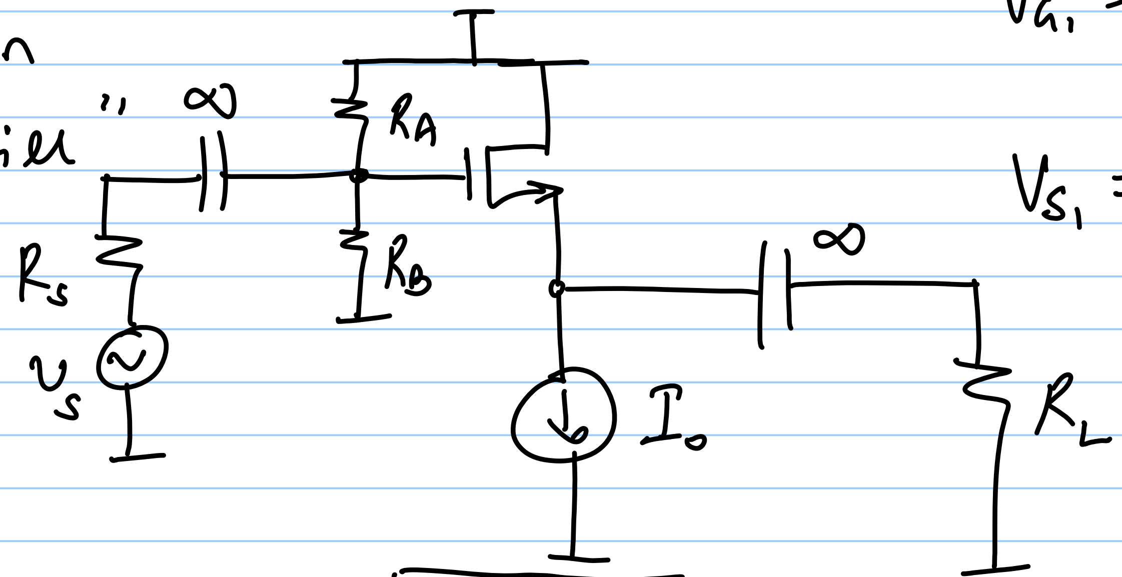
28/8/19

"Common Drain Amplifier"

Lec 14



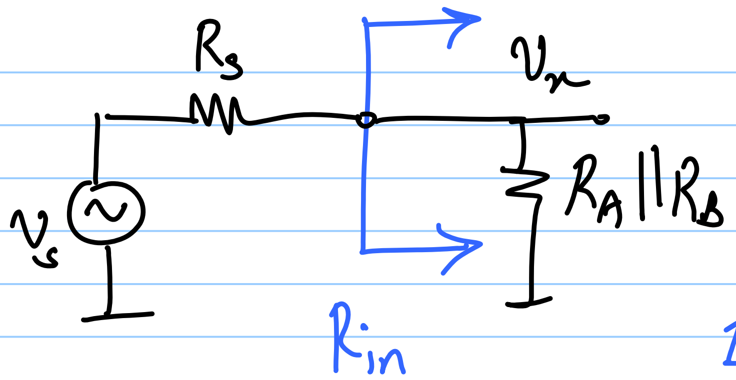
$$V_{GS_1} = V_T + \sqrt{\frac{2I_o}{\mu_n C_{ox}\left(\frac{W}{L}\right)}}$$

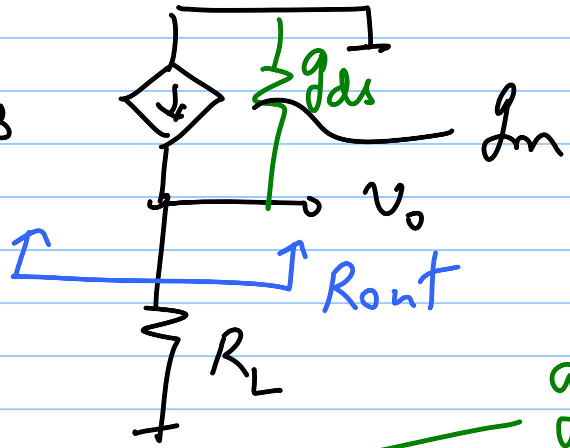
$$V_{D_1} = V_{DD}$$

$$V_{G_1} = \frac{R_B}{R_A + R_B} \cdot V_{DD}$$

$$V_{S_1} = V_{G_1} - V_{GS}\Big|_{I_o}$$

$$I_D = I_o$$





$$R_A || R_B \gg R_s$$

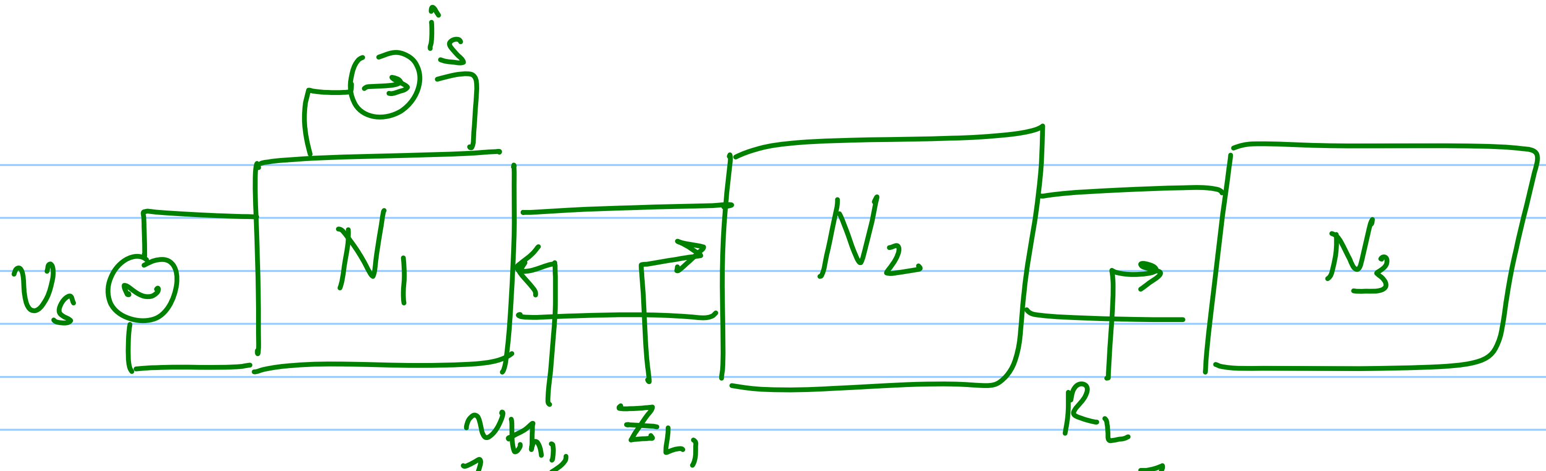
$$v_x = \frac{R_A || R_B}{R_A || R_B + R_s} \cdot v_s \approx v_s$$

$$i_d = g_m (v_s - v_o)$$

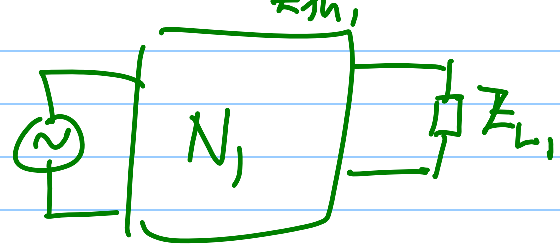
$$v_o = \frac{g_m R_L}{1 + g_m R_L} \cdot v_x \approx v_s \quad \text{if} \quad g_m \gg \frac{1}{R_L}$$

$$g_m \{ R_L || r_{ds} \}$$

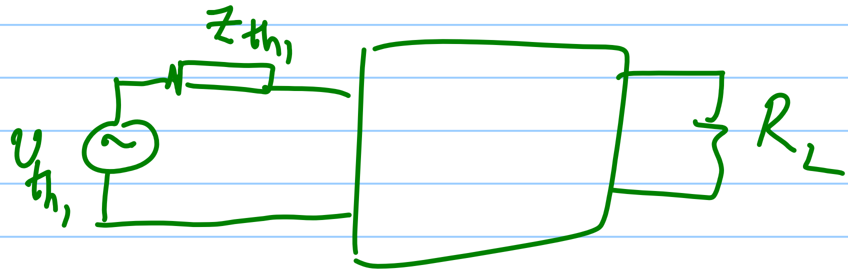
$$R_{in} = R_A || R_B \quad ; \quad R_{out} = \frac{1}{g_m} \quad \left\{ \frac{1}{g_m + g_{ds}} \right\}$$



i_s
v_s
N_1
N_2
N_3
v_{th_1}, Z_{th_1}
Z_{L_1}
R_L



N_1
Z_{L_1}



Z_{th_1}
v_{th_1}
R_L

Swing limits

$$v_o = \frac{g_m R_L}{1 + g_m R_L} \cdot v_s$$

$$v_s - v_o = v_s \left[1 - \frac{g_m R_L}{1 + g_m R_L} \right]$$

$$= \frac{v_s \cdot 1}{1 + g_m R_L}$$

$$i_d = g_m (v_s - v_o) = \frac{g_m}{1 + g_m R_L} \cdot v_s$$

$v_s = V_A \sin\omega t$

Triode Limit : $V_{DS} = V_{GS} - V_T$

$V_D - V_S = V_G - V_S - V_T$

$$\boxed{V_D = V_G - V_T}$$

$$V_{DD} = V_{G,} + V_{A,} \sin\omega t - V_T$$

$$\frac{V_{DD} \cdot R_B}{R_A + R_B}$$

$$\boxed{V_{A_1} = \frac{R_A}{R_A + R_B} \cdot V_{DD} + V_T}$$

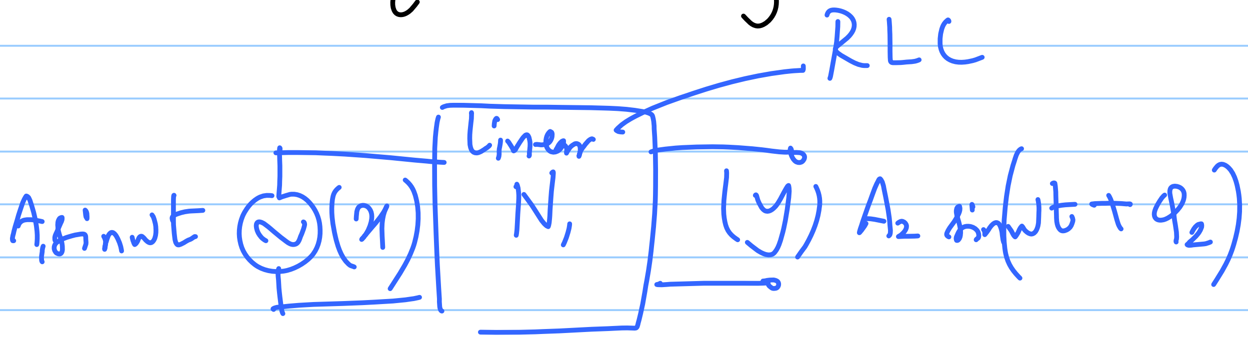
<u>Cut off limit</u>

$I_D = I_Q + i_d \longrightarrow$ goes to zero

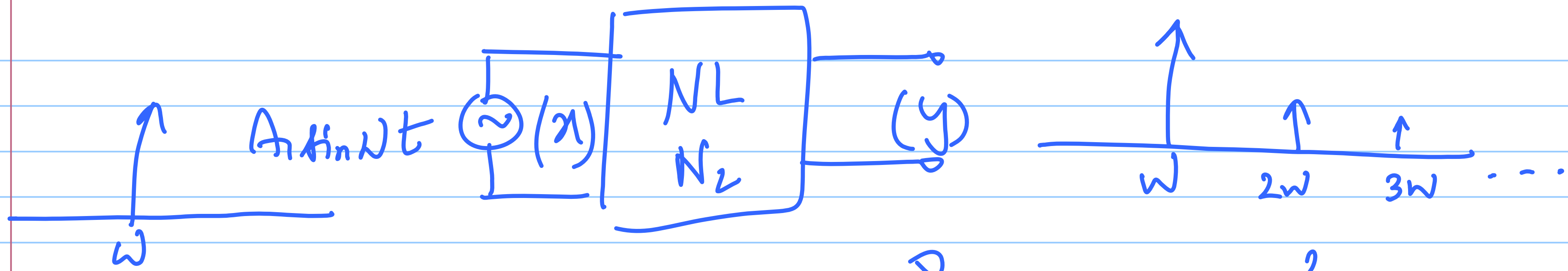
$$0 = I_o + \frac{g_m}{1 + g_m R_L} \cdot V_{A_2} \sin \omega t$$

$$\boxed{V_{A_2} = \frac{I_0}{g_m} \cdot \left(1 + g_m R_L\right)}$$

$$V_A = \min\left\{ V_{A_1}, V_{A_2} \right\}$$



$$y = mx$$



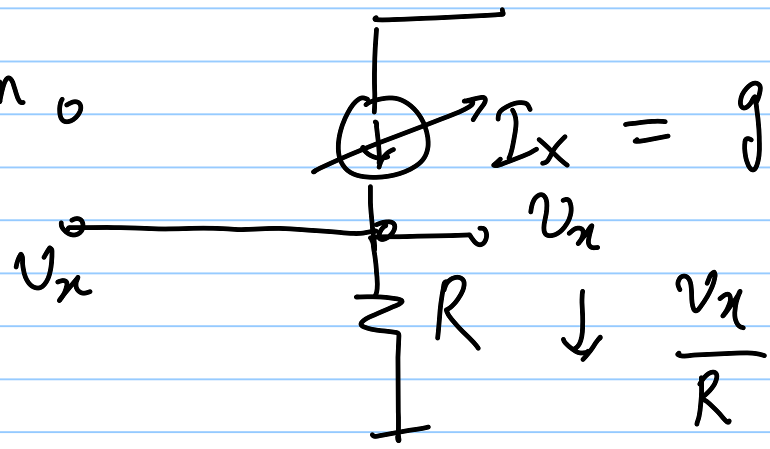
$$y = \cancelto{0}{a_0} + a_1 x + a_2 x^2 + \dots$$

inc. <u>VCCS</u> $\quad i_o = \dfrac{v_{in}}{R}$; $\quad R_{in} = \infty$

$R_{out} = \infty$

$$i_o = \frac{v_{in}}{R}$$

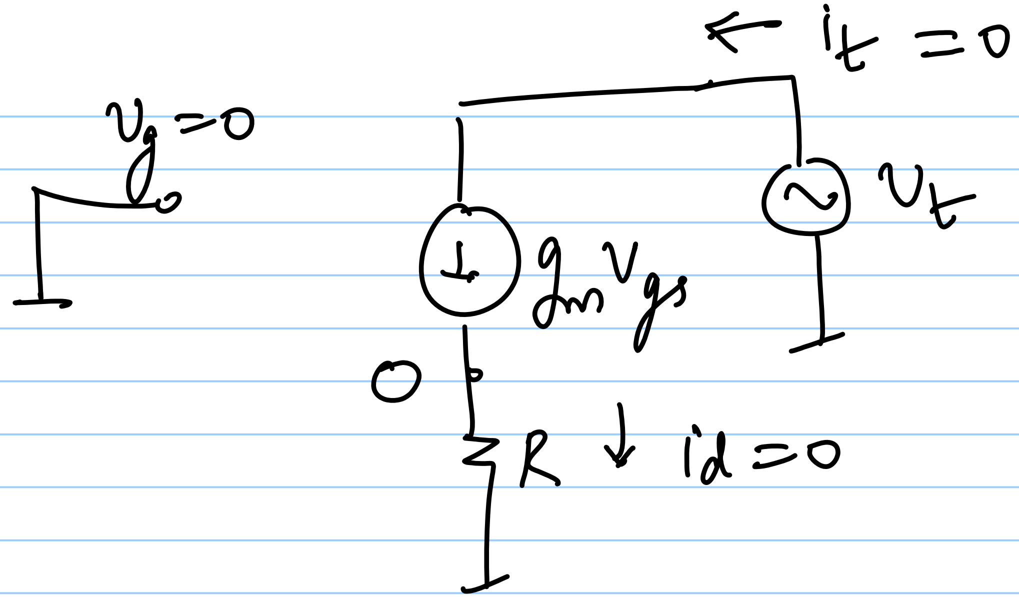
$v_g = v_{in}$



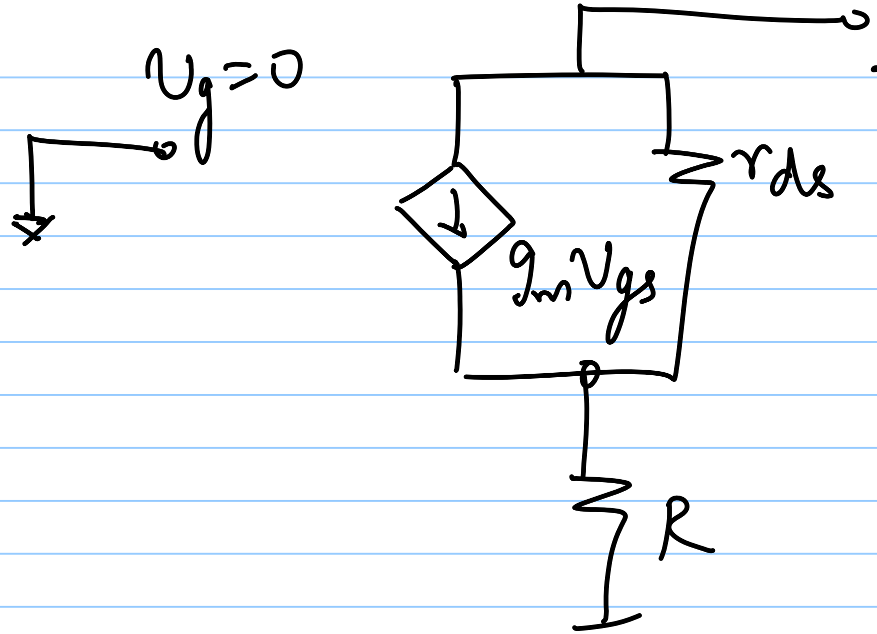
$$I_x = g_m(v_{gs}) = g_m(v_{in} - v_x)$$

$$= \frac{v_x}{R} = \frac{v_{in}}{R}$$

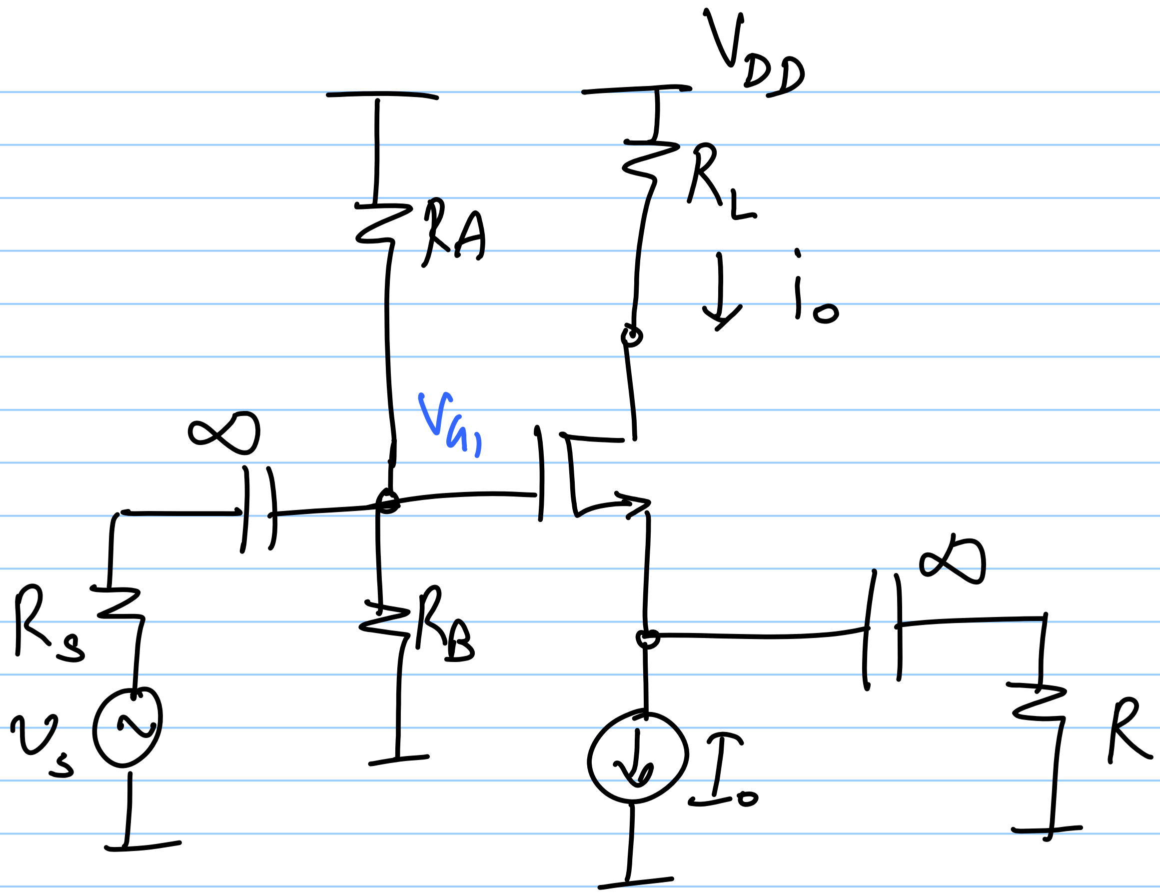
if $g_m = \infty$



$R_{out} = \infty$



$R_{out} = f(g_m, r_{ds}, R)$



V_{DD}
R_L
i_o
R_A
V_{G1}
∞
R_s
v_s
R_B
I_o
∞
R