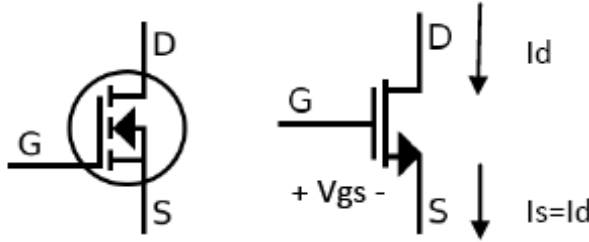


## ECE250 NMOSFET Equation Sheet (For Final Exam)

NMOSFET Sym



**Ohmic Mode**       $V_{gs} - V_{ds} > V_{TN}$        $I_d = K_N \cdot [2 \cdot (V_{gs} - V_{TN}) \cdot V_{ds} - V_{ds}^2]$

**Saturation Mode:**       $V_{gs} - V_{ds} < V_{TN}$        $I_d = K_N \cdot (V_{gs} - V_{TN})^2$

**Conduction Parameter:**       $K_N = k_N \cdot \frac{W}{2 \cdot L}$       Where  $k_N = \text{process gain}$ :       $k_N = \frac{\mu_n \cdot \epsilon_0 \cdot \epsilon_{ox}}{t_{ox}}$

$W = \text{Channel\_Width}$        $L = \text{Channel\_Length}$        $\mu_n = \text{Surface\_Mobility\_of\_Electrons\_in\_Silicon}$

$\epsilon_0 = 8.854 \cdot 10^{-12} \cdot \frac{F}{m}$        $\epsilon_{ox} = 3.9$        $t_{ox} = \text{Gate\_Oxide\_Thickness}$

**Small Signal AC Model of NMOSFET:**

$$g_m = \left[ \frac{d \cdot [K_N \cdot (V_{gs} - V_{TN})^2]}{dV_{gs}} \right]_{Q-Pt} = 2 \cdot K_N \cdot (V_{gsQ} - V_{TN}) \quad r_o = \frac{1}{\lambda \cdot I_{dQ}} = \frac{V_M}{I_{dQ}}$$

