EHB 335E HW#1

Due: 2 October 2019 @8:40 am – **No late homework will be accepted.**

1) Derive an expression for the voltage gain of the amplifiers in Fig. 1a and Fig. 1b. For the circuit in Fig. 1b, assume that R_P is so low that it affects G_m of the circuit. Assume $V_A < \infty$ and $\lambda \neq 0$.

2) Calculate the input resistance and the voltage gain of the circuit in Fig. 1c. Assume that all transistors are in saturation, and $V_A < \infty$.

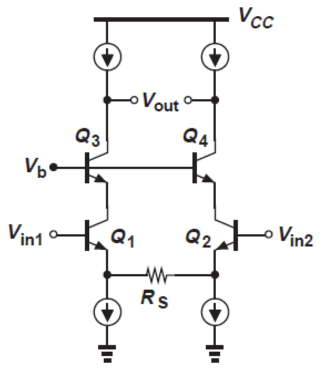

Fig. 1a

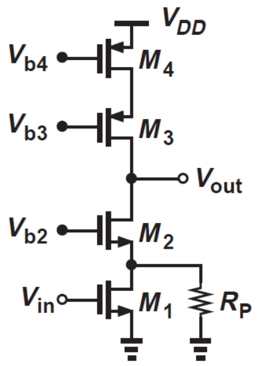

Fig. 1b

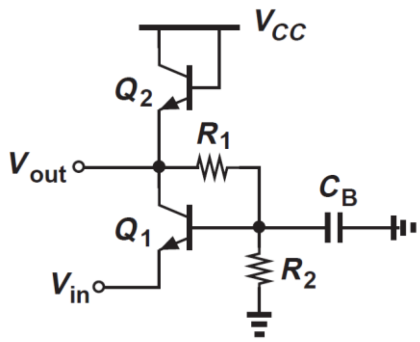

Fig. 1c

3) Draw the magnitude and phase Bode diagrams of the following transfer function. Compare your results with MATLAB simulations.

$$H(s) = \frac{10^4(10+s)(10000+s)}{(100+s)(1000+s)}$$

4) Derive the transfer function of the amplifier in Fig. 2a. Substitute $s = j\omega$, and obtain an expression for V_{out}/V_{in}. Determine the –3 dB bandwidth of the circuit. Assume that $\lambda = 0$.

5) Assuming perfect symmetry and $V_A > 0$, calculate the differential voltage gain of the amplifier in Fig. 2b. Design the circuit in LTSPICE/PSPICE by assuming that $V_{CC} = 2.8V$ and $I_{EE} = 1.5mA$. 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. No need for hand calculation, please just provide the outcomes of LTSPICE/PSPICE simulations.

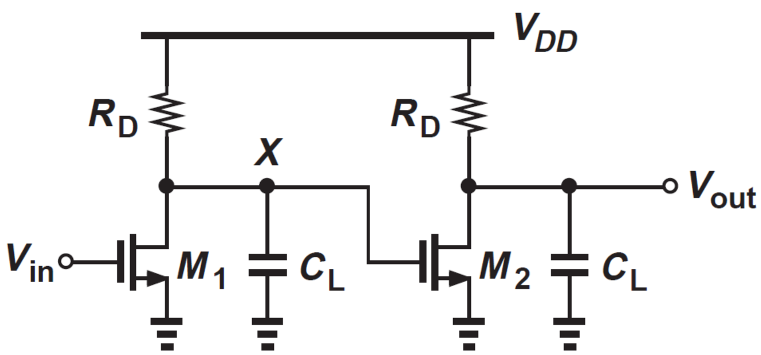

Fig. 2a

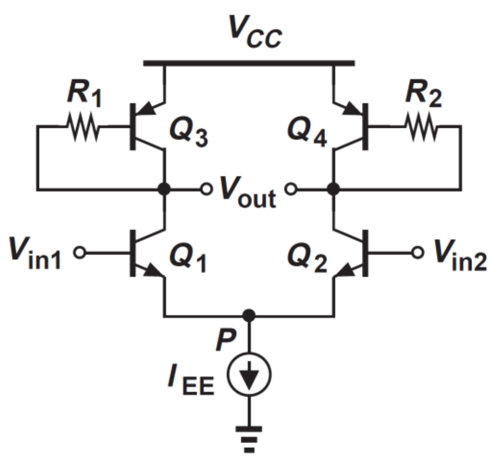

Fig. 2b