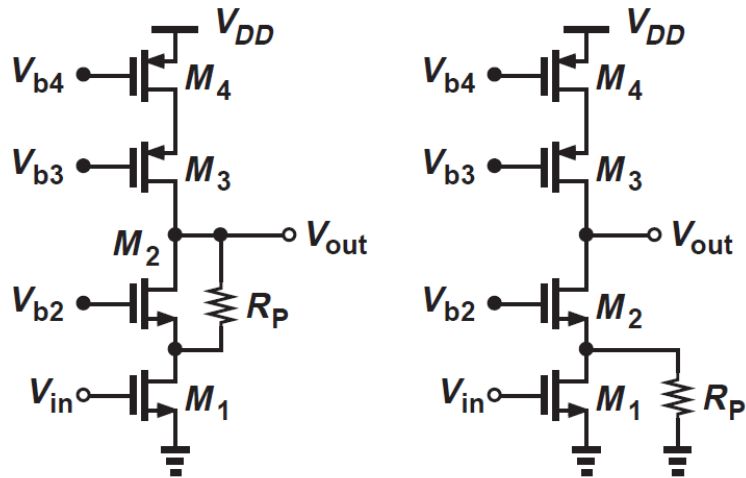
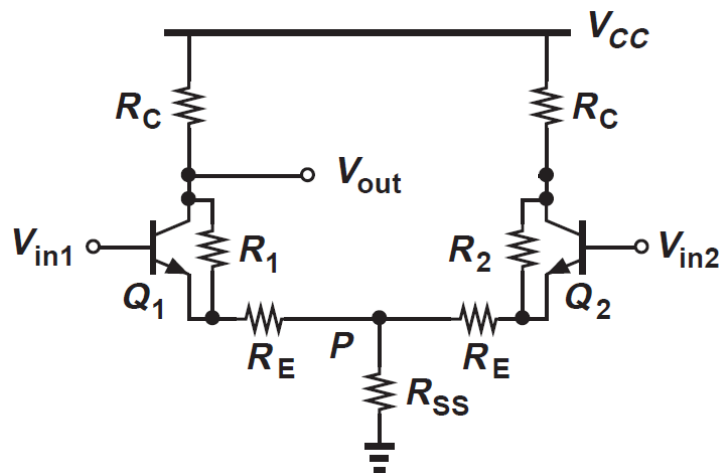


Due: 3 October 2018 @9:00 am – No late homework will be accepted.

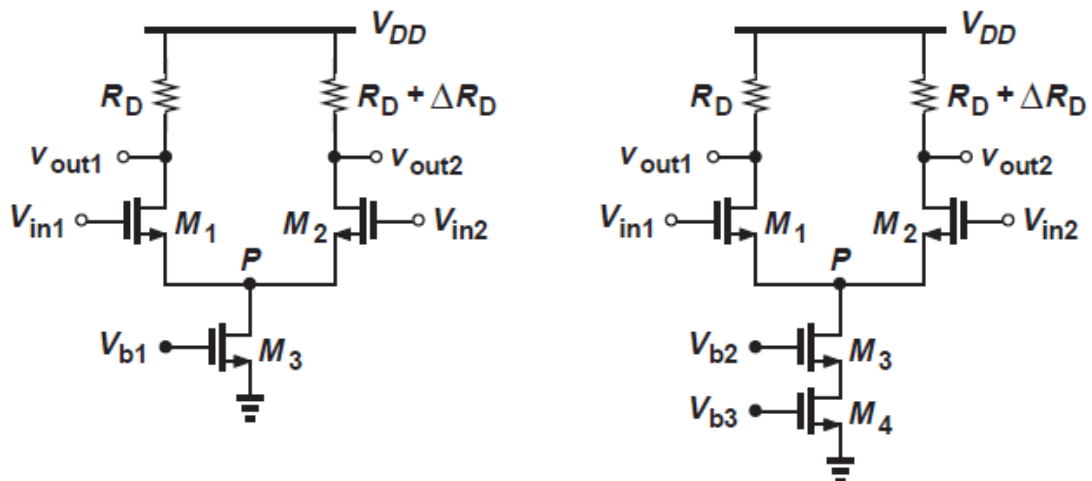
- 1) Derive an expression for the voltage gain of the following amplifiers.



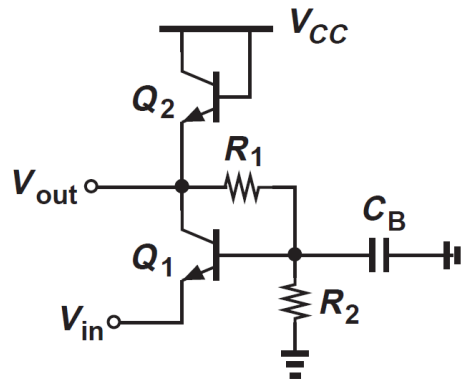
- 2) Provide expressions for the common mode gain ( $= V_{out} / V_{in1}$ ) of the following amplifiers.



- 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  $V_{CC} = 2.4V$  and  $I_{EE} = 1.2mA$ . 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.

