EHB 335E HW#1

1) Derive an expression for the differential voltage gain of the following amplifier.
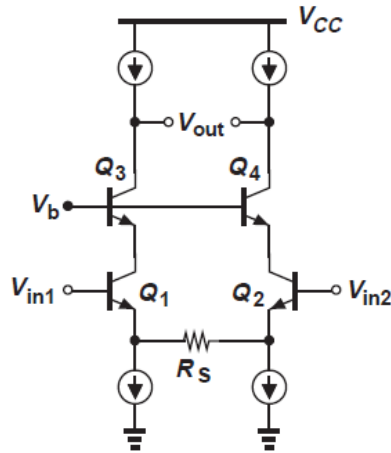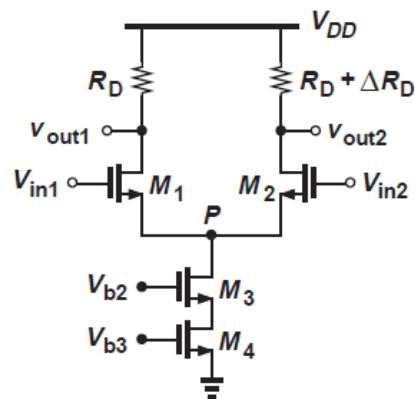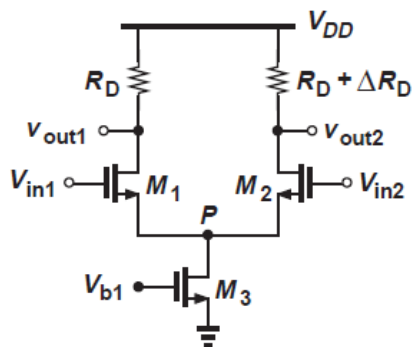

2) Provide expressions for the common mode gain (= V_{out} / V_{in1}) of the following amplifiers.
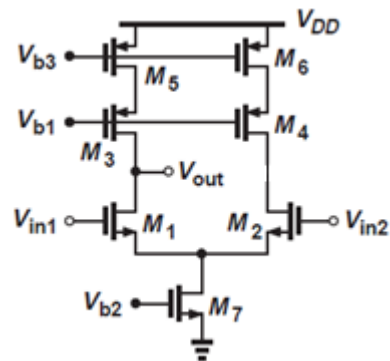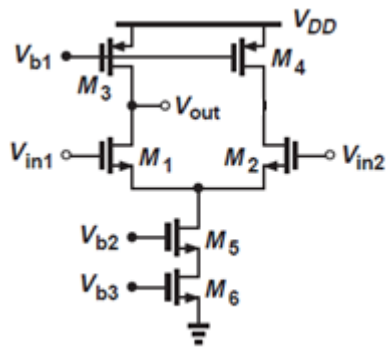
3) Provide expressions for the CMRR of the following amplifiers. For simplicity, you can neglect the channel length modulation in M_1 and M_2 but not in other transistors. You can use the CMRR equations derived in your textbooks.

4) Calculate the input resistance and the voltage gain of the circuit below. Assume that all transistors are in saturation, and $\lambda \neq 0$.
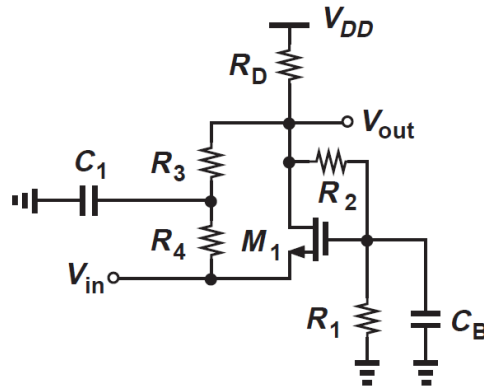
5) Assuming perfect symmetry and $V_A > 0$, calculate the differential voltage gain of the amplifier below. Design the circuit in LTSPICE/PSPICE by assuming that $V_{CC} = 2.5V$ and $I_{EE} = 1mA$. Optimize your circuit to obtain a high differential gain. Use Q2N2222 and Q2N2907 transistors for npn and pnp, respectively. Provide the AC simulation plot of your amplifier. Also, provide the transient response of your amplifier to a sine wave of 10 mV amplitude and 1 kHz frequency.