1. Simulate the circuit below in Pspice using Q2N2222 transistors with $I_{ref} = 0.1 \text{ mA}$ and $I_{ref} = 10 \text{ mA}$ to obtain:

(a) $I_{o,dc}$ vs. $V_{o,dc}$, where $V_{o,dc}$ is varying from 0.1 V to 1 V.

(b) $R_o$ vs. $V_{o,dc}$, where $V_{o,dc}$ is varying from 0.1 V to 1 V.

Note that DC sweep analysis is required for part (a), whereas parametric AC analysis is needed for part (b). Comment on the results.

2. Show that $R_o$ in the following circuit can be approximated to $\beta r_o/2$. Assume that all transistors are active and matching.

3. Design the differential amplifier below (determine $R_C$, $V_{i,dc}$ and $I_T$, and build the current source using transistors) to obtain the maximum symmetrical swing at the output with the following specifications:

(a) $|A_{dm}| \geq 40$, CMRR $\geq 65 \text{ dB}$.

(b) $|A_{dm}| \geq 30$, CMRR $\geq 110 \text{ dB}$. 
4. In the following circuit, assume that all transistors are active with $\chi = 0$ and nonzero $\lambda$. Find $v_{od}/v_{id}$ in terms of small-signal parameters.

5. Assume that all transistors in the following circuit are active, $V_x$ is a DC voltage, and $V_A$ is finite. Find $v_{o}/v_{id}$ in terms of small-signal parameters.