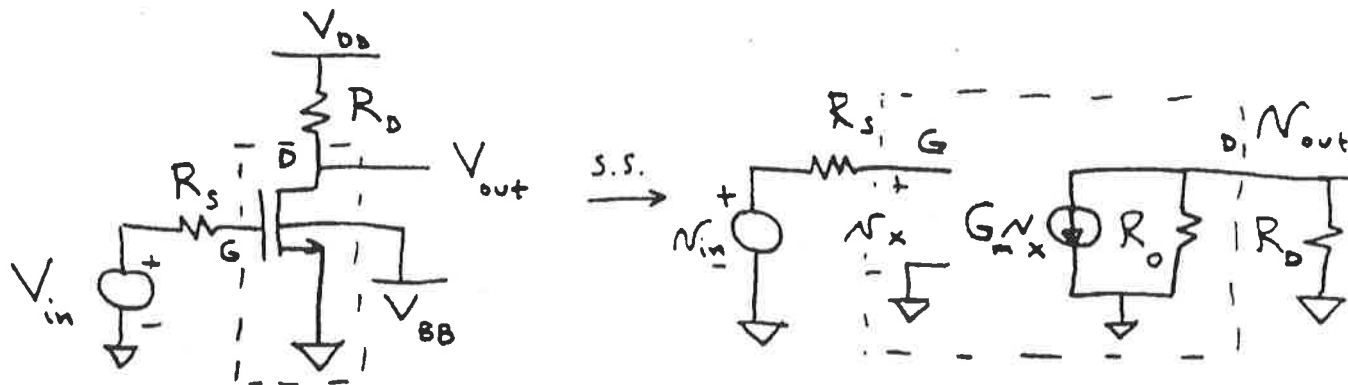


# MOS Amplifier Models

①

P. Hurst 9/12

a) Common Source

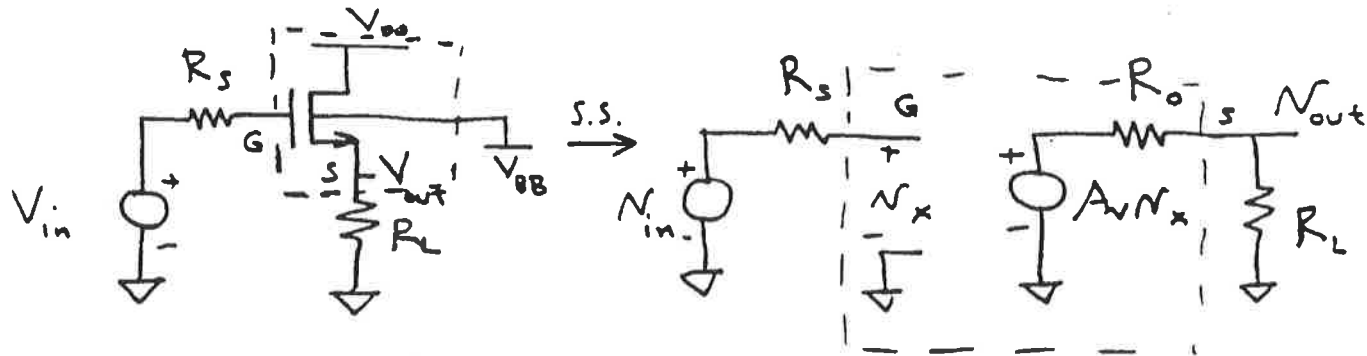


$$G_m = g_m$$

$$R_o = r_o$$

$$R_{in} = \infty \Omega$$

b) Common Drain

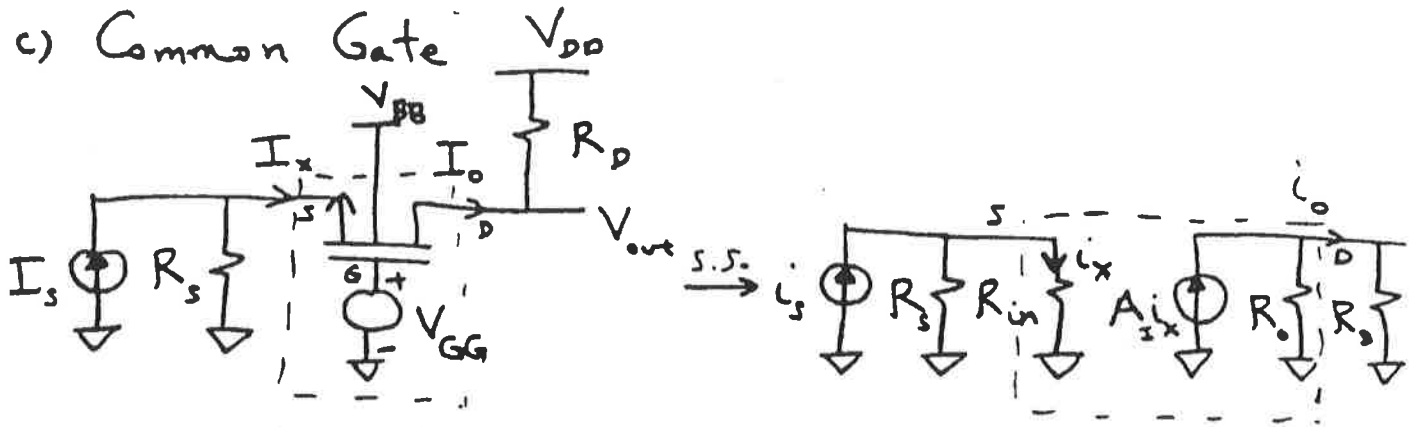


$$R_{in} = \infty \Omega$$

$$R_o = \frac{1}{\frac{1}{r_o} + g_m + g_{m_b}} \approx \frac{1}{g_m + g_{m_b}}$$

$$A_v = \frac{g_m}{g_m + g_{m_b} + \frac{1}{r_o}} \approx \frac{g_m}{g_m + g_{m_b}} = \frac{1}{1 + \frac{g_{m_b}}{g_m}} < 1$$

c) Common Gate



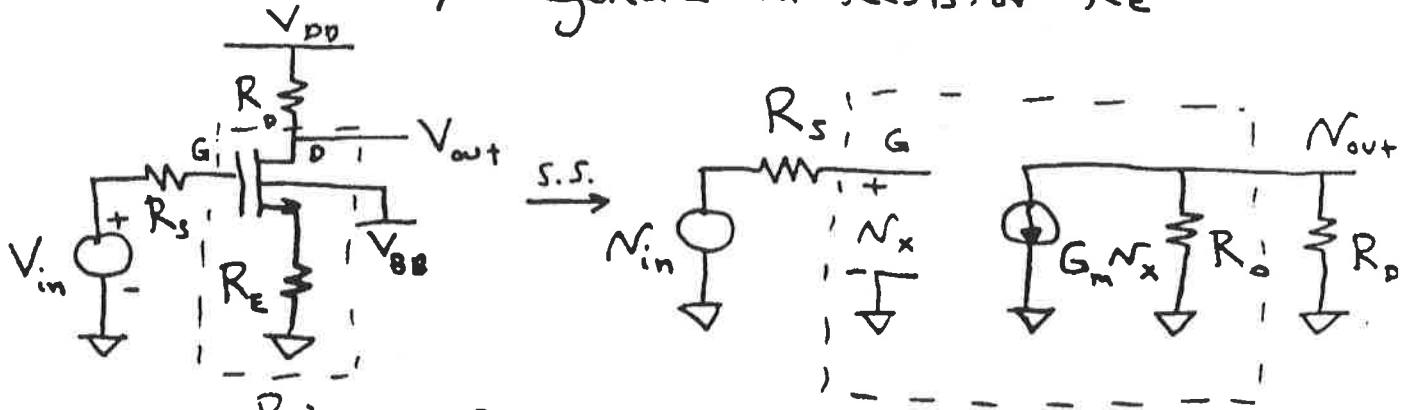
let  $g_m' = g_m + g_{m_b}$

$$R_{in} = \frac{1}{g_m'} \cdot \frac{r_o + R_D}{r_o + \frac{1}{g_m'}} \approx \frac{1}{g_m'} \quad \text{if } r_o \gg R_D$$

$$R_o = R_s + r_o [1 + g_m' (R_s \parallel r_o)] \approx r_o (1 + g_m' R_s)$$

$$A_I = 1 + \frac{R_D}{R_o} \approx 1$$

d) Common Source w/ Degeneration Resistor  $R_E$



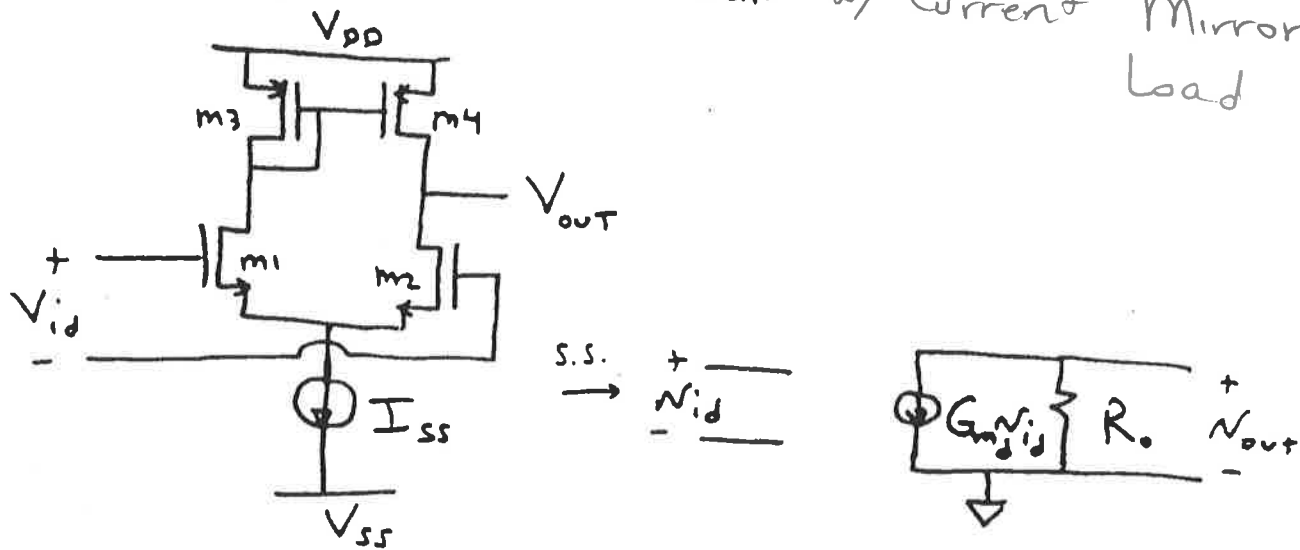
$$R_{in} = \infty \Omega$$

$$R_o = R_E + r_o [1 + (g_m + g_{m_b}) R_E] \approx r_o [1 + (g_m + g_{m_b}) R_E]$$

$$G_m = \frac{g_m}{1 + (g_m + g_{m_b}) R_E + \frac{R_E}{r_o}} \approx \frac{g_m}{1 + (g_m + g_{m_b}) R_E}$$

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e) Source-Coupled Differential Pair w/ Current Mirror Load



$$G_{m_d} = g_{m_1} = g_{m_2}$$

$$R_{in} = \infty \Omega$$

$$R_o = r_{o_4} \parallel r_{o_2}$$