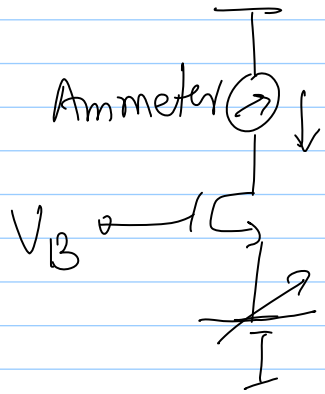
21-9-12

Lec 23

case 1 — measure I_D, change V_G

2 — " I_S, " V_S

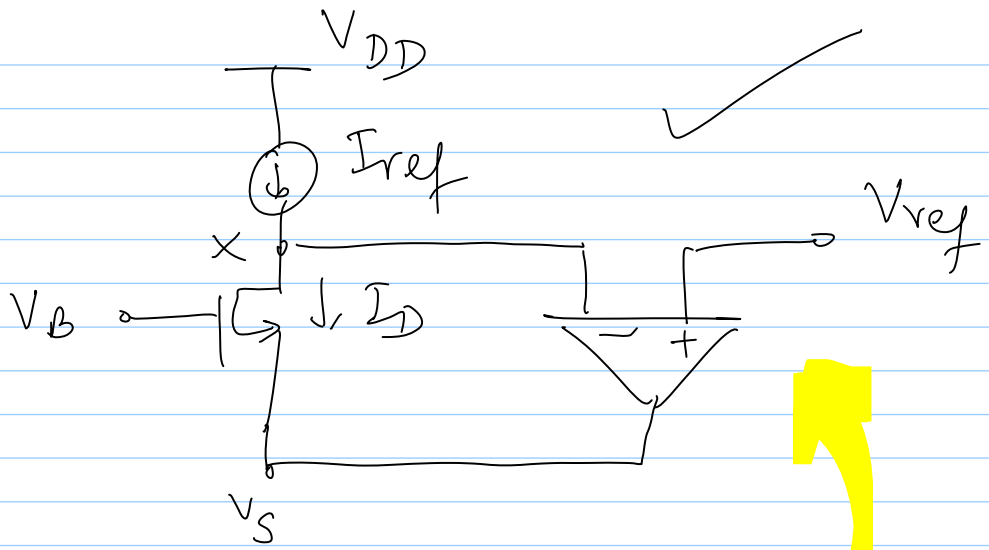
case 3 — " I_D, " V_S



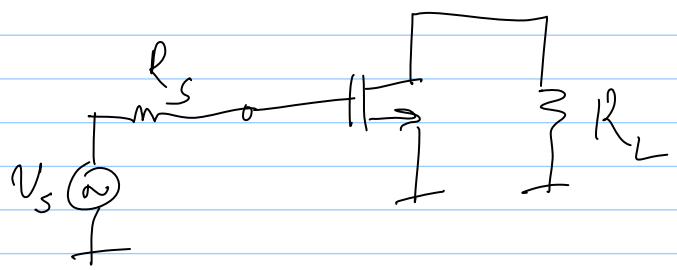
compare w/ I_{ref}

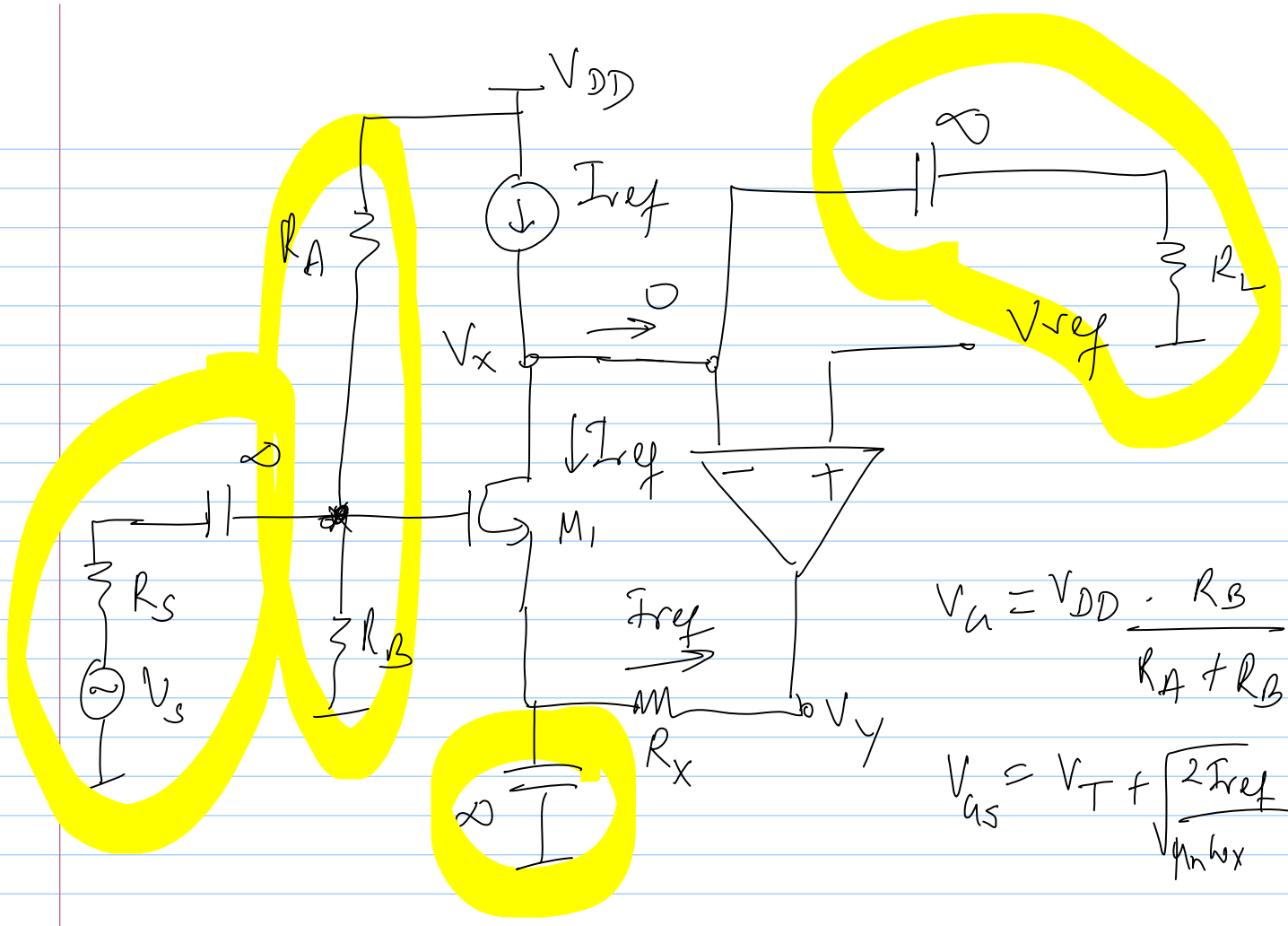
$I_D > I_{ref} \Rightarrow$ increase V_S

$I_D < I_{ref} \Rightarrow$ decrease V_S



$V_{ref} \geq V_B - V_T$





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

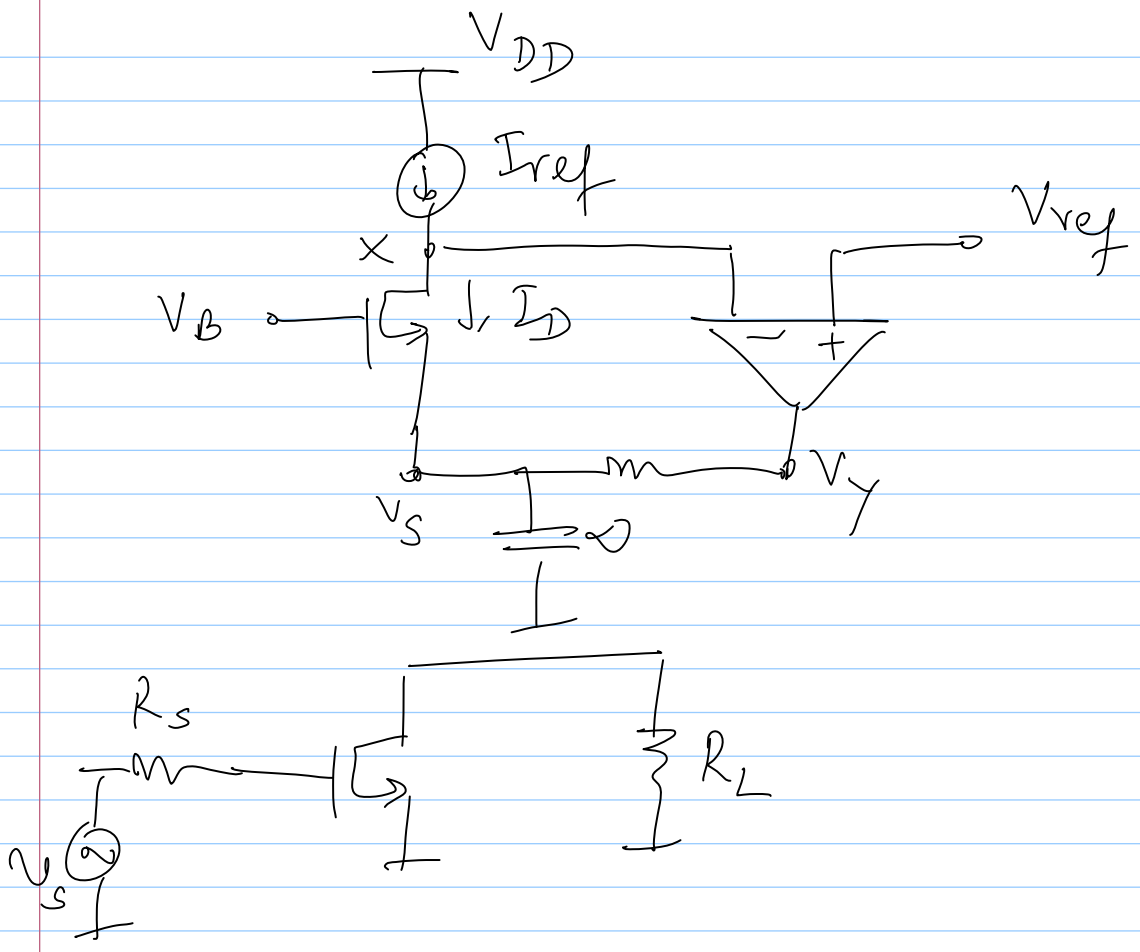
$$V_{GS} = V_T + \sqrt{\frac{2I_{ref}}{\mu_n C_{ox}}}$$

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

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

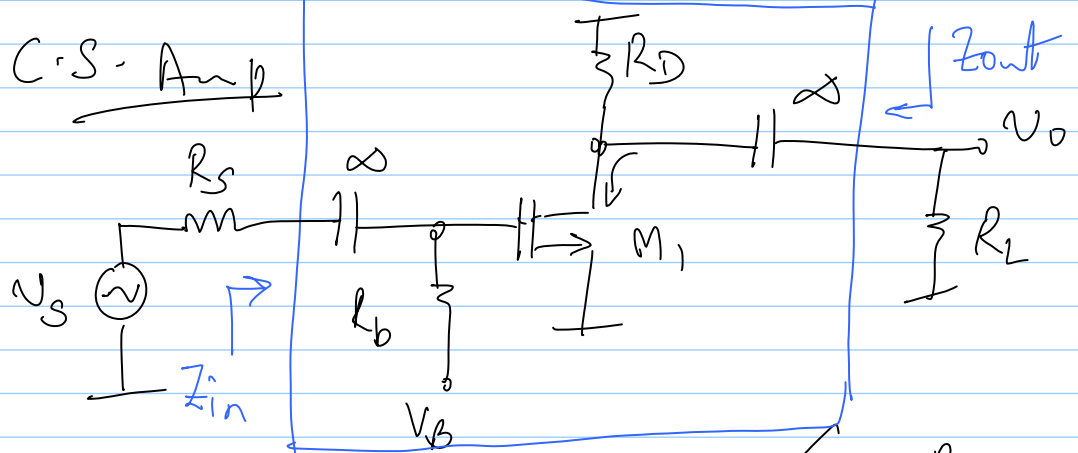
$$V_S = V_G - V_{GS} = \frac{V_{DD} R_B}{R_A + R_B} - V_T - \sqrt{\frac{2 I_{ref}}{\mu_n C_{ox} \left(\frac{W}{L}\right)}}$$

$$V_y = V_S - I_{ref} R_x$$



Case 4 : measure I_S feedback V_a) H.W.

C.S. Amp



$$\frac{V_o}{V_s} = -g_m (R_D \| R_L) \cdot \left\{ \frac{R_b}{R_S + R_b} \right\}$$

ideal VCVS

$Z_{in} = \infty$

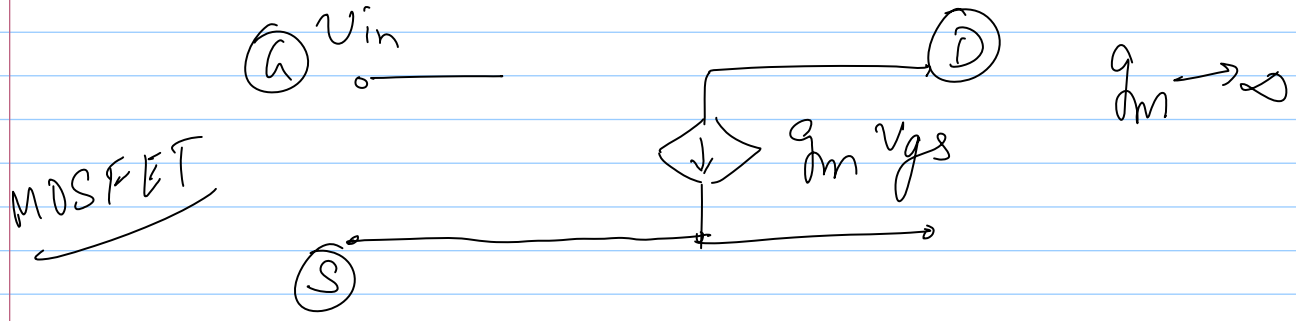
$Z_{out} = 0$

CS Amp

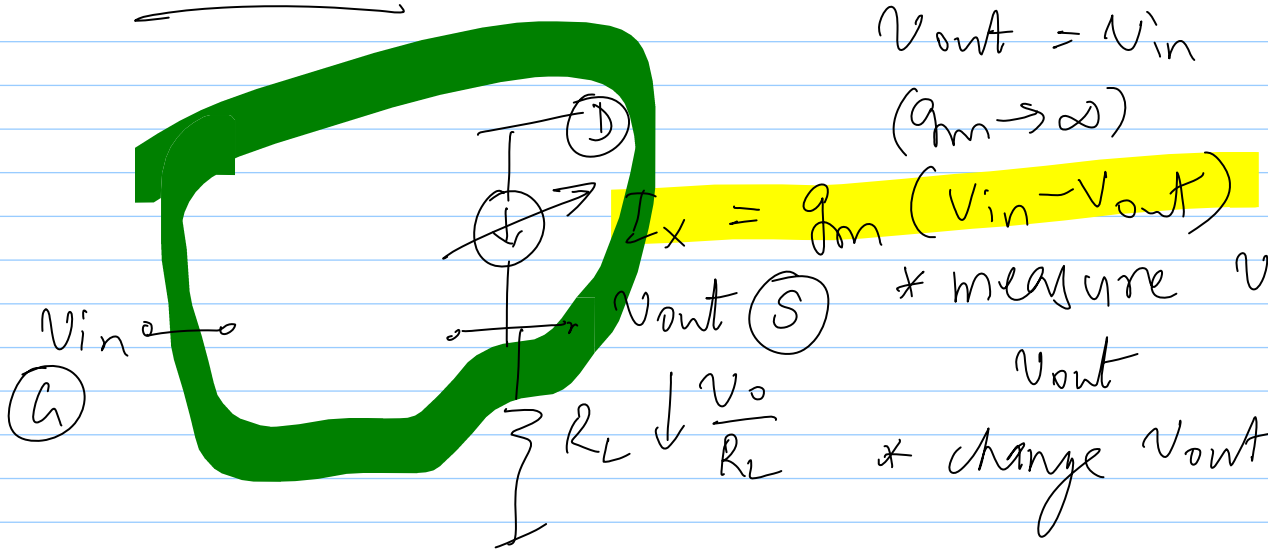
$Z_{in} = R_b$ ↑ R_b

$Z_{out} = R_D$ ← $R_D = 0 \Rightarrow gain = 0$

ideal VCVS



VCVS = 1



$v_{out} = v_{in}$

$(g_m \to \infty)$

* measure v_{in}, v_{out}

* change v_{out}

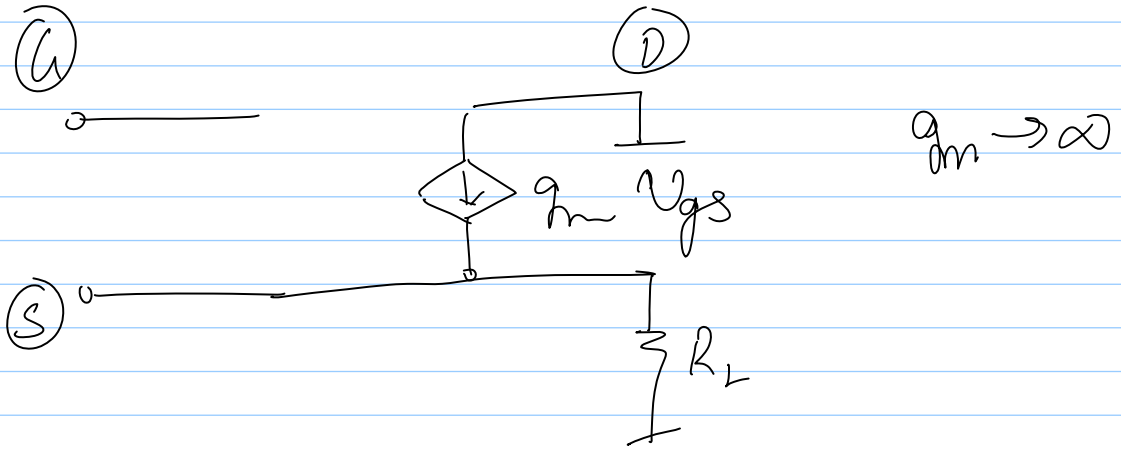
* If $v_{out} > v_{in} \Rightarrow$ reduce I_x

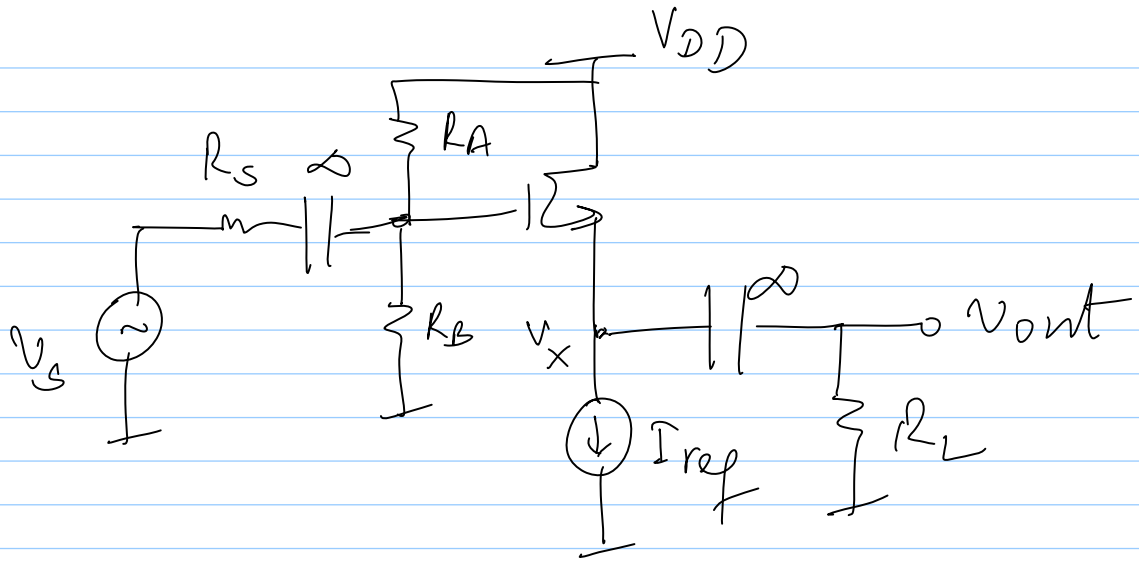
$v_{out} < v_{in} \Rightarrow$ increase I_x

* comparison $\Rightarrow (v_{in} - v_{out})$

$$\frac{V_{out}}{R_L} = g_m (V_{in} - V_{out})$$

$$V_{in} = V_{out} \Rightarrow g_m \to \infty$$





$$V_X = \frac{V_{DD} R_B}{R_A + R_B} - V_T - \sqrt{\frac{2 I_{ref}}{\mu_n C_{ox} \left(\frac{W}{L}\right)}}$$