The objective of this lab is to become familiar using the features of the myDAQ for signal measurement and generation, and to become familiar with analysis, simulation, fabrication, and measurement of circuits.

Warm-Up

1) Compute the voltage $V_{\text{out}}$ and current $I$ for the following circuit.

2) Dust off your E59 notes and give an analytical expression for output voltage $x(t)$ in the following circuit when the input is

(a) a step from 0 to 1 V
(b) $\cos(2\pi ft)$

0) myDAQ Familiarization

1) Software Setup

If you want to run the National Instruments software from your own computer, install it from the DVD that comes with the kit. The software includes LabView (for instrument control), ELVISmx (for easy test and measurement), and MultSim (for drawing and simulating schematics). The software only runs on Windows. If you are a reasonably savvy Mac or Linux user, you might wish to install Parallels or VirtualBox to be able to use Windows on your computer. The installation takes a while, so start early.

2) MultiSim

a) Draw and simulate the voltage divider in MultiSim.

Use the Place -> Component command to place VCC (5V), GROUND, and two 1k resistors. Then Place -> Wires to connect them together. Double-click on the output node and give it a name, and check "Show Net Name" so your name is visible.

To find the voltage and current, choose Simulate -> Analyses -> DC Operating Point. Choose the variables of interest and simulate, then check that the results match your expectations.

b) Draw and simulate the RC circuit in MultiSim.

First, use a step voltage source. Run a transient analysis with TSTOP = 5 ms. Then use an AC source and run an AC analysis from 1 Hz to 1 MHz. Click on the magnitude axis and change the scale to decibels. Compare the results against your expectations.

3) Connect the myDAQ

Plug your myDAQ into a USB port of your computer or an ECF computer. Plug the screw terminals into the myDAQ. Plug the red and black multimeter leads into the myDAQ.

The two analog inputs are differential, but you generally will be using them like oscilloscope inputs by making measurements relative to ground. Therefore, cut two short black wires and connect the 0- and 1- analog inputs to AGND using the screw terminals.

You may wish to cut some longer (~12") colored wires to connect +15, -15, AGND, 5V, and analog output AO0 screw terminals to your breadboard.

4) Power Supply and Multimeter

Use the multimeter in ELVISmx to measure the 5, 15, and -15V outputs of the power supply and confirm that they are correct.
Measure the resistance of the two 1k resistors from your kit. Are they within tolerance?

Build the voltage divider from the warm-up question. Measure the output voltage and the current and compare with expectations. (Remember that one of these measurements is done in parallel and the other in series, and that the probes must be in the right sockets of the meter to do these measurements.) Is the error within expectations, considering the actual resistance values and the tolerances of the myDAQ?

5) Function Generator and Oscilloscope

Use the function generator and oscilloscope in ELVISmx to generate and view the following signals. What nonidealities do you observe?

a) 1 kHz square wave between 0 and 5 V.
   b) 10 kHz sinusoid between -1 and +7 V.
   c) 20 kHz triangle wave between 0 and 3 V.

Build the RC circuit from the warm-up question. Apply a 200 Hz square wave between 0 and 1 V and measure the output. Compare against expectations.

Please report on each report how long you spent (total for both warmup and lab).