Exercises for Tutorial 4: Feedback, Stability, Frequency Compensation

1) Problem 10.1 in the course book.

2) Problem 10.9 in the course book. In part (b) assume that the gain crossover point is the same as that of part (a). Also assume $\mu_n C_{ox} = 134\ \mu A/V^2$, $\lambda_n = 0.1\ V^{-1}$ and $\lambda_p = 0.2\ V^{-1}$. All transistors are in saturation region.

3) Figure 8 shows an amplifier schematic. For simplicity we can ignore all parasitics of M_1 and M_2. Also, we assume $g_{m1} \gg 1/r_{o1}$ and $\gamma = 0$.

   a) Determine the transfer function of the amplifier.

   b) If $g_{m1} = g_{m2} = 1\ mA/V$, $R = r_{o2} = 20\ k\Omega$ and $C_1 = C_2 = 1\ pF$, calculate the phase margin of the circuit.

   c) Use the assumptions in part (b) to calculate the AC gain, if the input frequency is $f = \frac{1}{2\pi} \times 10^8\ Hz$.

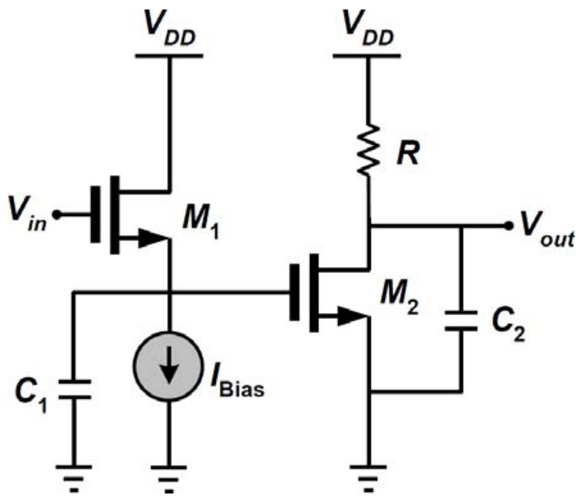

Figure 8 An amplifier schematic.

4) Figure 9 shows an amplifier schematic. For simplicity we can ignore all parasitics of M_1 and M_2. Also we assume $\lambda = 0$.

   a) Determine the transfer function of the amplifier.

   b) If the amplifier behaves like a single-pole system, show $g_{m2}R = 1$.

   c) If $g_{m1} = g_{m2} = 0.32\ mA/V$, $R = 5\ k\Omega$, $C_1 = 0.2\ pF$ and $C_2 = 1\ pF$, calculate the phase shift through the amplifier circuit for an input signal with $f = 143.3\ MHz$.

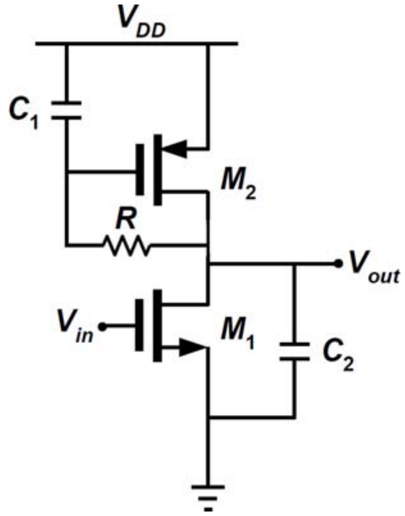

Figure 9 An amplifier schematic.

5) An amplifier circuit has two poles at $100\ Mrad/s$ and $500\ Mrad/s$, with no zeros. Calculate the DC gain of the amplifier to get a phase margin of $90°$.

6) Figure 10 shows a source-follower circuit. For simplicity we can ignore all parasitics. Also we assume $\lambda = 0$.

   a) Determine the transfer function of the circuit.

   b) If $g_{m1} = 1\ mA/V$, $R = 10\ k\Omega$, $C_1 = 1\ pF$ and $C_2 = 0.1\ pF$, calculate the AC gain and the phase shift through the source-follower circuit for an input frequency of $5\ Grad/s$.

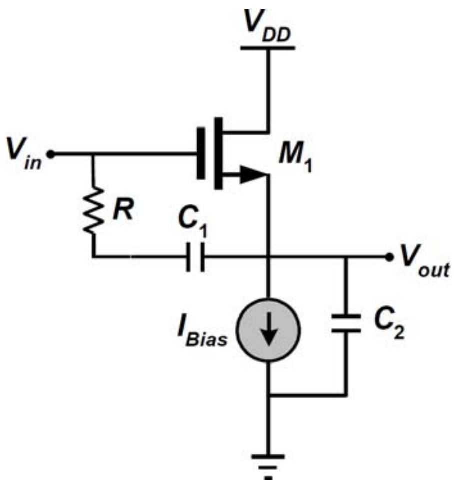

Figure 10 Source follower.