

Quiz 4.

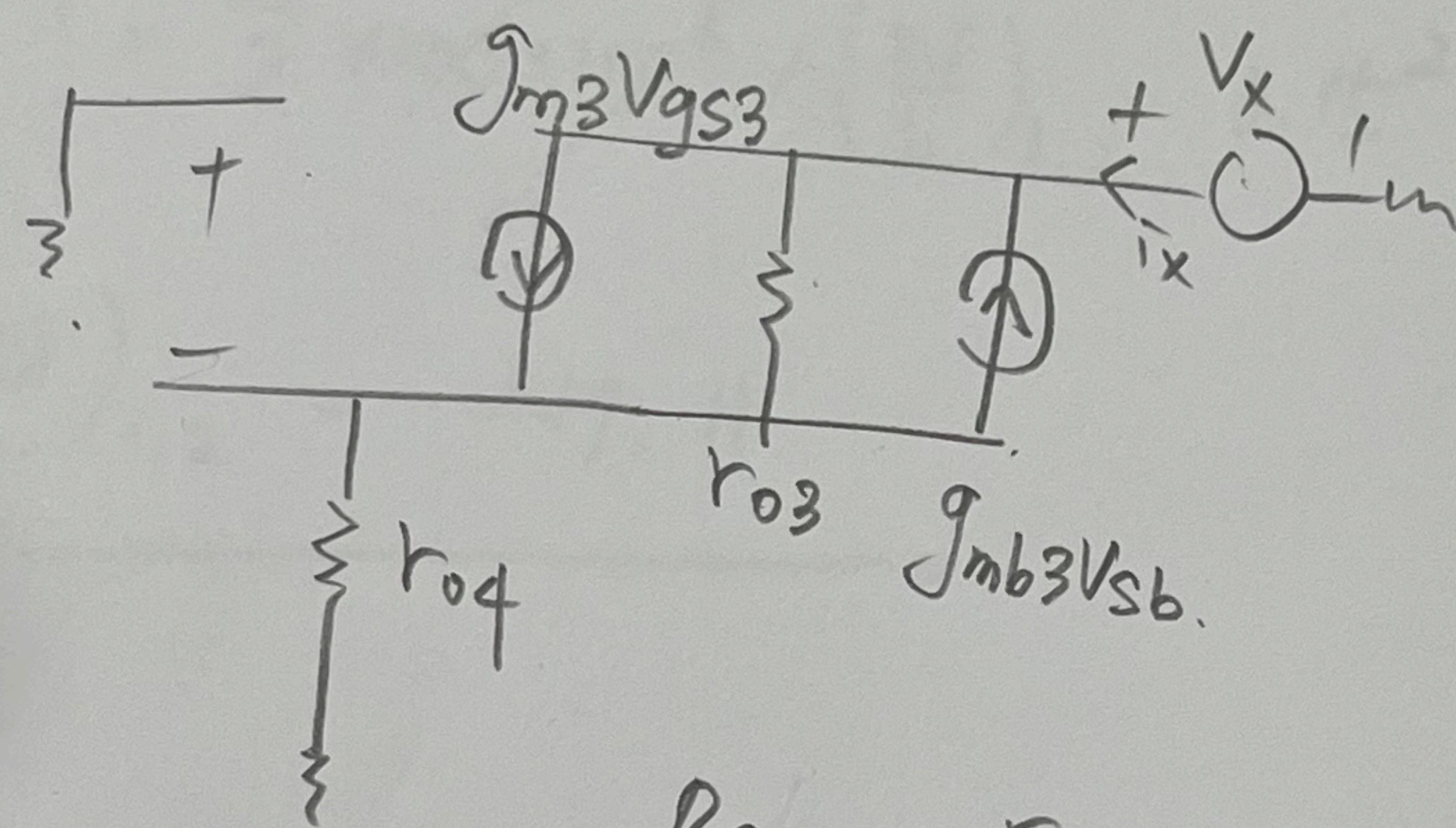
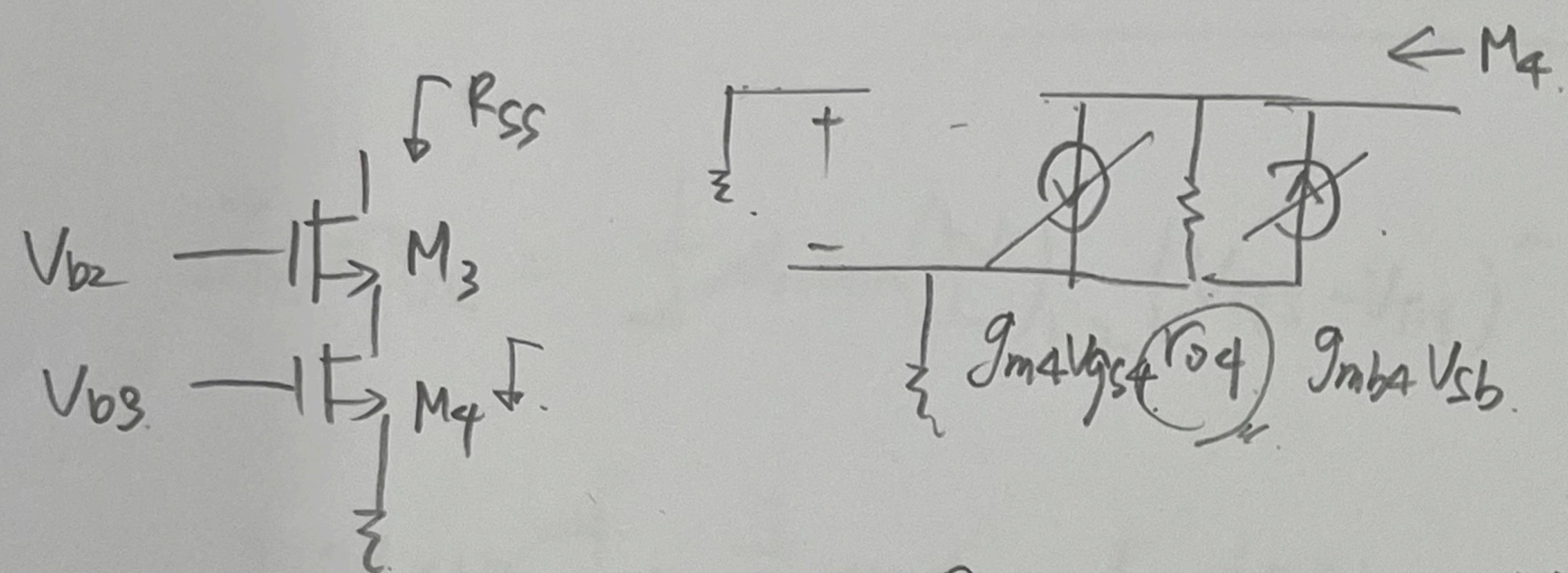
Q1.

$$\text{half-Circuit } A_{DM} = -g_m R_o.$$

Since,

$$\Delta V_x = -\Delta V_{m,CM} \frac{g_m R_o}{1 + 2g_m R_{SS}}, \quad \Delta V_f = -\Delta V_{m,CM} \frac{g_m (R_o + \Delta R_o)}{1 + 2g_m R_{SS}}$$

$$\Delta V_{out} = \frac{+g_m \Delta R_o}{1 + 2g_m R_{SS}} \Delta V_{m,CM}.$$



$$R_{SS} = r_{o3} + r_{o4} + (g_{mb3} + g_{m3})r_{o3}r_{o4}$$

thus, $\Delta V_{out} = \frac{+g_m \Delta R_o}{1 + 2g_m (r_{o3} + r_{o4} + (g_{mb3} + g_{m3})r_{o3}r_{o4})} \Delta V_{m,CM}$

$$\text{CMRR} = \left| \frac{A_{DM}}{A_{CM-DM}} \right| = \frac{\frac{g_m R_o}{g_m \Delta R_o}}{1 + 2g_m (r_{o3} + r_{o4} + (g_{mb3} + g_{m3})r_{o3}r_{o4})}$$

$$= \frac{1 + 2g_m (r_{o3} + r_{o4} + (g_{mb3} + g_{m3})r_{o3}r_{o4}) R_o}{g_m \Delta R_o}$$

Q2

$$P = 1 \text{ mW} \quad V_{DD} = 1.8 \text{ V}$$

$$I_{\text{total}} = \frac{1 \times 10^{-3}}{1.8} = \underline{\underline{5.56 \times 10^{-4} \text{ A}}}$$

$$g_m = g_{m1} = g_{m2} = \frac{2I_{D1}}{V_{GS} - V_{TH}} = \frac{\underline{\underline{I_{\text{total}} \text{ A}}}}{0.15 \text{ V}} = \underline{\underline{0.0037 \text{ S}}}$$

$$|Av| = g_m R_o = 5 \Rightarrow R_o = \underline{\underline{1351.35}}$$

$$I_{D1} = I_{D2} = \frac{1}{2} \mu n C_{ox} \left(\frac{W}{L} \right)_{1,2} (V_{GS} - V_{TH})^2$$

$$2.78 \times 10^{-4} = \frac{1}{2} \times 100 \times 10^{-6} \times \left(\frac{W}{L} \right)_{1,2} \times 0.15^2$$

$$\left(\frac{W}{L} \right)_{1,2} = 247.11$$

$\overbrace{\qquad\qquad\qquad}^{=}$