EEO-311
Quiz 5

Pete Mills

1 Circuit A - Current Mirror

Find R_{out}, Vmin (V_{ov})

$$V_{min} = V_{ov} = \sqrt{\frac{2 \cdot 100\,\mu\text{A}}{\frac{100\,\mu\text{m}}{1\,\mu\text{m}} \cdot 200\,\mu\text{A/V}^2}} = 100\,\text{mV}$$

$$R_{out} = \frac{20\,\text{V}}{100\,\mu\text{A}} = 200\,\text{k}\Omega$$

2 Circuit B - Cascode current mirror

Find $R_{out} = r_o \cdot A_o$, $V_{min} = 2V_{tn} + 2V_{ov}$

$$V_{min} = 2 * 0.7\,\text{V} + 2 * 0.1\,\text{V} = 1.6\,\text{volt}$$

$$R_{out} = \frac{20\,\text{V}}{100\,\mu\text{A}} \cdot \frac{2 * 20\,\text{V}}{0.1\,\text{V}} = 80\,\text{M}\Omega$$

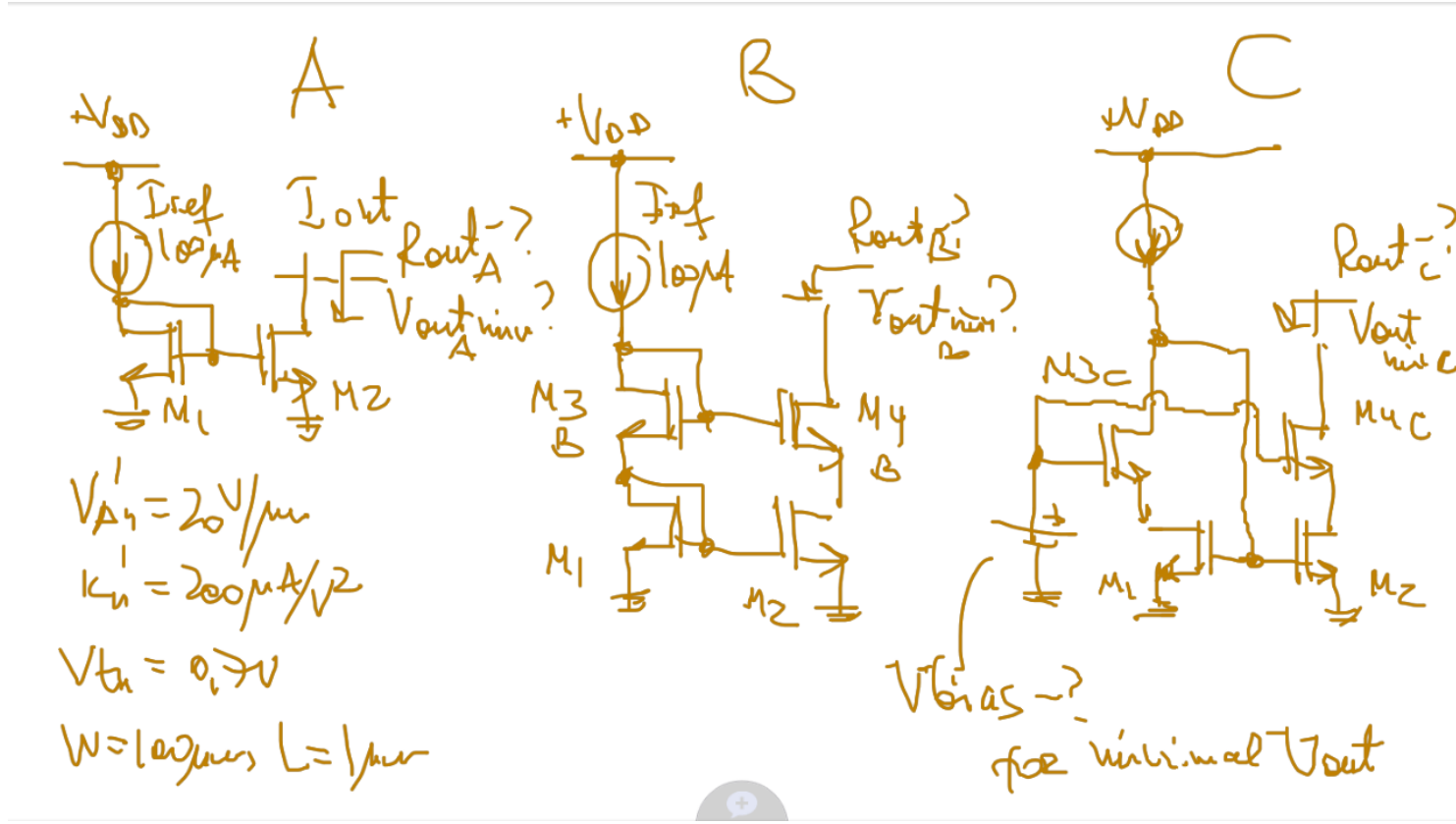
3 Circuit C - Wide-Swing, low voltage cascode current mirror

Find $R_{out} = r_o \cdot A_o$, $V_{min} = 2V_{ov}$, $V_{bias} = V_{tn} + 2V_{ov}$

$$V_{min} = 2 * 0.1\,\text{V} = 0.2\,\text{volt}$$

$$R_{out} = \frac{20\,\text{V}}{100\,\mu\text{A}} \cdot \frac{2 * 20\,\text{V}}{0.1\,\text{V}} = 80\,\text{M}\Omega$$

$$V_{bias} = 0.7\,\text{V} + 2 * 0.1\,\text{V} = 0.9\,\text{volt}$$



Input formulae

$$V_{ov} = \frac{I_D}{K'_n \cdot \frac{W}{L}}, \text{ Overdrive voltage}$$

$$r_o = \frac{V_A}{I_C} \qquad V'_A = \frac{V_A}{L}$$

$$A_o = \frac{2V'_A L}{V_{ov}}, \text{ Intrinsic gain}$$