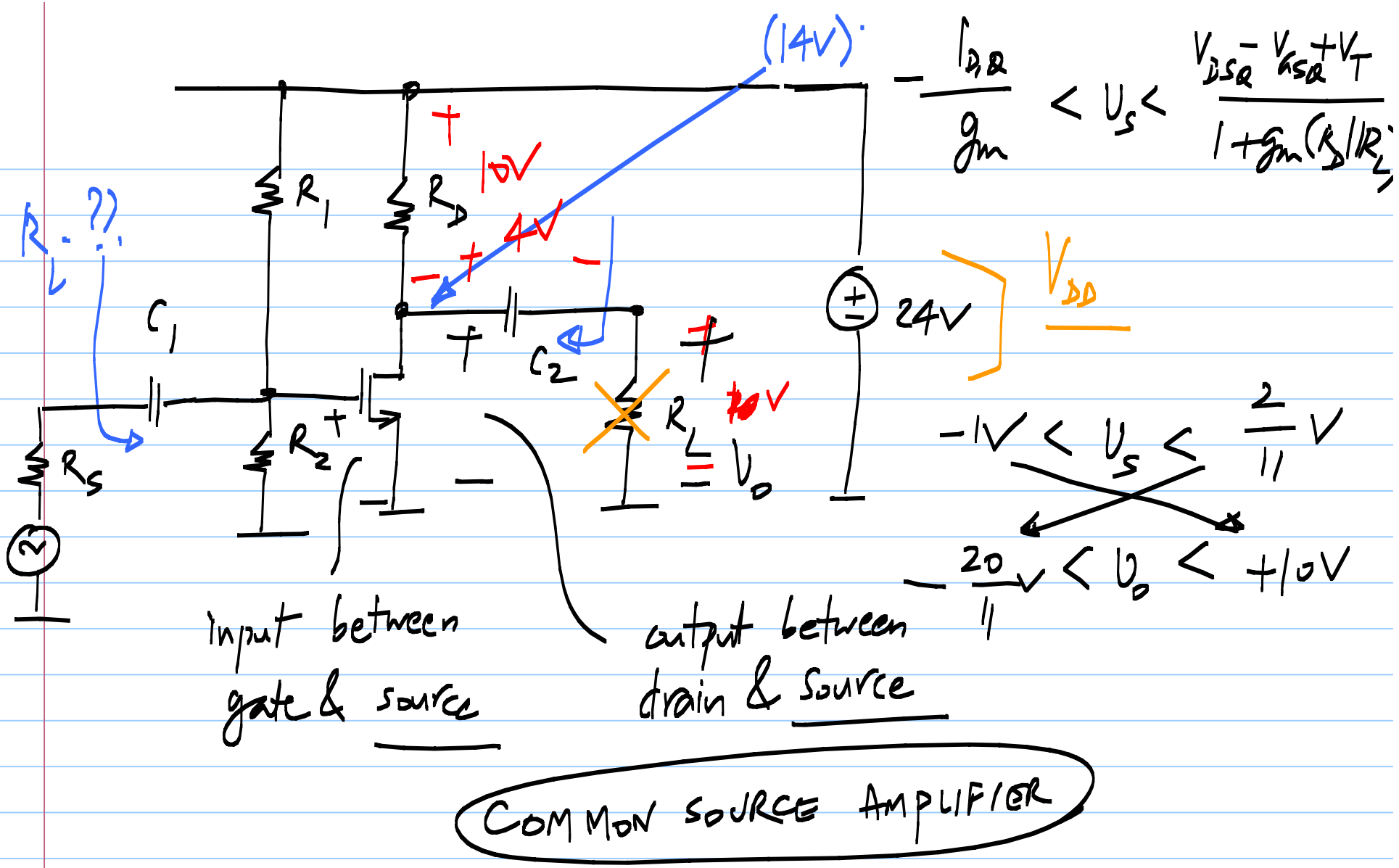

(14V)
R_1
R_D
10V
4V
C_1
C_2
24V
V_{DD}
R_L = ??
R_S
R_2
R_L
10V
$= V_o$
Input between gate & source
output between drain & Source
$-\frac{I_{D,Q}}{g_m} < V_s < \frac{V_{DSQ} - V_{GSQ} + V_T}{1 + g_m(R_S \| R_L)}$
$-1V < V_s < \frac{2}{11}V$
$-\frac{20}{11}V < V_o < +10V$
COMMON SOURCE AMPLIFIER

Common source amplifier:

Small signal

- Gain: $-g_m (R_D \| R_L)$ $\quad \{ R_1 \| R_2 \gg R_S \}$
- R_i : $R_1 \| R_2$
- R_o : R_D

$$-\frac{I_{D,Q}}{g_m} < V_S < \frac{V_{DSQ} - V_{GSQ} + V_T}{1 + g_m (R_D \| R_L)}$$

Triode (linear) region:

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

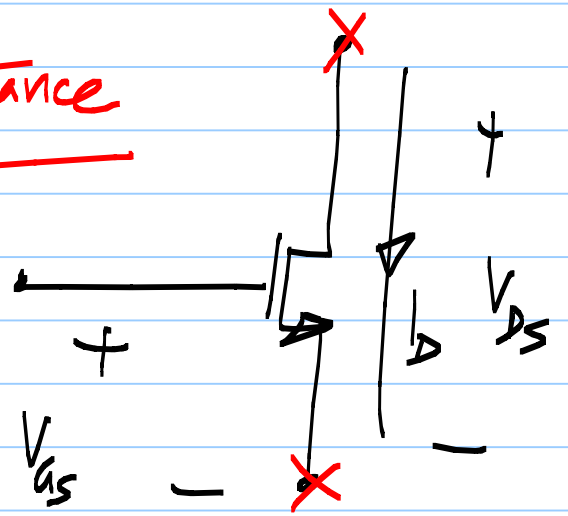
$$I_D = \mu C_{ox} \frac{W}{L} \left[(V_{GS} - V_T) V_{DS} - \frac{V_{DS}^2}{2} \right]$$

$V_{DS} \ll V_{GS} - V_T$

Conductance

$$\simeq \mu C_{ox} \frac{W}{L} (V_{GS} - V_T) V_{DS}$$

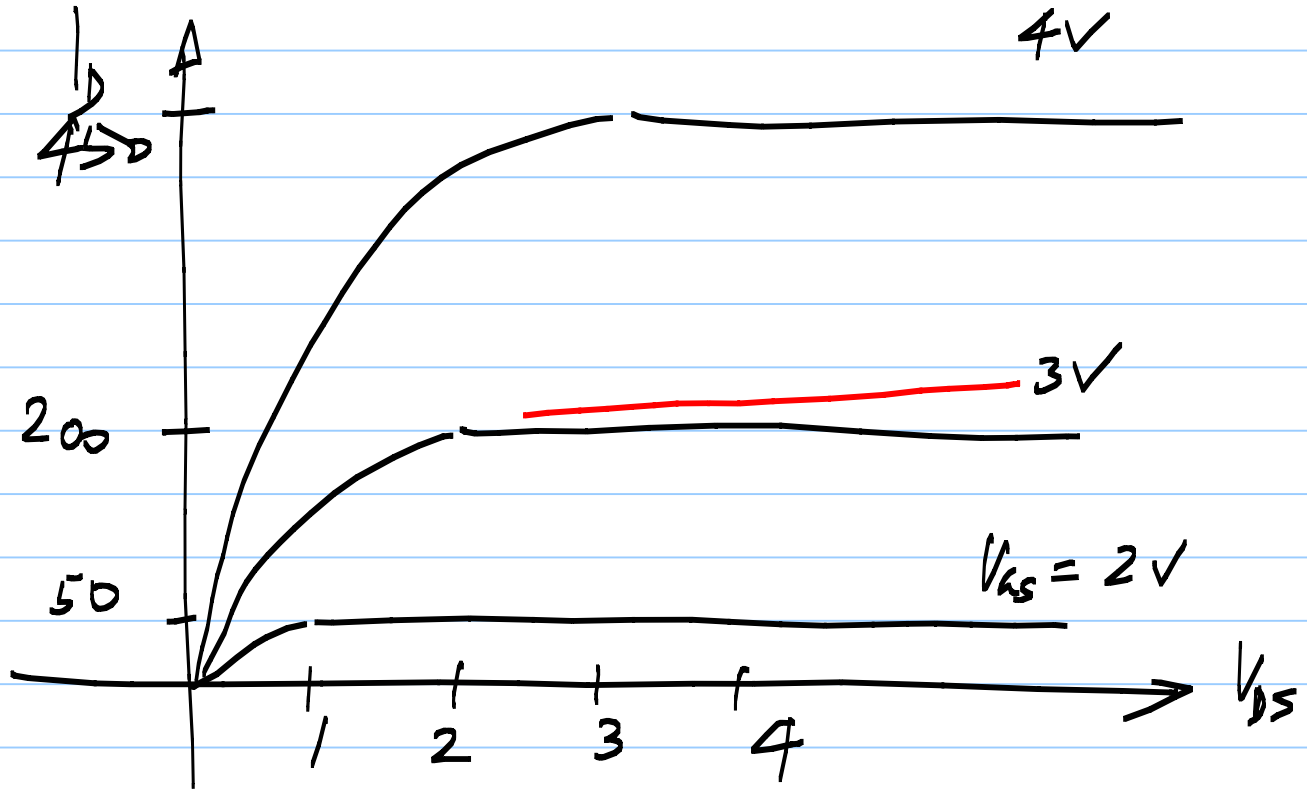
$$R_{MOS} = \frac{V_{DS}}{I_D} = \frac{1}{\mu C_{ox} \frac{W}{L} (V_{GS} - V_T)}$$



Saturation region: $\lambda = 0.05\ V^{-1}$

$$I_D = \frac{\mu C_{ox}}{2} \frac{W}{L} (V_{GS} - V_T)^2 (1 + \lambda V_{DS})$$

$$\left[\begin{array}{l} V_{GS} > V_T \\ V_{DS} > V_{GS} - V_T \end{array} \right.$$



g_{ds}

$$y_{22} = \frac{\partial I_D}{\partial V_{DS}} = \frac{\mu C_{ox}}{2}\frac{W}{L}(V_{GS}-V_T)^2 \cdot \lambda = \lambda I_D$$

$$r_{ds} = \frac{1}{\lambda I_D}$$

$$I_D = \frac{\mu C_{ox}}{2}\frac{W}{L}(V_{GS}-V_T)^2(1+\lambda V_{DS})$$

$$\simeq \frac{\mu C_{ox}}{2}\frac{W}{L}(V_{GS}-V_T)^2$$

} for op. point calculations

$$r_{ds} = \frac{1}{0.05V^{-1}\cdot 200\mu A} = 100k\Omega$$

$$\lambda = 0.05V^{-1}$$