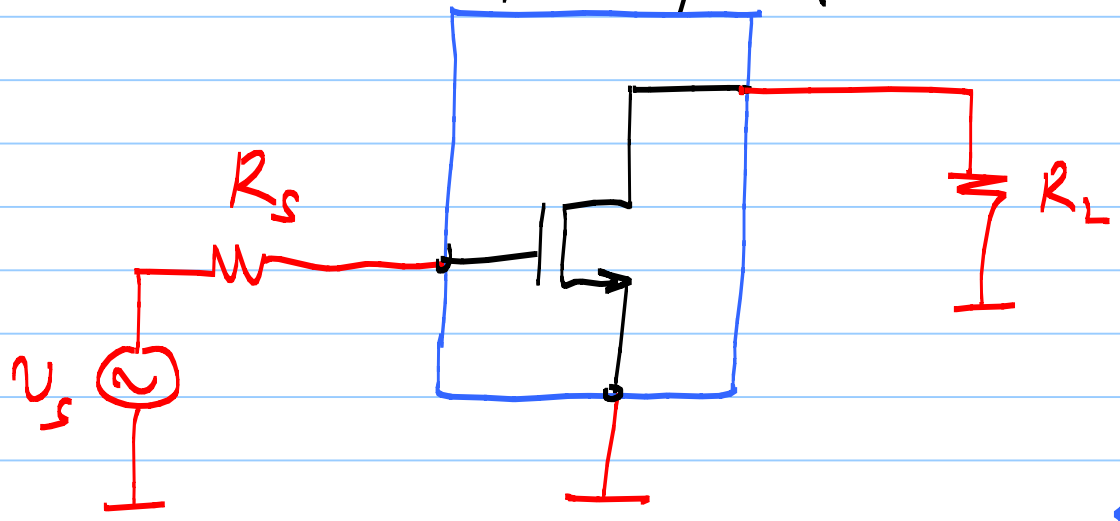
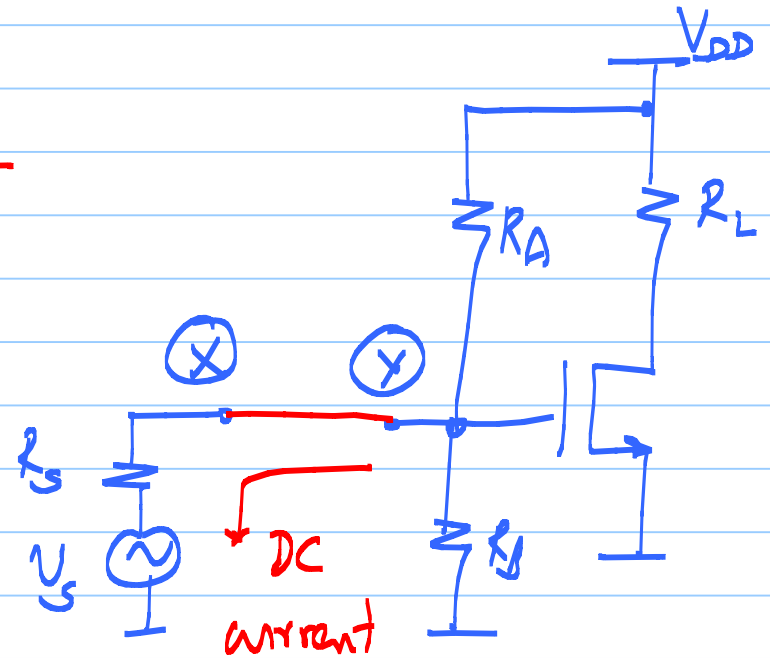
19/8/2020

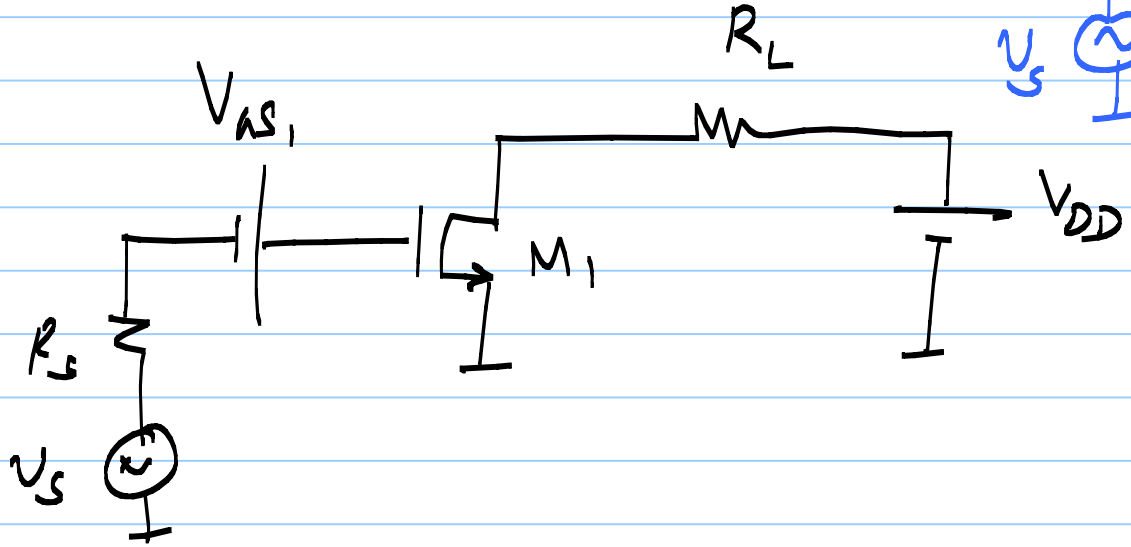
Lecture 9

NL 2-port (incremental view





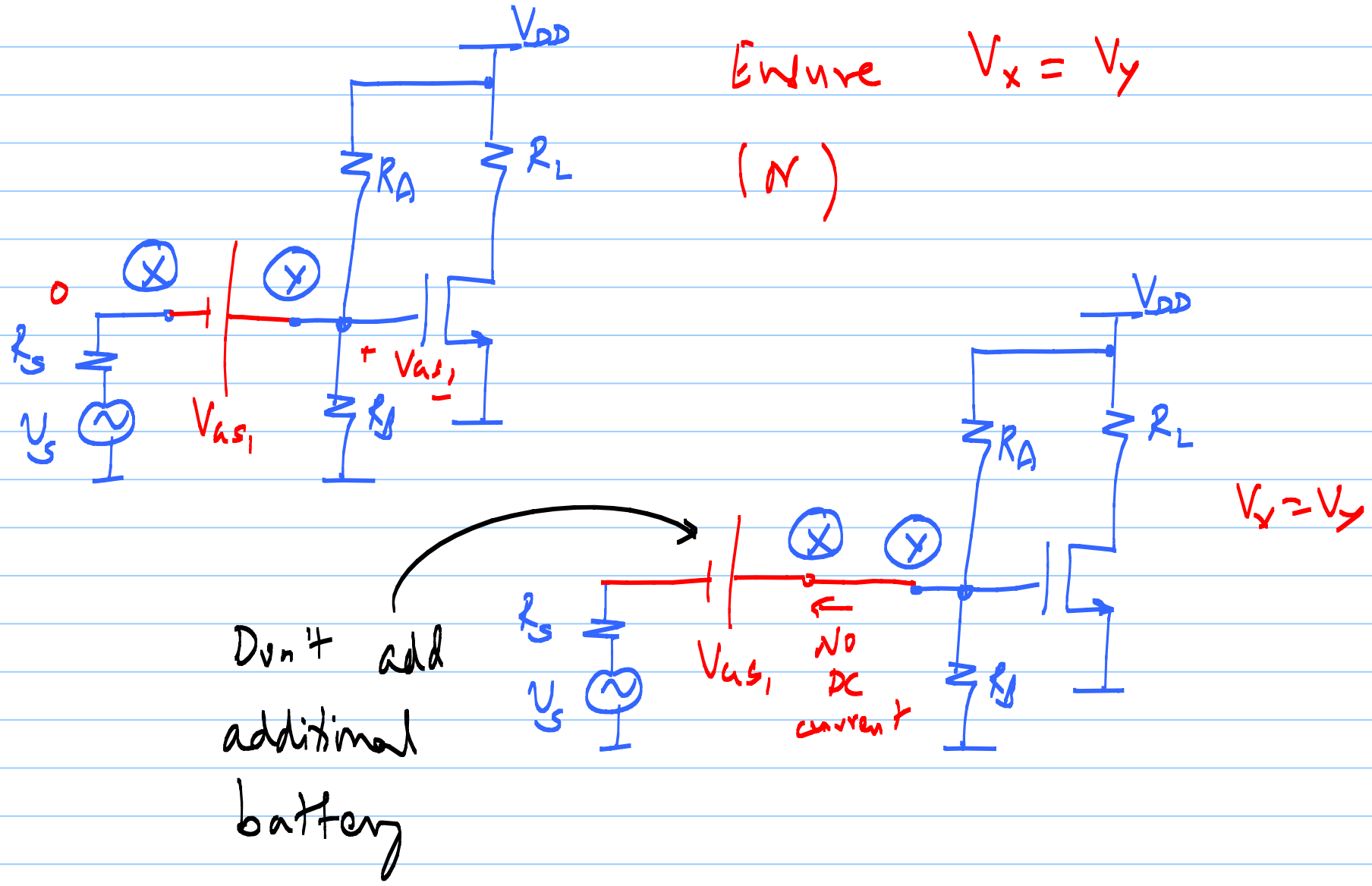
→ * Might disturb op pt. of preceding circuit

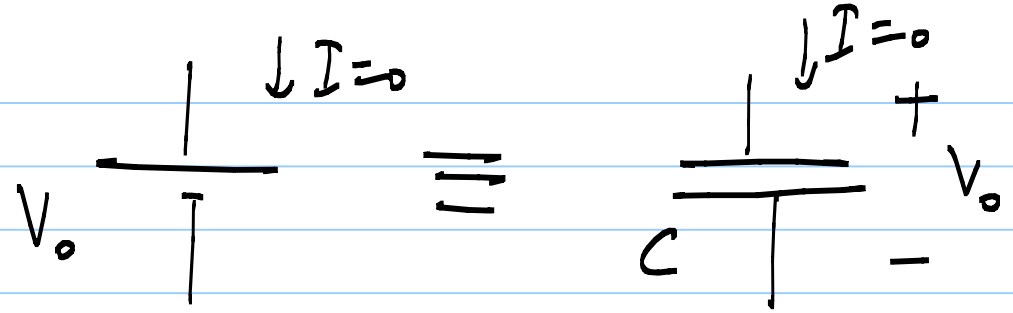


* V_{GS_1} itself changes

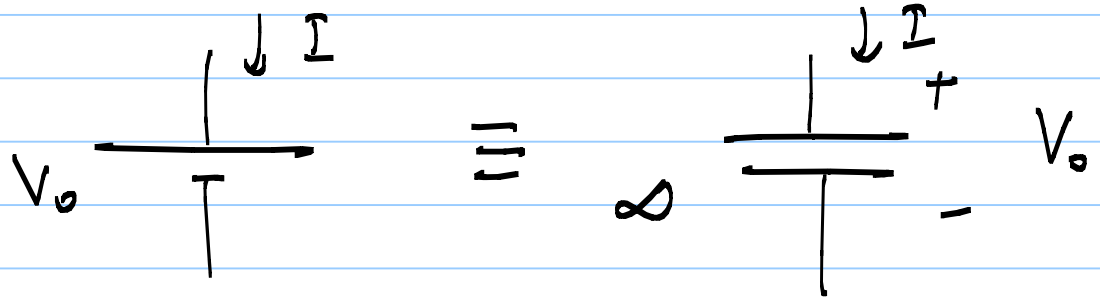
$$V'_{GS_1} = \frac{R_B \| R_S}{R_A + R_B \| R_S} \cdot V_{DD}$$

* We want no DC current flow through R_s

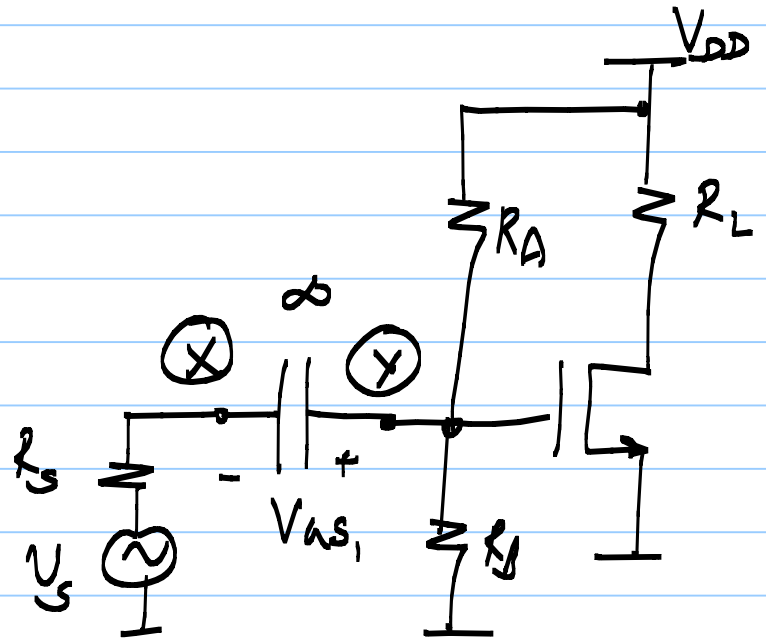




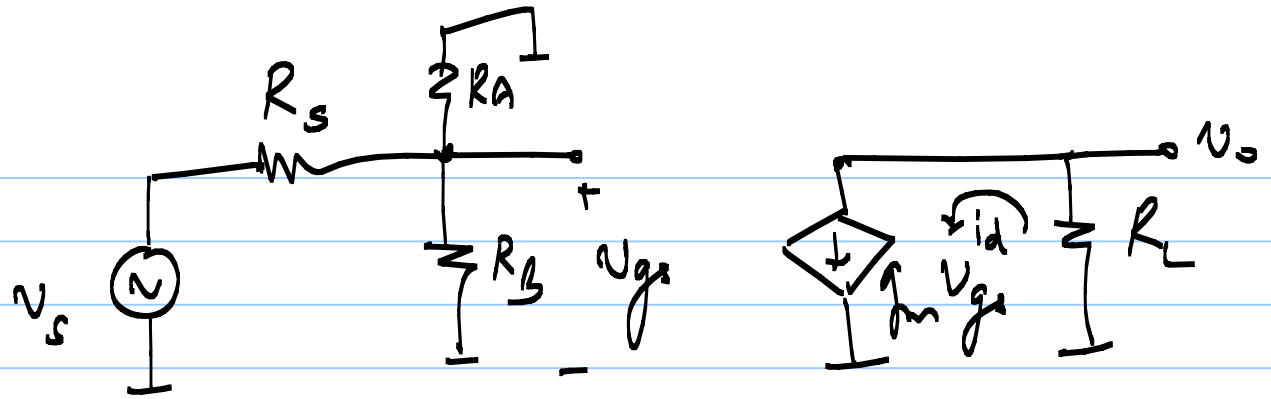
iff no current is drawn



even if you draw current



MOSFET Common-Source Amplifier



$y_{11} \neq 0$

$$v_{gs} = \frac{R_A \| R_B}{R_s + R_A \| R_B} \cdot v_s$$

$$v_o = -g_m R_L \cdot v_{gs} = -g_m R_L \cdot \frac{R_A \| R_B}{R_s + R_A \| R_B} \cdot v_s$$

1) Choose $R_A \| R_B \gg R_s$

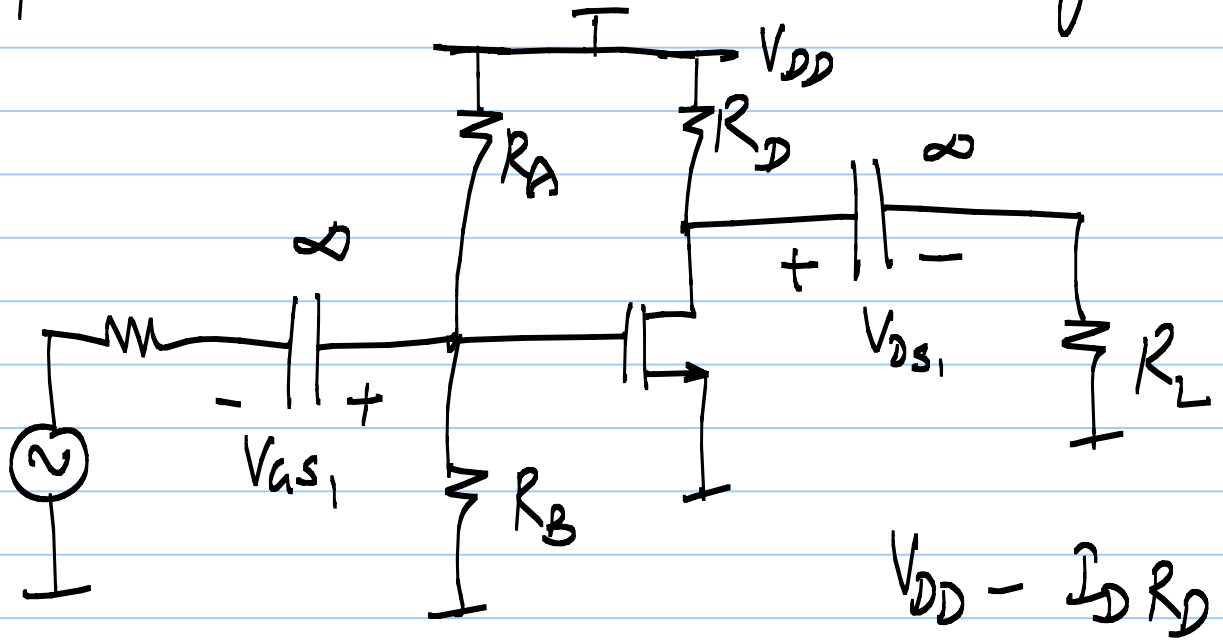
$$\frac{R_B}{R_A + R_B} \cdot V_{DD} = V_{GS,}$$

2) Then $\frac{v_o}{v_s} \approx -g_m R_L$

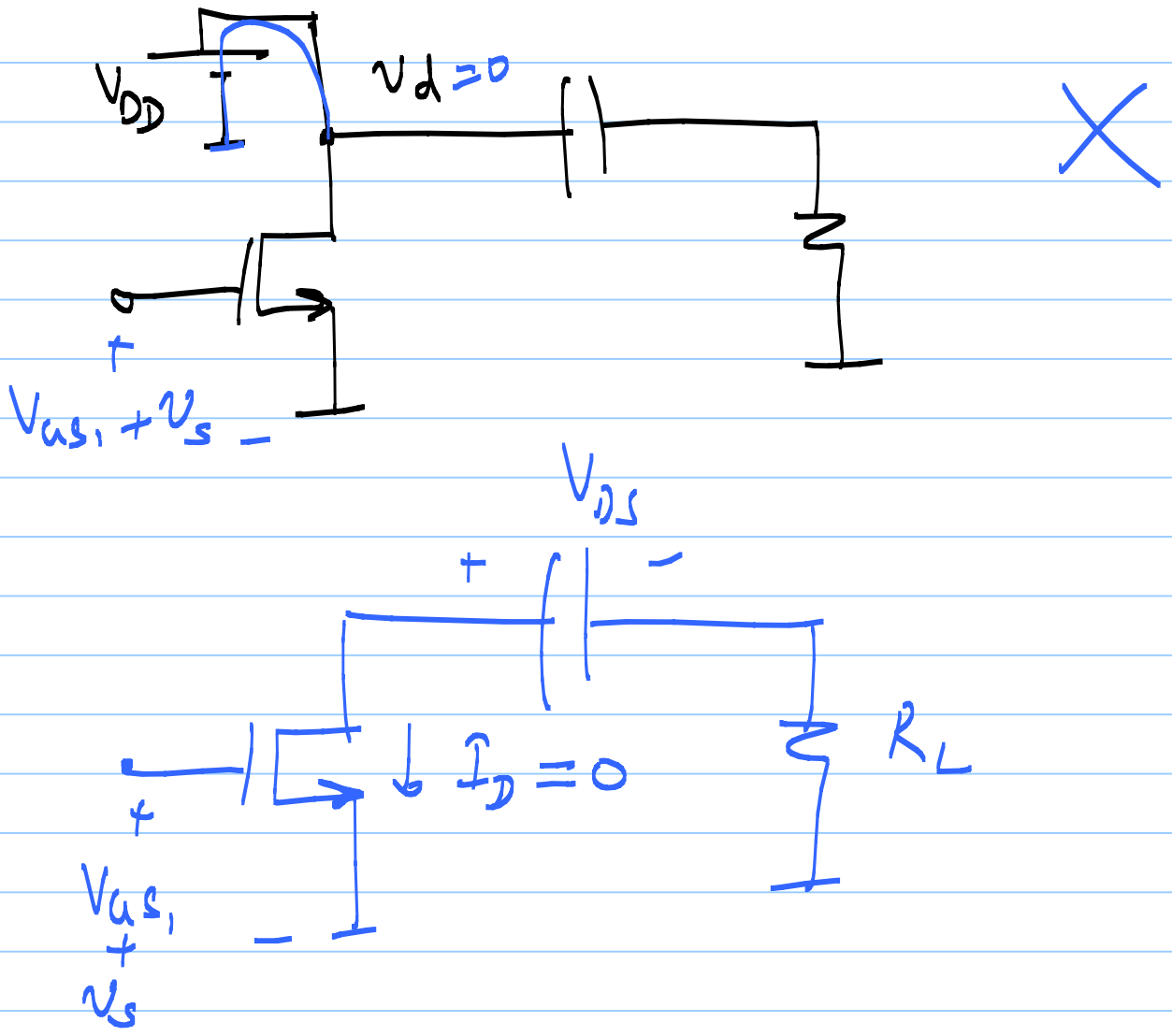
$$i_d = g_m v_{gs} = g_m \cdot \left(\frac{R_A \| R_B}{R_S + R_A \| R_B} \right) \cdot v_s$$

$$v_d = v_o = -i_d R_L$$

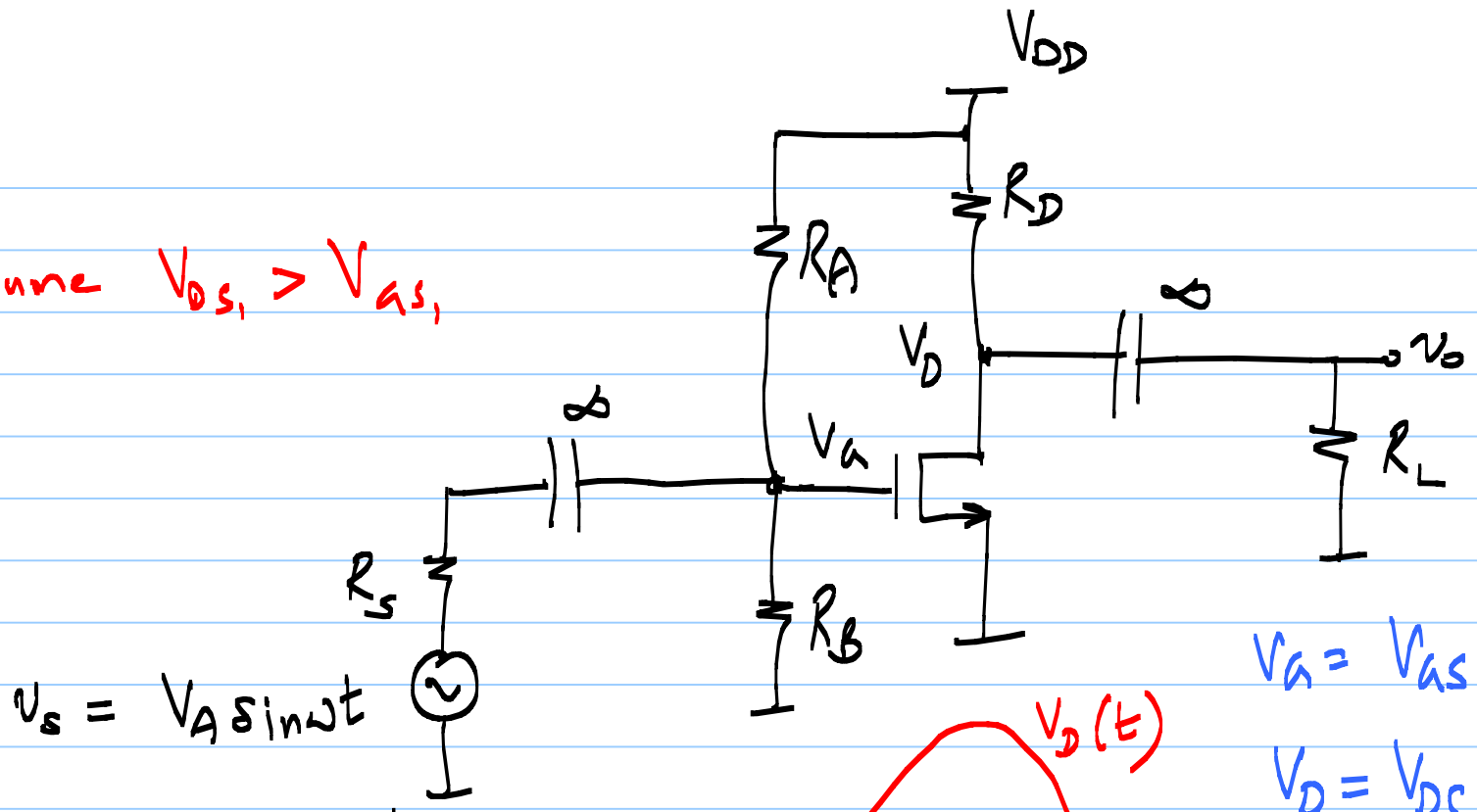
3) Suppose: No DC current through R_L:



$$V_{DD} - I_D R_D = V_{DS_1}$$


V_{DD}
$v_d = 0$
+
$V_{GS_1} + v_s$ −
V_{DS}
+
−
$I_D = 0$
R_L
+
V_{GS_1}
−
+
v_s

Assume $V_{DS_1} > V_{GS_1}$



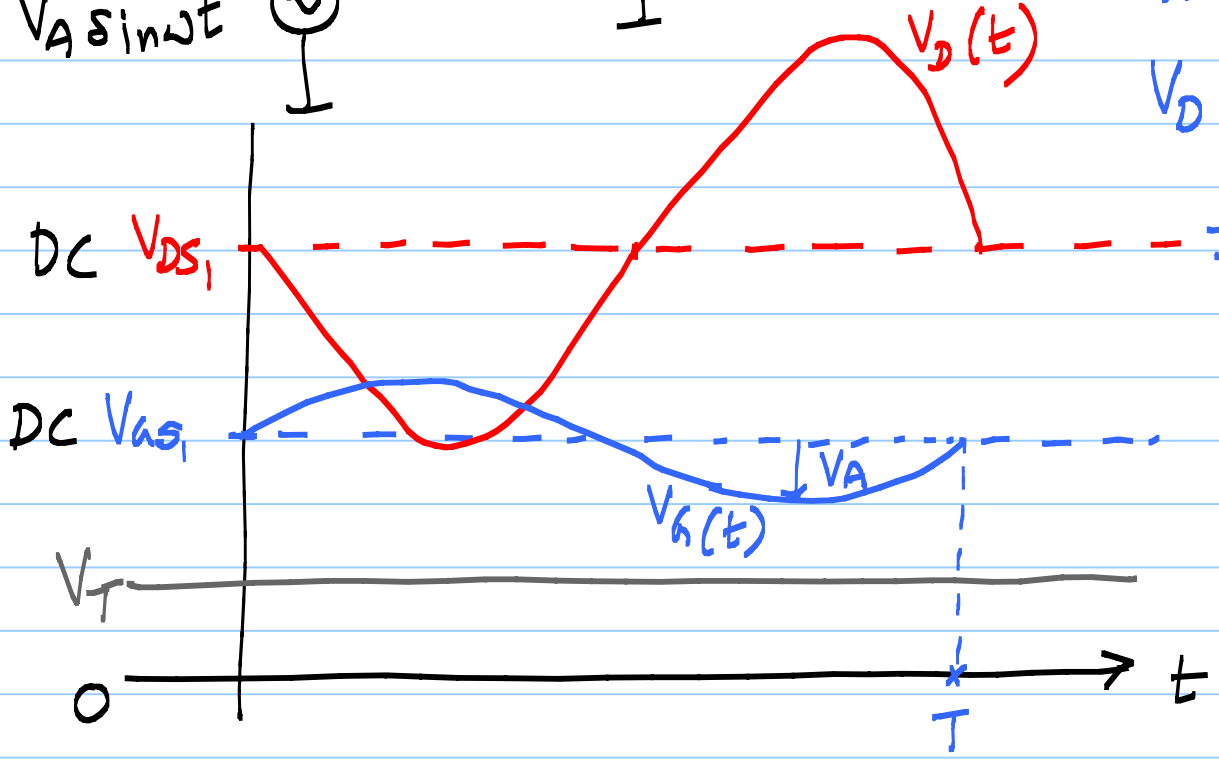
CSA

$$\frac{v_o}{v_s} = -g_m(R_D \| R_L)$$

$V_G = V_{GS_1} + V_A \sin\omega t$

$V_D = V_{DS_1} - g_m(R_D \| R_L) V_A \sin\omega t$

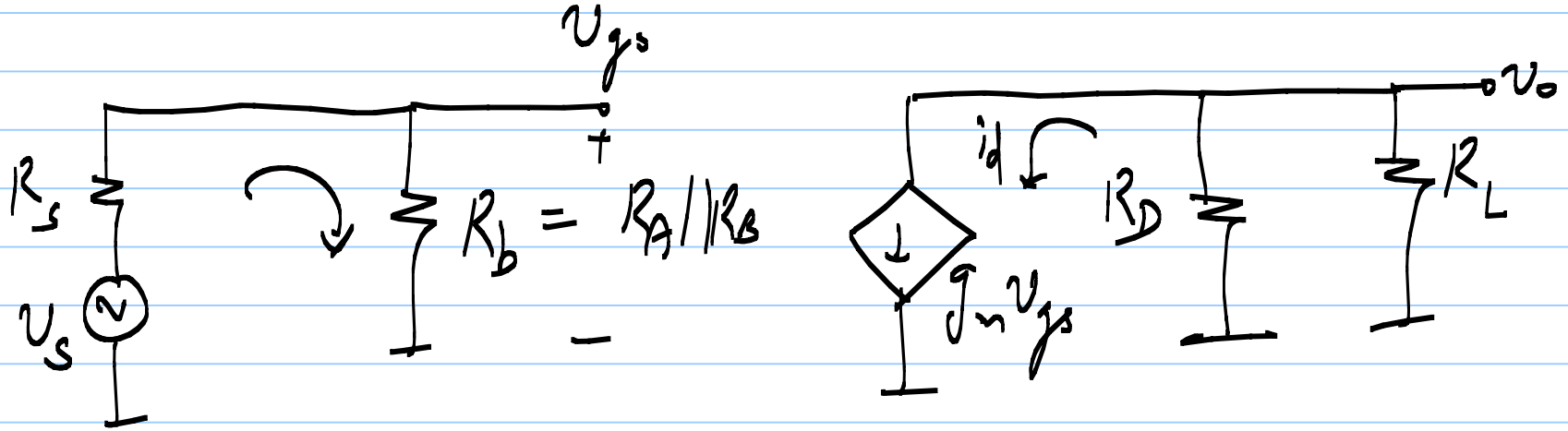
$= V_{DS_1} - G V_A \sin\omega t$



Triode boundary

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

at all time instants.



$$v_{gs} = \frac{R_b}{R_s + R_b} \cdot v_s \approx v_s \quad \text{if} \quad R_s << R_b$$

$$i_d = g_m v_{gs} \approx g_m v_s$$

$$v_o = -i_d \cdot (R_D \| R_L) = -g_m v_s (R_D \| R_L)$$

$$\frac{v_o}{v_s} = -g_m (R_D \| R_L) = -G$$