EE303 - Problem Set

Problem 1

For the circuit shown in Fig. P3.16, prove the following results, quantifying the Thevenin's resistance seen between each pair of transistor terminals. Neglect the finite r_o of the MOSFET.

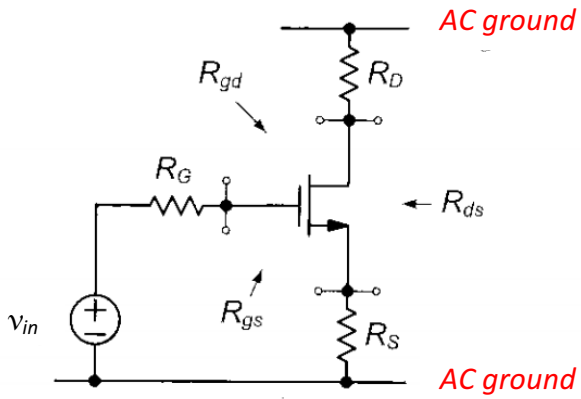

Figure P3-16

$$R_{gs} = \frac{R_G + R_S}{1 + g_m R_S}$$

$$R_{ds} = \frac{R_D + R_S}{1 + g_m R_S}$$

$$R_{gd} = R_G + R_D + G_m R_D R_G$$

where:

$$G_m = \frac{g_m}{1 + g_m R_S}$$

Problem 2

Compute the output resistance of the circuits depicted in Fig. 9.50. Assume all of the transistors operate in saturation and $g_m r_O \gg 1$.

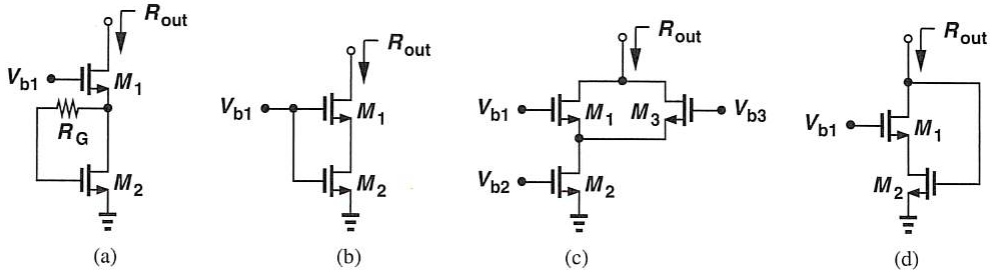

Figure 9.50

Problem 3

The MOS cascode of Fig. 9.47 must provide a bias current of 0.5 mA with an output impedance of at least 50 kΩ. If $\mu_n C_{ox} = 100\ \mu\text{A/V}^2$ and $W/L = 20/0.18$ for both transistors, compute the maximum tolerable value of λ.

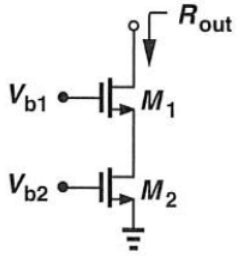

Figure 9.47

Problem 4

Consider the circuit shown in Fig. 9.49, where $V_{DD} = 1.8$ V, $(W/L)_1 = 20/0.18$, and $(W/L)_2 = 40/0.18$. Assume $\mu_n C_{ox} = 100\,\mu\text{A/V}^2$ and $V_{TH} = 0.4$ V.

(a) If we require a bias current of 1 mA and $R_D = 500\,\Omega$, what is the highest allowable value of V_{b1}?

(b) With such a value chosen for V_{b1}, what is the value of V_X?

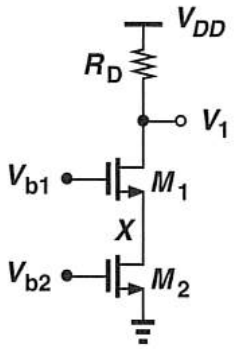

Figure 9.49

Problem 5

The MOS cascode of Fig. 9.20(a) must provide a voltage gain of 200 with a bias current of 1 mA. If $\mu_n C_{ox} = 100\,\mu\text{A/V}^2$ and $\lambda = 0.1\,\text{V}^{-1}$ for both transistors, determine the required value of $(W/L)_1 = (W/L)_2$.