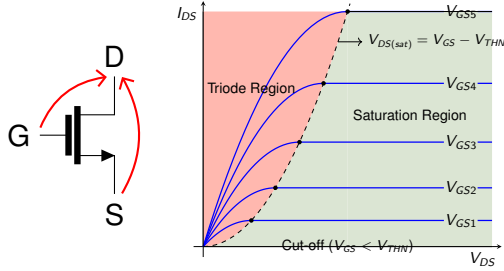
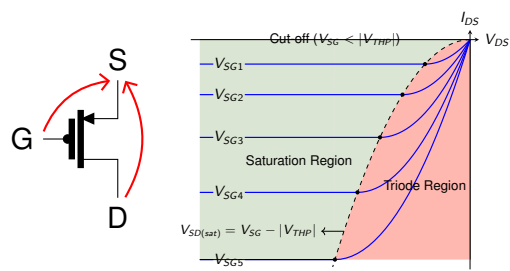


MOSFET Device Equation Sheet

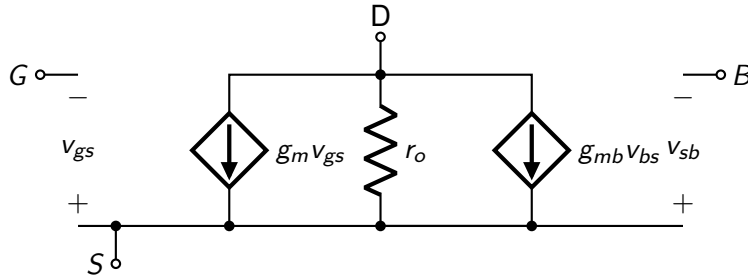
Dr. Roshan Weerasekera

Large Signal Models:

	NMOS	PMOS
	 $k_n = k'_n \frac{W}{L}; k'_n = \mu_n C_{ox}; V_{THN} > 0$	 $k_p = k'_p \frac{W}{L}; k'_p = \mu_p C_{ox}; V_{THP} < 0$
Cut-off	$V_{GS} < V_{THN}$ $I_{DS} = 0$	$V_{SG} < V_{THP} $ $I_{SD} = 0$
Triode	$V_{GS} \geq V_{THN}$ and $V_{DS} < V_{GS} - V_{THN}$ $I_{DS} = \frac{k_n}{2} \{2(V_{GS} - V_{THN})V_{DS} - V_{DS}^2\}$	$V_{SG} \geq V_{THP} $ and $V_{SD} < V_{SG} - V_{THP} $ $I_{SD} = \frac{k_p}{2} \{2(V_{SG} - V_{THP})V_{SD} - V_{SD}^2\}$
Saturation (Active)	$V_{GS} > V_{THN}$ and $V_{DS} \geq V_{GS} - V_{THN}$ $I_{DS} = \frac{k_n}{2} (V_{GS} - V_{THN})^2 (1 + \lambda_n V_{DS})$	$V_{SG} > V_{THP} $ and $V_{SD} \geq V_{SG} - V_{THP} $ $I_{SD} = \frac{k_p}{2} (V_{SG} - V_{THP})^2 (1 + \lambda_p V_{SD})$

Small Signal Model:

Hybrid-pi Model



$$g_m = \mu_n C_{ox} \frac{W}{L} (V_{GS} - V_{TH}) = \sqrt{2\mu_n C_{ox} \frac{W}{L} I_D} = \frac{2I_D}{(V_{GS} - V_{TH})}$$

$$g_{mb} = \eta g_m; r_o = \frac{1}{\lambda I_D} = \frac{V_A}{I_D}$$

T Model

