Chapter 5 MOSFETs

Triode Mode

$$I_D = k_n'\left(\frac{W}{L}\right)\left[(V_{GS}-V_t)V_{DS} - \frac{1}{2}V_{DS}^2\right)$$

$n \to p$ for PMOS

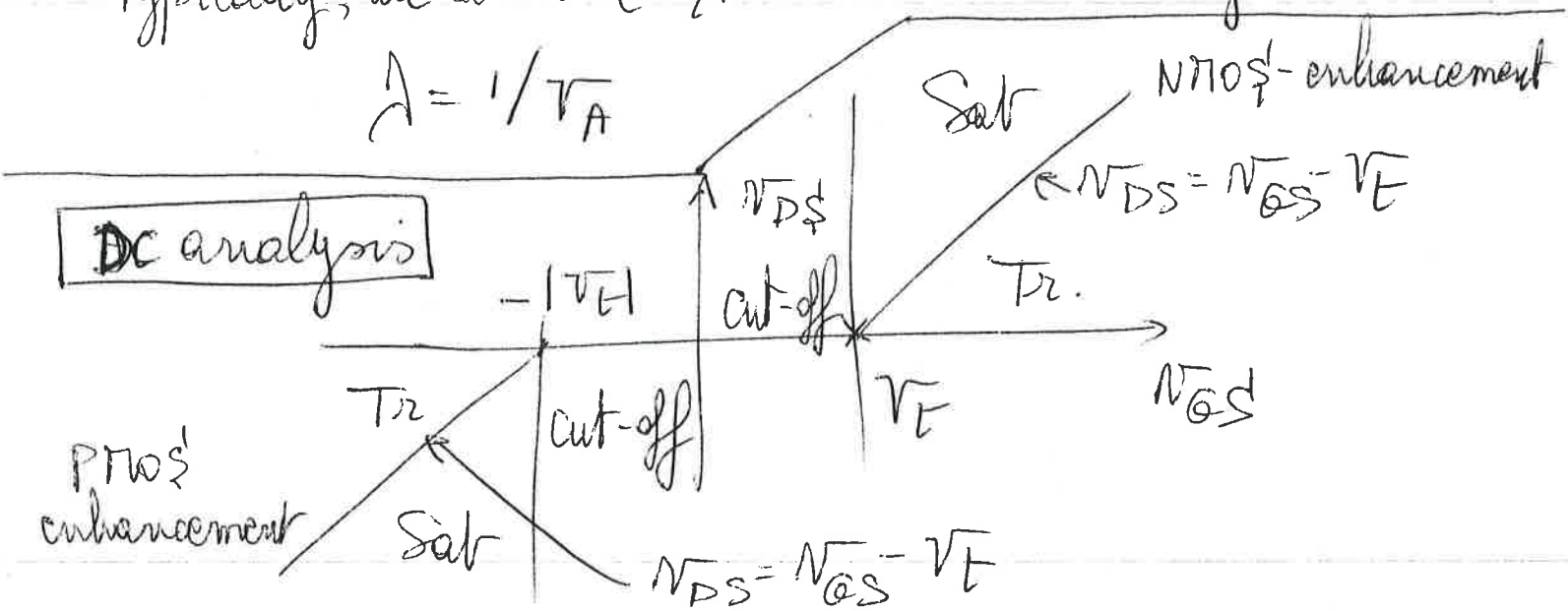
Saturation Mode

$$I_D = \frac{1}{2}k_n'\left(\frac{W}{L}\right)\left[V_{GS}-V_t\right)^2\left(1+\lambda V_{DS}\right)$$

Typically, we assume $\lambda = 0$ in DC analysis.

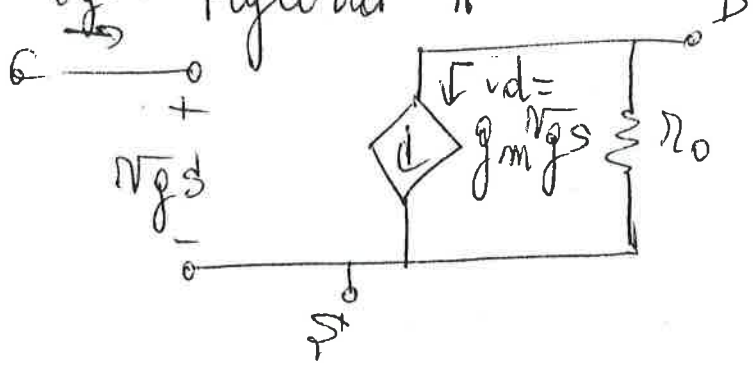
$\lambda = 1/V_A$

DC analysis



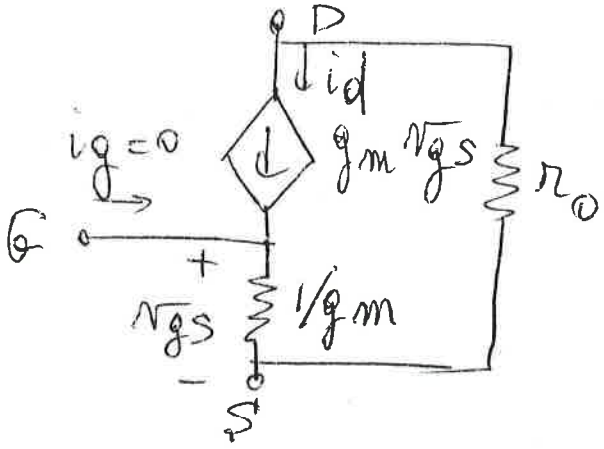
AC analysis

$i_g = 0$ Hybrid-π



$$g_m = k_n' \frac{W}{L}\left(V_{GS}-V_t\right)$$

T-Model



$$r_o = \frac{V_A}{I_D}\ ;\quad r_o = \infty \text{ if neglected}$$

Chapter 6 BJTs

DC Equations

$$I_C = I_S e^{|V_{BE}|/V_T}$$

$V_T = 25\,mV$ at $300K$

$I_B = I_E/(\beta+1)$

$I_B = I_C/\beta$

$I_C = \alpha I_E$

$\alpha = \frac{\beta}{\beta+1}$

$\beta = \frac{\alpha}{1-\alpha}$

AC equations

$$V_{be} = V_\pi = r_e i_e = r_\pi i_b$$

$$i_c = g_m V_{be}$$

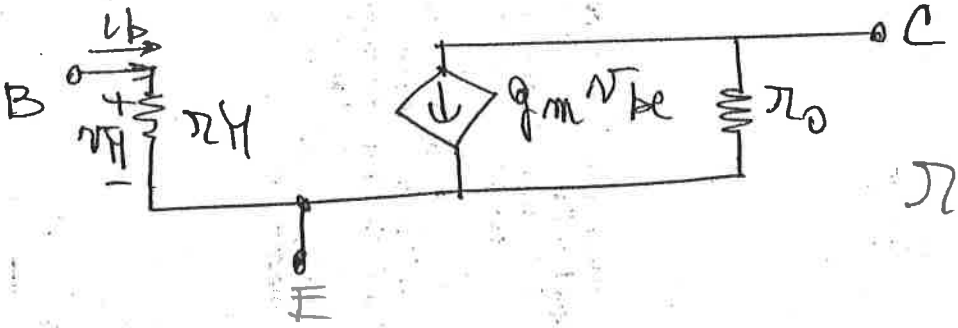
$r_\pi = \frac{V_T}{I_B}$

$r_e = \frac{V_T}{I_E}$

$g_m = \frac{I_C}{V_T}$

Small signal equivalent circuit

π- model



$r_o = \frac{V_A}{I_C}$

T- model