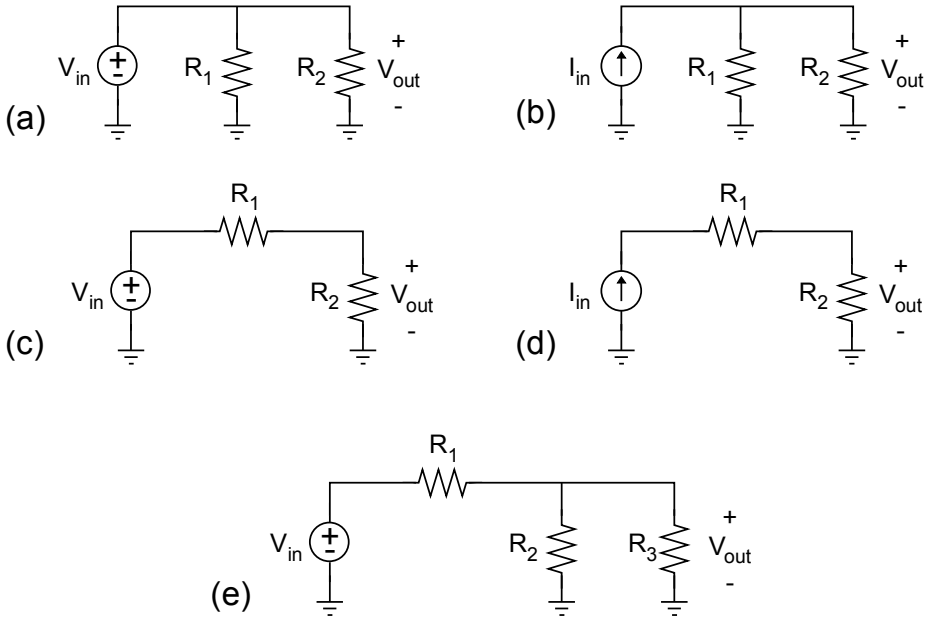
EE 551 Linear Integrated Circuits
Homework 1

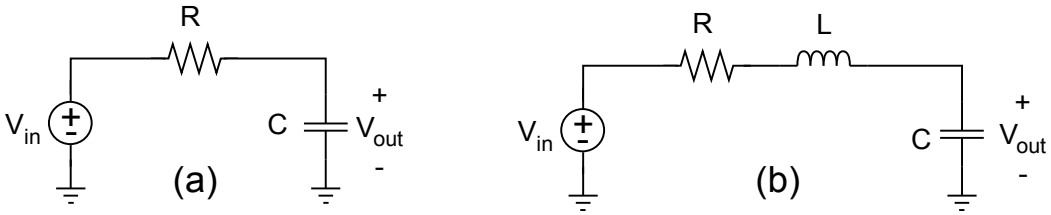
1. Solve for expressions for V_{out}, the voltage across each resistor, and the current through each resistor for all parts a-e. Also, solve for the numerical values, as well, given that

   $$R_1 = 1k\Omega,\ R_2 = 10k\Omega,\ R_3 = 10k\Omega,\ V_{in} = 1V, \text{ and } I_{in} = 1mA$$

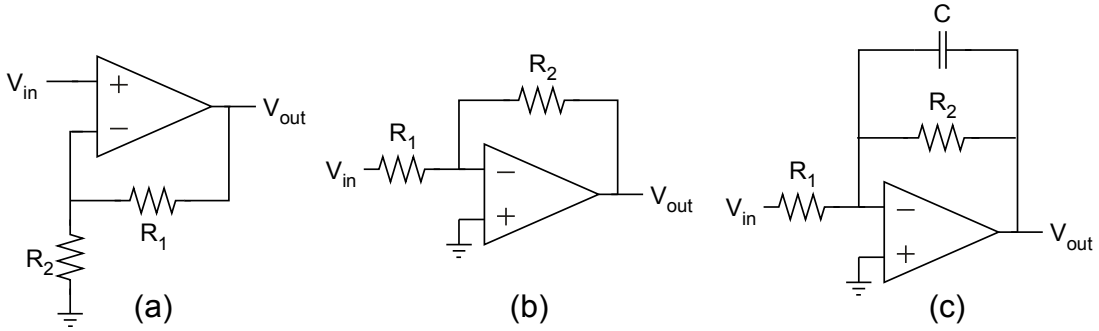
   Additionally, derive expressions for the current through each resistor in Part b and the voltage across each resistor in Part C.



2. Solve for the Laplace-domain transfer function of each of the following circuits. If the circuit performs a filtering operation, determine the type of filtering operation and also the order of the filter.



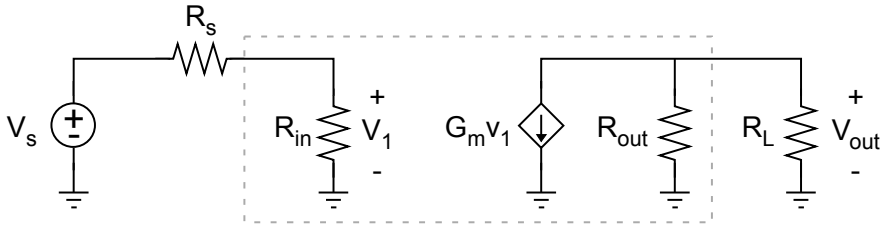
3. For each of the following circuits, solve for the transfer function. Assume all opamps are idea. If any of the circuits perform filtering, determine the order of the filter and the type of filtering operation, and then sketch the frequency response of the filter (both magnitude and phase).



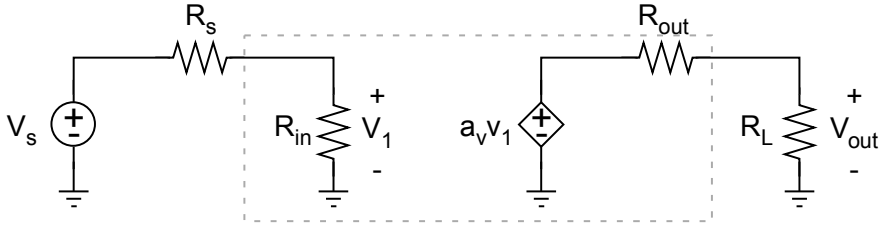
4. Draw the two-port amplifier model that is described below
    - Forward transconductance = 1mS
    - Reverse transconductance = 10nS
    - Input impedance = 1MΩ
    - Output impedance = 100kΩ

    Determine the forward voltage gain of this amplifier.

5. For each circuit below, the amplifier is drawn within the dotted lines. Perform the following.
    - Determine the unloaded voltage gain of the amplifier (i.e. ideal voltage source and load impedance)
    - Determine the actual voltage gain of the amplifier (i.e. using the circuit shown below)
    - Assuming we have control over the input/output impedances of the amplifier, but not the source and load, how can we design the amplifier to maximize the voltage gain
    - Convert the amplifier of Part a to a voltage output (i.e. Thevenin). Convert the amplifier of Part b to a current output (i.e. Norton)

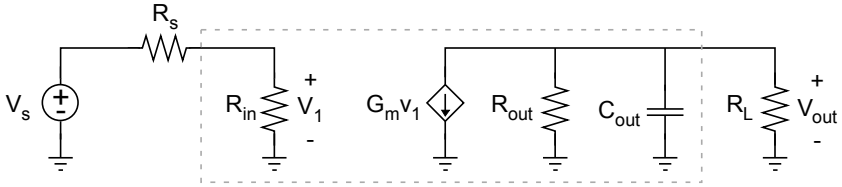


(a)

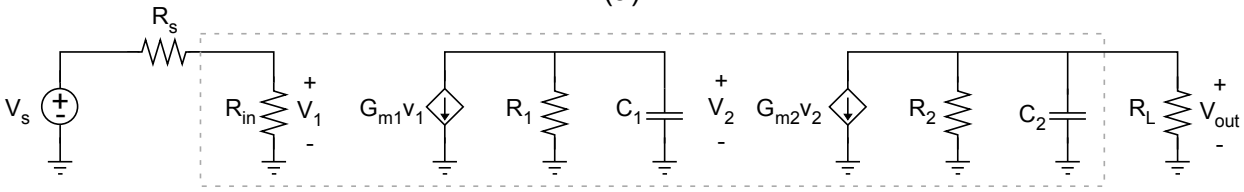


(b)

6. For each circuit below, the amplifier is drawn within the dotted lines. Determine the unloaded and loaded voltage gains of each amplifier. How can we design the amplifier to maximize the voltage gain and the corner frequency?



(a)



(b)