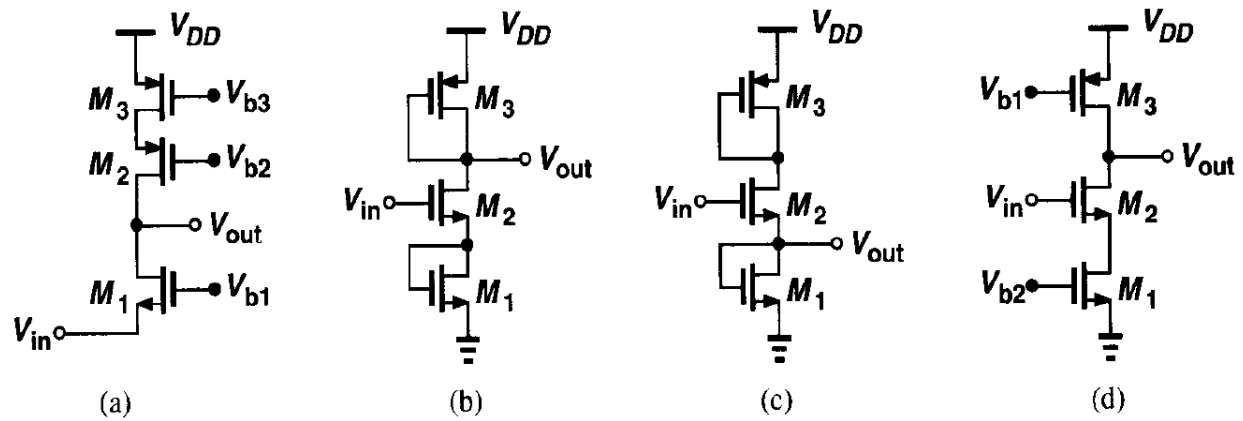


PROBLEM SET #10

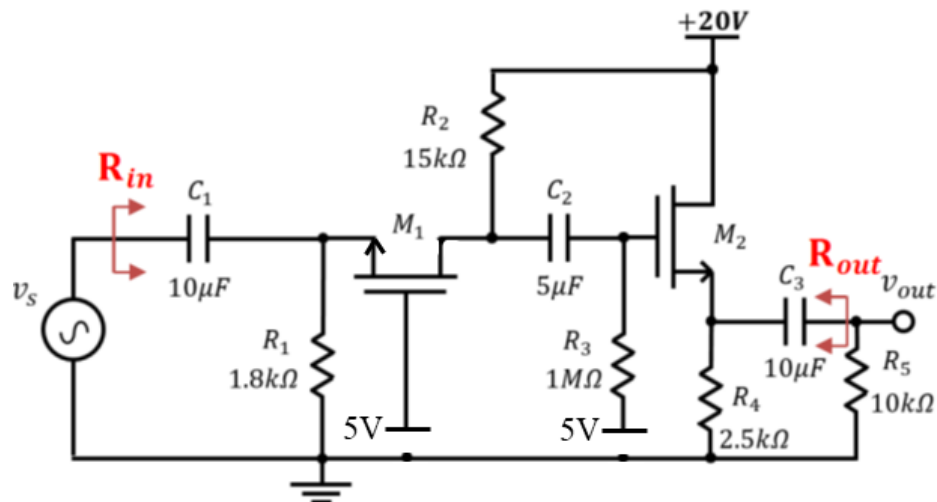
Issued: Friday, November 8, 2019

Due: Friday, November 22, 2019, 12:00 noon via Gradescope.

1. Sedra & Smith, Problem 8.48.
2. Sedra & Smith, Problem 8.98.
3. Find an expression for the small signal voltage gain of each circuit ($\lambda \neq 0$, $\gamma = 0$).



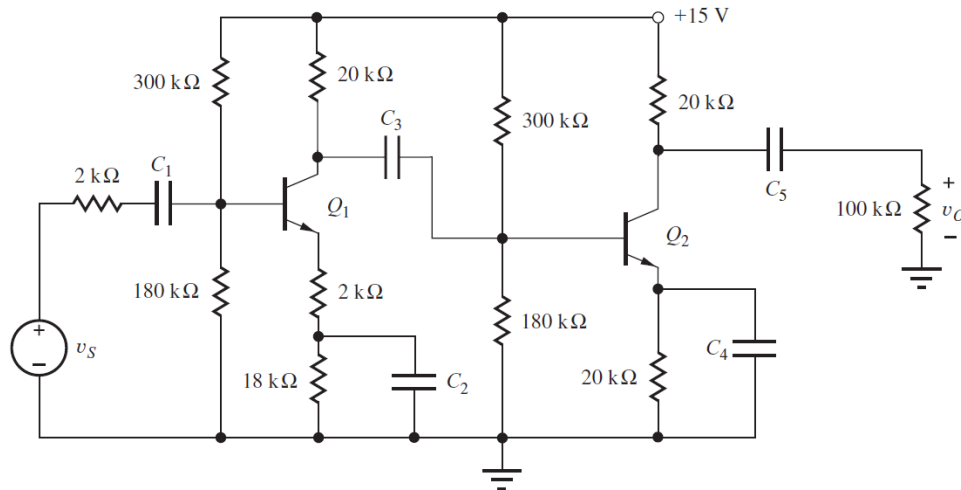
4. Calculate the small signal voltage gain v_{out}/v_s , R_{in} , R_{out} , f_L and f_H for the following amplifier. M_1 and M_2 are identical. Parameters: $W=200\mu\text{m}$, $L=1.2\mu\text{m}$, $\mu_n=450\text{cm}^2/(\text{Vs})$, $C_{ox}=0.5\text{fF}/\mu\text{m}^2$, $V_t=2\text{V}$, $L_{ov}=0.1\mu\text{m}$, $C_{db0}=20\text{fF}$, $C_{sb0}=20\text{fF}$, $V_0=0.7\text{V}$, $\lambda=0.02\text{V}^{-1}$, $\gamma=0$.



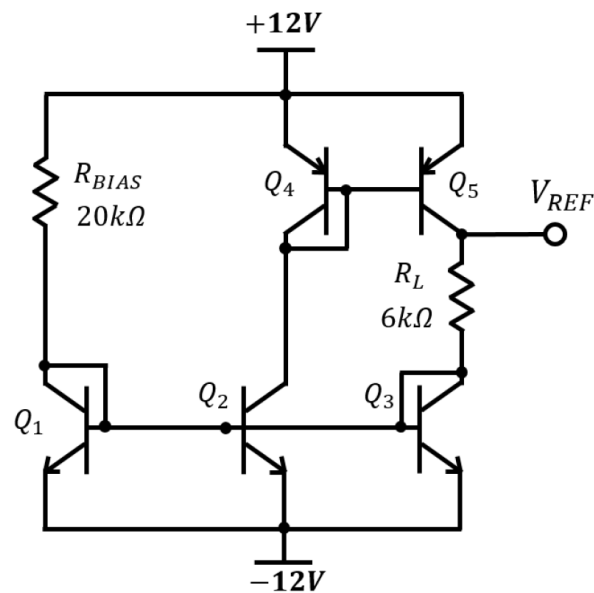
5. Calculate the gain v_{out}/v_s , R_{in} , R_{out} , f_L and f_H for the following amplifier.

BJT parameters: $\beta=100$, $V_A=70V$, $C_{jc,0}=20fF$, $C_{je,0}=20fF$, $\phi_j=0.7V$, $\tau_F=350ps$, $V_{BE,on}=0.7V$.

$C_1=C_3=C_5=1\mu F$, $C_2=C_4=0.1\mu F$.



6. Repeat problem 5 for the gain v_{out}/v_s , R_{in} and R_{out} with C_2 and C_4 removed.
7. For the circuit shown below, Q_1 , Q_2 and Q_3 have the same properties, and Q_4 and Q_5 have the same properties. $V_{BE,on,Q1}=0.7V$, $V_{BE,on,Q4}=0.65V$. Solve for V_{REF} . Neglect early effect.



8. A common-gate amplifier is needed with an input resistance of 10Ω . Two n -channel MOSFETs are available: one with $K_n = 5 \text{ mA/V}^2$ and the other with $K_n = 500 \text{ mA/V}^2$. Both are capable of providing the desired value of R_{in} . Which one would be preferred and why?