EE-320 – Exercise 4 Solutions - Fall 2025

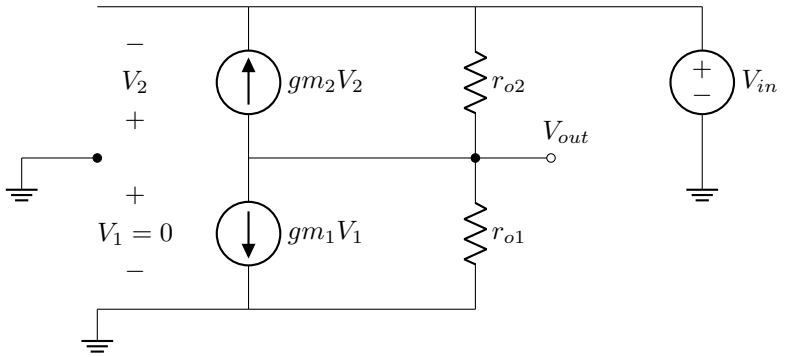
1

$$|I_{D_2}| = I_1 - 0.75I_1 = \frac{I_1}{4} \qquad for\ \lambda = 0 \qquad A_V = -\frac{g_{m_1}}{g_{m_2}}$$

$$g_m = \frac{2I_D}{V_{GS} - V_{TH}} \Rightarrow A_V = -\frac{\frac{2I_1}{(V_{GS1} - V_{TH1})}}{\frac{\frac{2I_1}{4}}{(|V_{GS2} - V_{TH2}|)}} = -4\frac{|V_{GS2} - V_{TH2}|}{V_{GS1} - V_{TH1}}$$

$$|A_V| = 4\frac{|V_{GS2} - V_{TH2}|}{V_{GS1} - V_{TH1}}$$

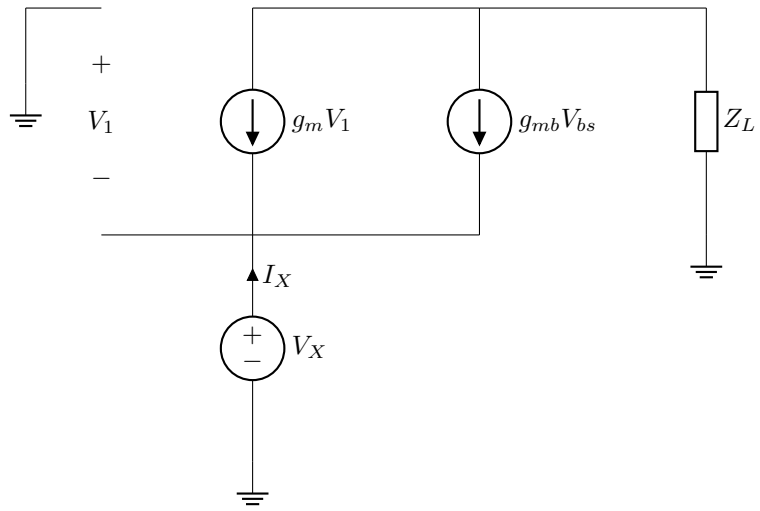
2



$$KCL\ @\ V_{out}: \frac{V_{out}}{r_{o1}} + \frac{V_{out} - V_{in}}{r_{o2}} + g_{m2}V_2 = 0 \qquad V_2 = -V_{in}$$

$$\Rightarrow V_{out}(\frac{1}{r_{o1}} + \frac{1}{r_{o2}}) = V_{in}(\frac{1}{r_{o2}} + g_{m2})$$

$$\frac{V_{out}}{V_{in}} = \frac{g_{m2} + \frac{1}{r_{o2}}}{\frac{1}{r_{o1}} + \frac{1}{r_{o2}}} = (\frac{1 + g_{m2}r_{o2}}{r_{o1} + r_{o2}})r_{o1}$$



3

$(V_{in} = 0)$

$$\begin{cases} V_x = -V_1 & I_X = -g_m V_1 - g_{mb} V_{bs} \Rightarrow I_X = V_X(g_m + g_{mb}) \\ V_{bs} = -V_X & \dfrac{V_X}{I_X} = \dfrac{1}{g_m + g_{mb}} \qquad if\ \gamma = 0 \Rightarrow R_X = \dfrac{1}{g_m} \end{cases}$$