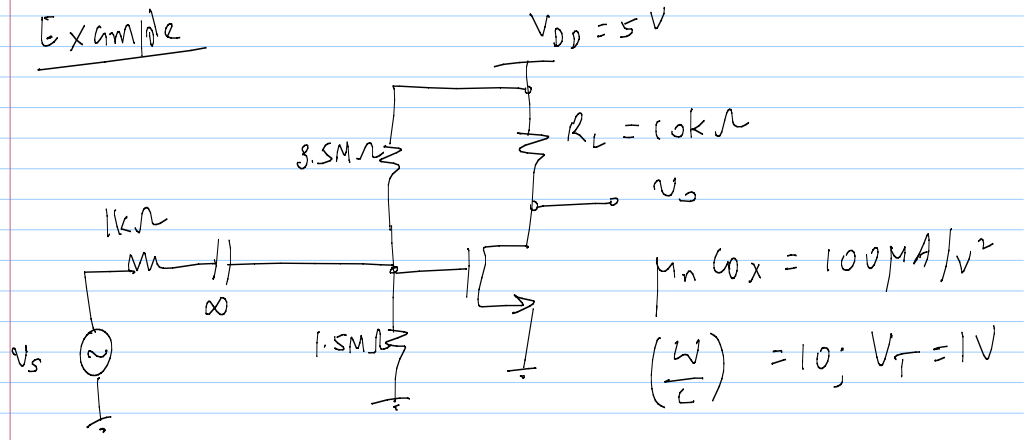
5/9/14

Lec 18

Example



$\mu_n C_{ox} = 100\mu A/V^2$

$\left(\frac{W}{L}\right) = 10;\ V_T = 1V$

$V_{GS_1} = 1.5V$

$I_{D_1} = \frac{1}{2}(100\mu)(10)(0.5)^2 = 125\mu A$

$V_{DS_1} = V_{DD} - I_D R_L = 5 - (0.125)(10k)$

$= 3.75V$

$g_m = \frac{2I_{D_1}}{V_{GS_1} - V_T} = \frac{0.25mA}{0.5V} = 0.5mS$

$G = -g_m R_L = -5$

Swing limits

1) triode (+ve HC)

$V_G = 1.5V + V_A \sin\omega t$

$V_D = 3.75V - 5V_A \sin\omega t$

for triode limit: $V_D = V_G - V_T$

$3.75 - 5V_{A_{max_1}} = 1.5V + V_{A_{max_1}} - 1$

$V_{A_{max_1}} = \frac{3.25V}{6} = 541.67mV$

2) Cut-off (-ve HC)

$I_D = 0$ @ neg. peak

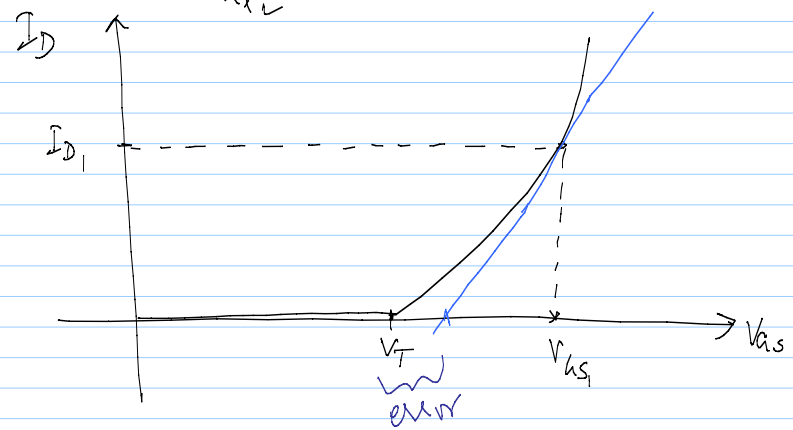
$I_D = 125\mu A + g_m V_A \sin\omega t$

$V_{A_{max_2}} = \frac{125\mu A}{0.5mS} = 250mV$

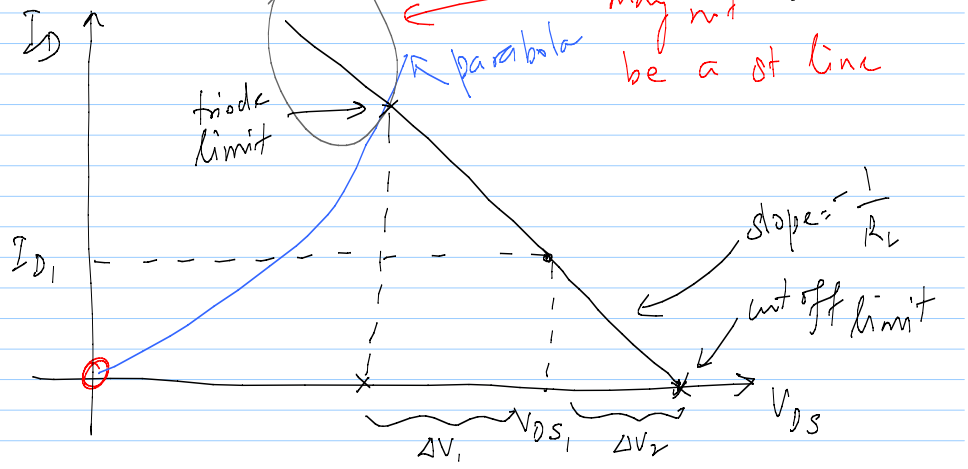
Apply $V_{GS} = V_T$ condition:

$V_{GS_1} - V'_{A_{max_2}} = V_T$

$V'_{A_{max_2}} = V_{GS_1} - V_T = 0.5V$



$$V_{Amax} = \min\{V_{Amax_1}, V_{Amax_2}\}$$



$$\frac{\partial I_D}{\partial V_{DS}} = \frac{i_d}{v_{ds}} = \frac{g_m v_s}{-g_m(R_D \| R_L) v_s} = \frac{-1}{(R_D \| R_L)}$$

$$\Delta V_1 = (g_m R_L)(V_{Amax_1})$$

$$\Delta V_2 = (g_m R_L)(V_{Amax_2})$$

$\therefore$ Set $V_{Amax_1} = V_{Amax_2}$ for maximum swing limit