EE 230
Experiment 2
Fall 2006

Transfer Characteristics and Transfer Functions

Objectives: The primary objective of this experiment is to review laboratory measurement procedures and to explore basic concepts of transfer characteristics and transfer functions.

Equipment:
Computer with SPICE software
HP E3631A or equivalent power supply
HP 33120A or equivalent signal generator
HP 34401A or equivalent multimeter
HP 54602B or equivalent oscilloscope

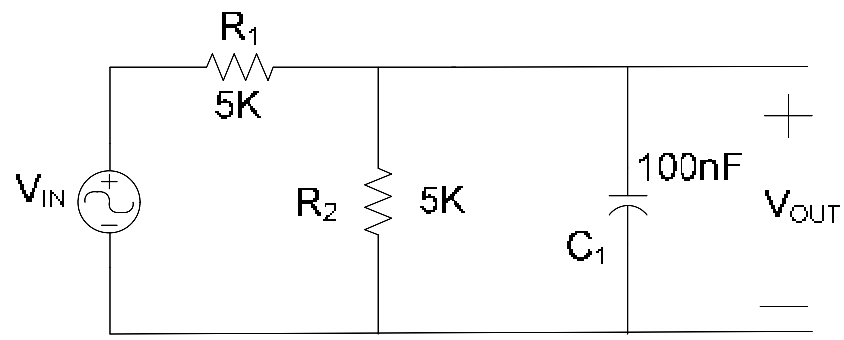
Parts:
3 1kΩ, 3.3kΩ, and 3 4.7kΩ, ¼ W reistors
3 100nF capacitors
2 rectifier diodes

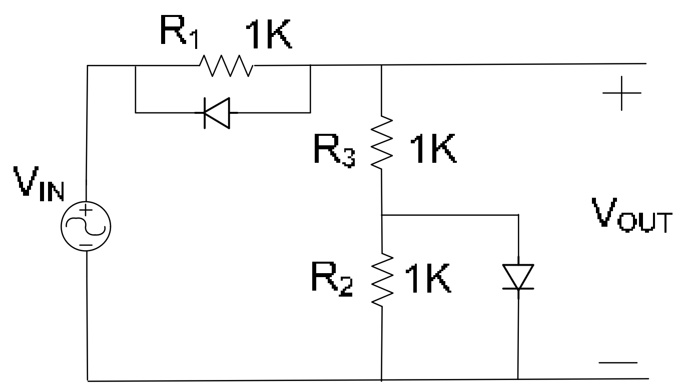
Practical Details: Transfer Characteristics relate the input and output electrical port variables of any two-port network and are most often used to relate the pseudo-static input-output performance of the network. The pseudo-static input-output performance is that obtained when the input changes so slowly with time that even slower changes with time do not appreciably change the output. The pseudo-static transfer characteristics are often termed the DC transfer characteristics. Correspondingly, Transfer Functions are only defined for linear networks and relate the input-output performance of the network throughout a frequency range of interest.

In Part 1, diodes are used in the circuit. Since diodes have not yet been discussed in class, a mathematical analysis of the circuit is not required or expected. The DC transfer characteristics can be measured even if the models for the devices have not been developed.

Part 1 Determine the DC Transfer Characteristics

a) In the laboratory, determine the DC transfer characteristics for the following two circuits. Any diode you have in your parts kit should work for the diode. The measurements can be done either by hand or with Signal Express but the latter should make the data acquisition much easier.
b) Using the results from part A, label each circuit as linear or nonlinear.





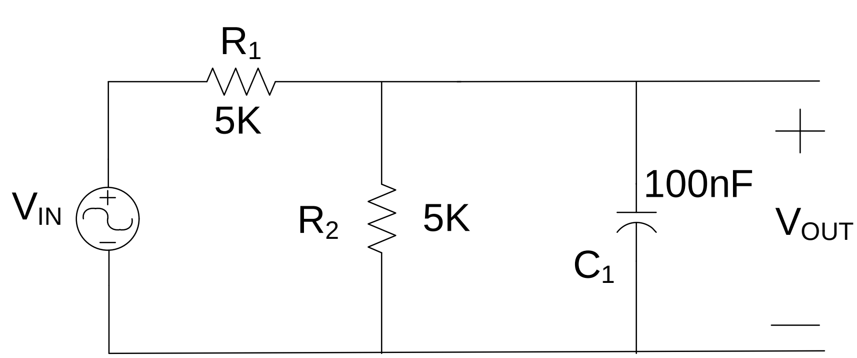
Part 2 Transfer Functions

a) Obtain an analytical expression for the transfer function T(s) for the following network.

b) Plot $|T(jw)|$ and arg(T($j\omega$)) for 0<ω<5000. These measurements will be simplified if computer controlled measurements are made.

c) Measure $|T(jw)|$ and arg(T($j\omega$)) for 0<ω<5000 both in the laboratory and with SPICE simulation.

d) Compare analytical expressions, measured results and SPICE simulation.



Part 3 Measurement of 3dB Bandwidth

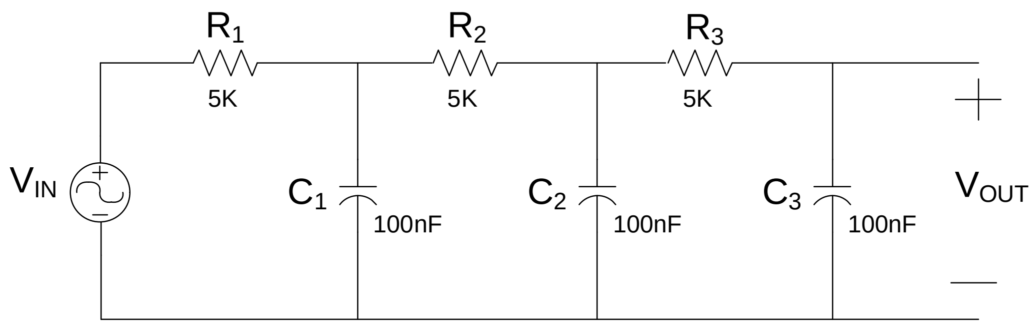
Measure the 3dB bandwidth for the circuit of Part 2. The 3dB bandwidth is the distance between real frequencies where the output drops by 3dB. Where there is only one real frequency at which the output drops by 3dB the bandwidth will be from the 3dB frequency to 0.

Part 4 Steady-State Response of a Passive RC Network

a) Analytically determine the sinusoidal steady-state response of the following network for an input of $V_{in}(t) = 4\sin(1000t)$.

b) Measure the response in the laboratory and with SPICE simulation.

c) Compare the results obtained in the laboratory, those obtained by hand analysis and those obtained from a SPICE simulation.



Part 5 Steady State Response of RC Networks with Dependent Sources

Analytically determine the response for the circuit in Part 4 if unity gain dependent sources were inserted between the stages as shown below.

a) Determine the output using SPICE simulation.

b) Compare the results obtained by hand analysis and SPICE simulation.