Homework Assignment #5
Due in the 105 box on the 2nd floor of Cory, 5pm Friday 2/18/2010

Problem 1: An NMOS transistor with \( u_n C_{ox} = 200 \mu A/V^2 \), \( V_{TH} = 0.5 \), and \( \lambda = 0.1 \ V^{-1} \) must provide a transconductance \( g_m = 10 \text{mS} \).
   a) if you pick an operating point with \( V_{GS} = 1.5 \text{V} \), what W/L is necessary (you may ignore channel length modulation)? What is the bias current and output resistance? Draw the low frequency small signal model.
   b) If you pick W/L=100\mu/1\mu, what \( V_{GS} \) is needed? What is the bias current and output resistance?
   c) If you pick \( I_D = 0.5 \text{mA} \), what \( V_{GS} \) is needed? What W/L?

Problem 2: A bipolar transistor with \( I_s = 10^{-14} \text{A} \), \( V_A = 50 \text{V} \), and \( V_{CEsat} = 0.3 \text{V} \), must provide a transconductance of \( 1/26 \ \text{S} \) at room temperature.
   a) what is the bias current necessary?
   b) What is the base/emitter bias necessary assuming \( V_A \) is infinite?
   c) At this base/emitter bias point, over what range (min to max) of collector/emitter voltage will the transistor maintain a transconductance within 20% of the desired value?

Problem 3: Razavi 4.21, 22, 23

Problem 4: Razavi 6.16, 18, 19, 21. Read the note at the beginning of the problems for Chapter six for default parameter values.