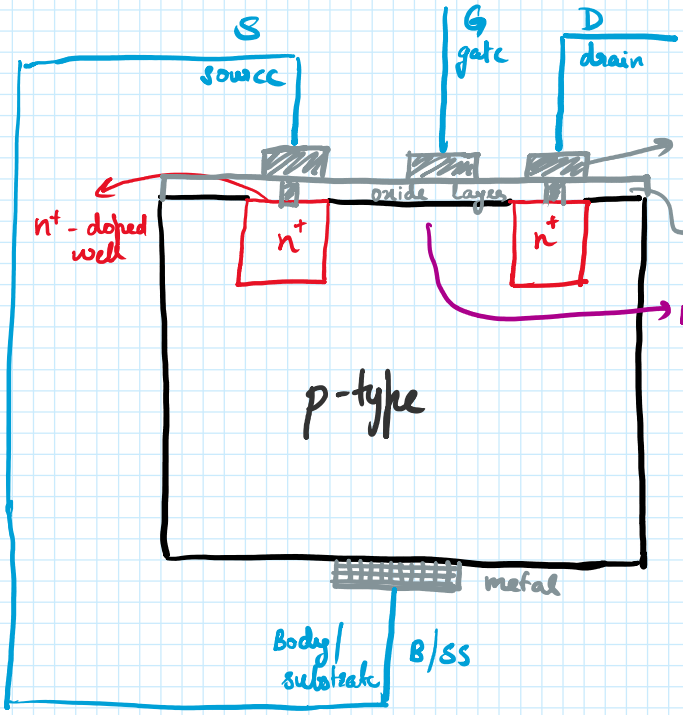
10. MOSFET

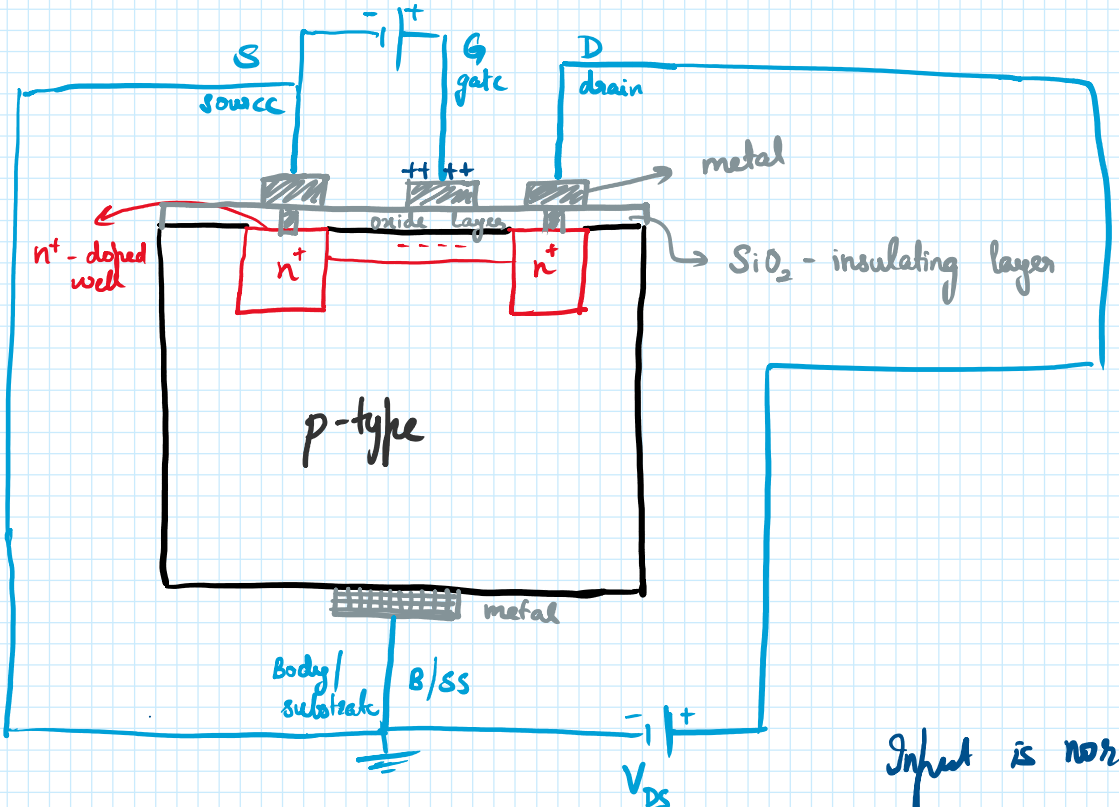
04 October 2023 11:39

MOSFET

Metal Oxide Semiconductor Field Effect Transistor



n - channel enhanced type MOSFET



- Gate V_T

  $V_{GS} > V_T$ → only then MOSFET is ON ($I_D = I_C$)

Input is normally V_{GS}

$$I_D = -k\left(V_{GS} - V_T\right)^2$$

$k =$ $I_{D(on)}$

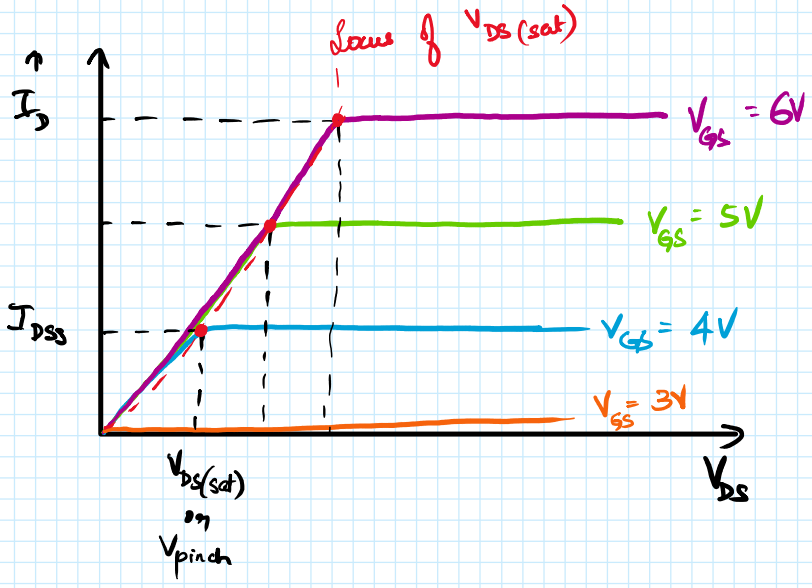
$V_{GS} > V_T$ only then → MOSFET is ON ($I_D = I_S$)

- Keeping $V_{GS} > V_T$ as constant, increase V_{DS} as (I_D or I_S) ↑
- V_{DS} ↑ till V_{DSS} (saturated) or V_{pinch}

I_{DSS} → max current (saturated)

$$k = \frac{I_{D(ON)}}{(V_{GS(ON)} - V_T)^2}$$

Drain / Output Characteristics



$$V_{DS(sat)} = V_{GS} - V_T$$

$$k = \frac{I_{D(on)}}{(V_{GS(on)} - V_T)^2}$$

NUMERICALS

① If $V_{GS} = 6V$ and $V_T = 3V$, find $V_{DS(sat)}$

Soln $V_{DS(sat)} = V_{GS} - V_T$

$= 6 - 3$

$= \underline{3V}$

② For $V_{GS} = 6V$, $I_D = 10mA$, find k

Soln $k = \frac{I_D}{(V_{GS} - V_T)^2}$

$k = \frac{10 \times 10^{-3}}{(6-3)^2} = \frac{10 \times 10^{-3}}{9} = 1.11\ mA/V^2$

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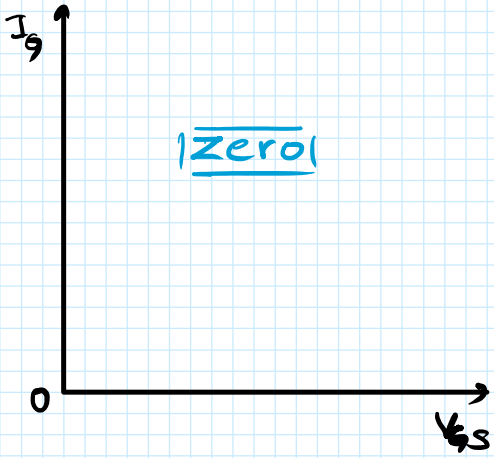
Input or Gate Characteristics



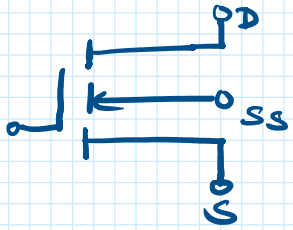
Difference from BJT

- MOSFET → voltage controlled
- Higher input impedance for MOSFET

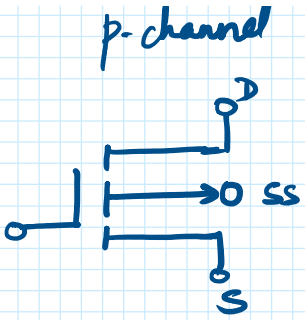
n-channel

p-channel

n - channel



p- channel



- source and drain is interchangeable as they are made of same material, same doping concentration