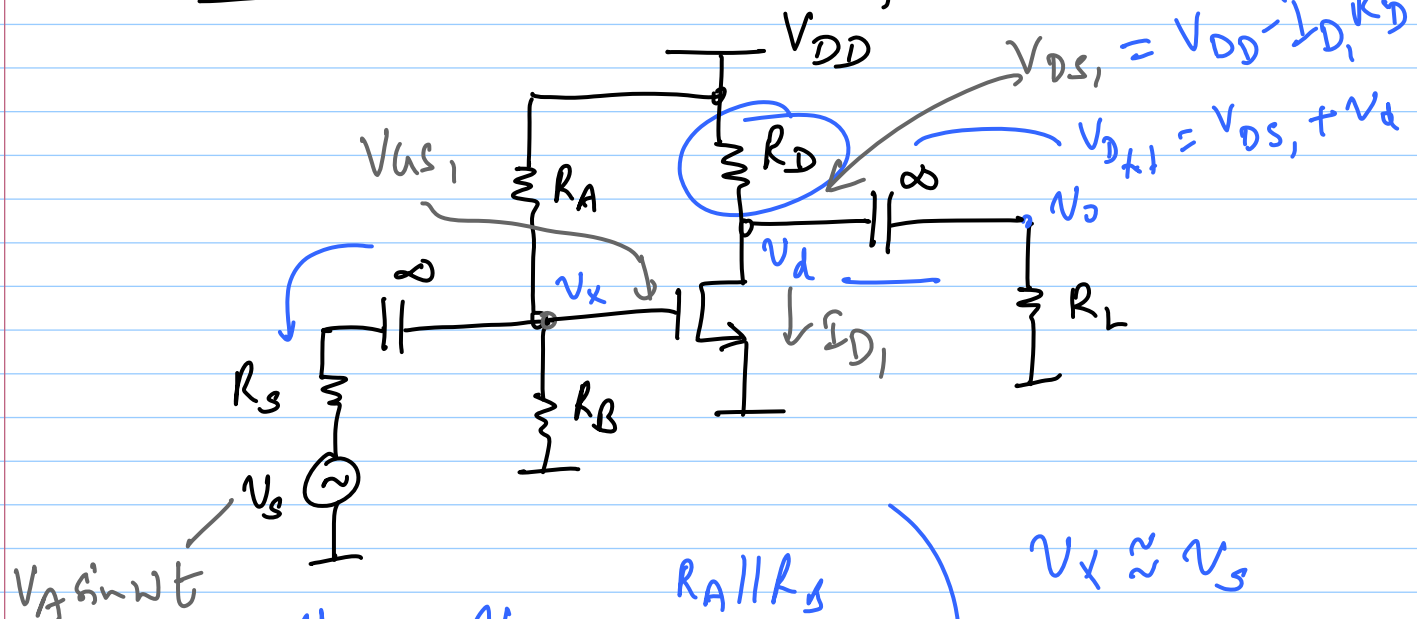
16-8-12

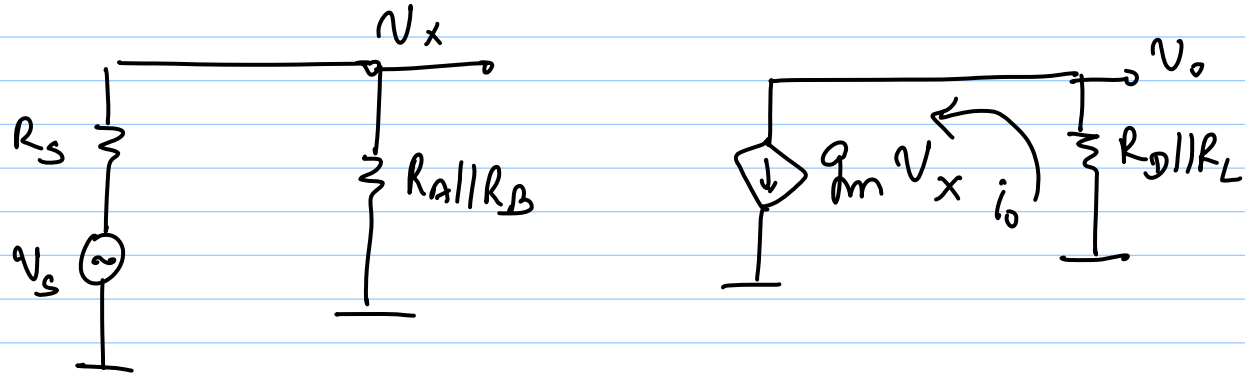
Lec 9

Common Source Amplifier



$$V_x = V_s \cdot \frac{R_A \| R_B}{R_A \| R_B + R_s}$$

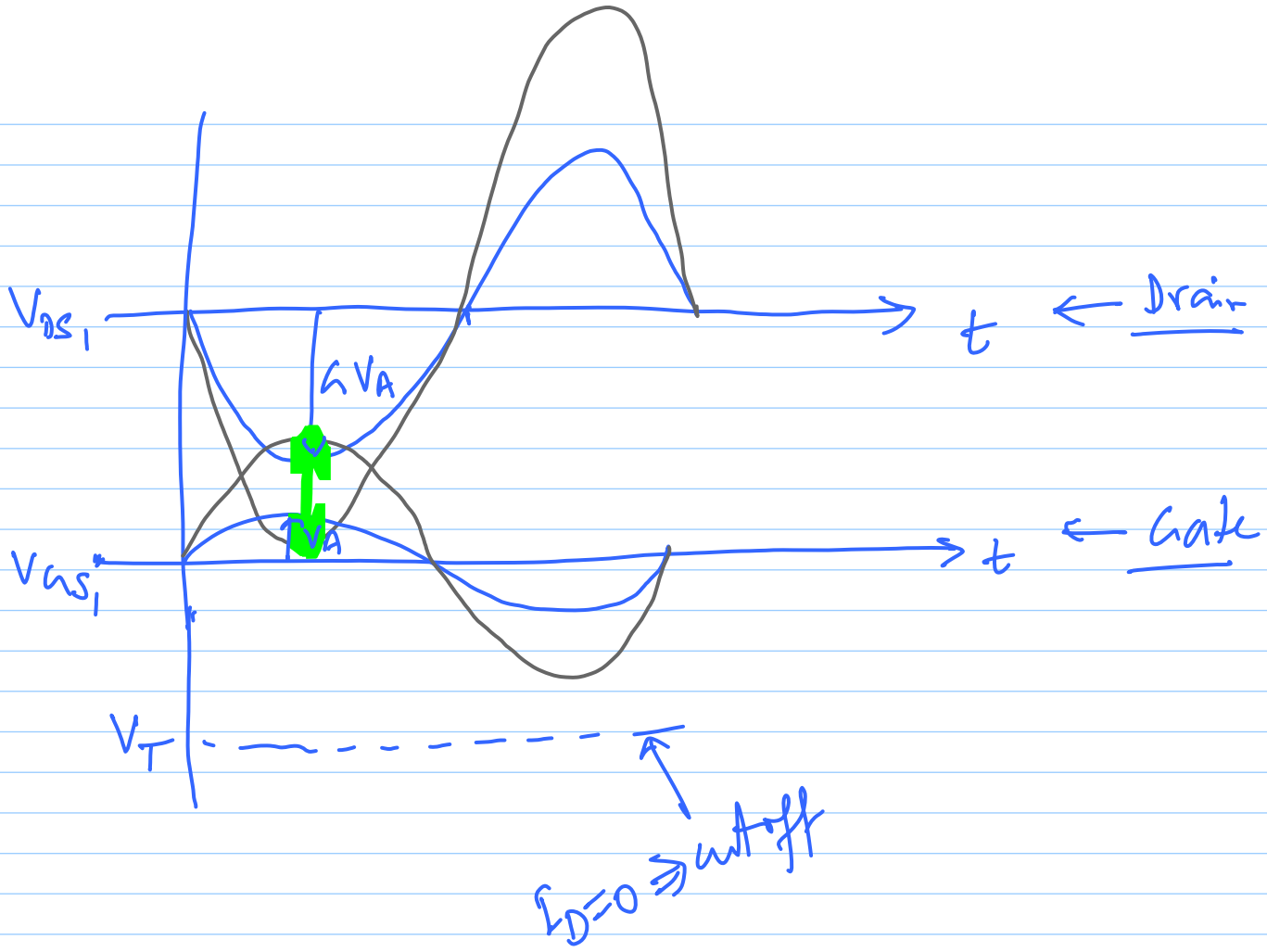
$V_x \simeq V_s$

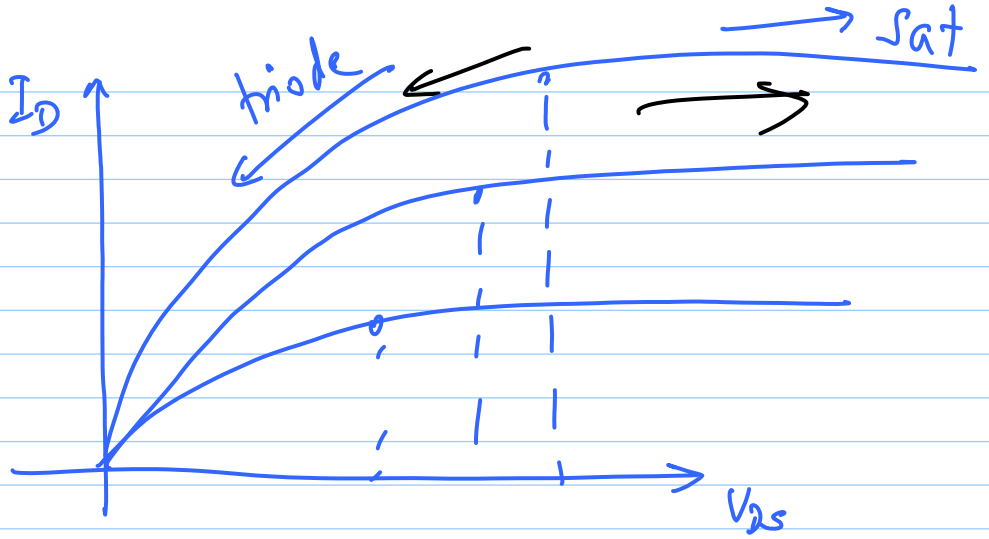


$$\frac{V_o}{V_s} = \frac{V_x}{V_s} \cdot \frac{V_o}{V_x} = \frac{V_x}{V_s} \cdot \frac{i_o}{V_x} \cdot \frac{V_o}{i_o}$$

$$= \frac{R_A \| R_B}{R_A \| R_B + R_s} \cdot \{-g_m (R_D \| R_L)\}$$

$$\simeq -g_m (R_D \| R_L) = -G$$





$$V_{DS} = V_{GS} - V_T$$

$$V_D - V_S = V_G - V_S - V_T$$

$$\boxed{V_D = V_G - V_T}$$ limit of triode region

In triode

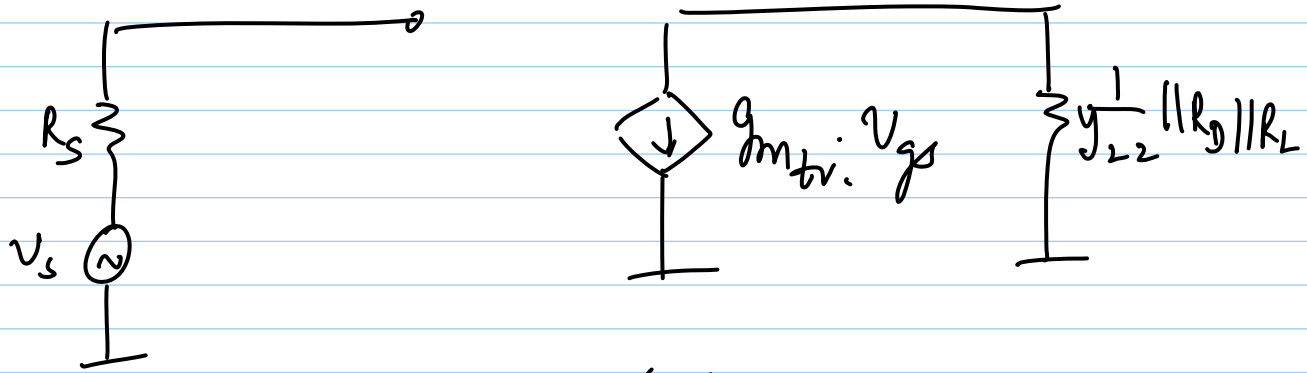
$$I_D = \mu_n C_{ox} \left(\frac{W}{L}\right) \left[(V_{GS} - V_T) V_{DS} - \frac{V_{DS}^2}{2} \right]$$

$$y = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} \qquad y_{11} = 0 \qquad y_{12} = 0$$

$$y_{21} = \frac{\partial I_D}{\partial V_{GS}} = \mu_n C_{ox} \left(\frac{W}{L}\right) V_{DS} = g_{m_{triode}}$$

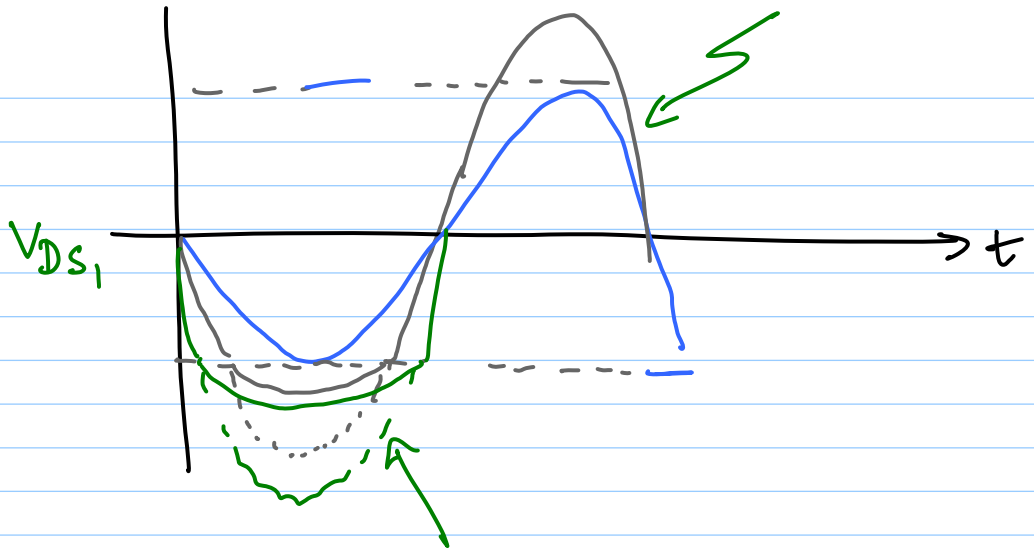
$$g_{m_{sat.}} = \mu_n C_{ox} \left(\frac{W}{L}\right) (V_{GS} - V_T)$$

$$y_{22} = \partial I_D / \partial V_{DS} = \mu_n C_{ox} \left(\frac{W}{L}\right) (V_{GS} - V_T - V_{DS})$$



$$gain = -g_{m_{tr.}} \cdot \left(\frac{1}{y_{22}} \| R_D \| R_L \right)$$

< gain in sat.


V_{DS_1}
t