ELEG 309 Laboratory 0

Lab Instrumentation.
Frequency Response of simple RC circuits

February 7, 2000

1 Objectives

The intent of Experiment 0 is twofold: First it is is to introduce you to the instruments you will encounter in your laboratory. Second, it is to make measurements of the frequency response of several simple RC circuits of the kind used in modeling the small signal response of amplifiers and other electronic circuits. The purpose is to increase your familarity with these simple circuits and their response to different signals. It is important that the behavior of these simple circuits become "second nature" to you. Finally, you are encouraged to make use of the software product called "Electronics Workbench," in which simulated instruments are an important visualization tool.

2 Components and Instrumentation

Basic laboratory instrumentation includes

- Prototyping Board (PB).
- Power Supplies.
- HP 34401 Digital multimeter (DMM).
- HP 54645 Digital Oscilloscope.
- HP 33120 Function generator.

A characteristic-curve tracer and a wavefonn analyzer will be available, on a shared-time basis. Components for this particular laboratory are as follows:

- Two 1 kΩ resisitors.
- Two of 0.1 μF and one 0.01 μF capacitors.

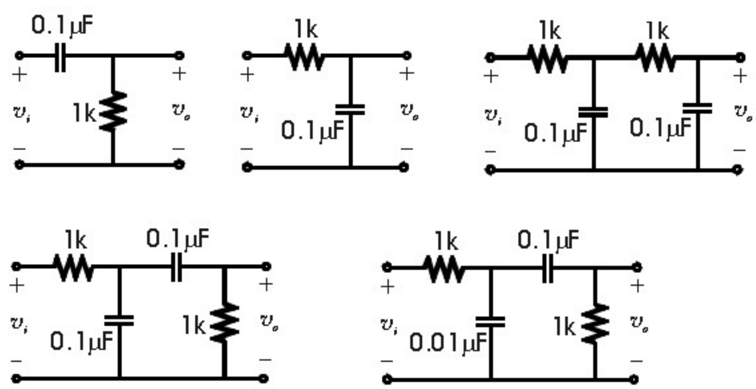

Figure 1. Simple RC cirucuits.

3 Reading

General familiarity with your Text and its Appendices, particularly Appendix F, and with this Manual, overall, would be useful. As well, make yourself familiar with "Electronics Workbench" supplied with your copy of Sedra and Smith.

4 Preparation

As noted above, the most important Preparation you can do in this and other experiments is to actually read the experiment, particularly the Exploration part, very early in your preparation process. Do so relatively quickly at first, to see what is there, just skimming the measurements to get an idea of where they are headed. Then go back for more thorough reading.

4.1 The tools for the task

4.1.1 The Digital Multimeter (DMM)

- A particular digital ohmmeter uses a DVM circuit and a constant-current supply to measure resistance. Sketch the circuit arrangement arranged to measure resistor R.
- If the most-sensitive range on the DVM is 1.99 mV full scale, what current do you need to create an ohmmeter with a 1.99 kΩ scale? What constant current would you use to create an ohmmeter with a full scale reading of 19.9 MΩ, for which the voltage across an open circuit is limited to 2.5 V?

Examine your DMM. Be prepared to answer the following questions: How many digits does it have? (The leading 0/1 is referred to as a half digit.) How many different major functions (including voltage, current, resistance, etc) does it perform? What kind of ac measurement does it make (eg, true rms, or rms-calibrated peak)? How many voltage/current/resistance ranges does it have? What are their full-scale values?

4.1.2 The Prototyping Board (PB)

- Read any description you may be given about the details of your prototyping board.
- How many isolated five-socket strips do you need on your PB to connect ten resistors, totally isolated from one another. If the resistors were all connected in parallel, what is the minimum number of five-socket strips that you need (be careful!). How many strips do you need if they are all connected in series? What if they are connected as a series of two groups of five resistors in parallel?

4.1.3 The Oscilloscope

Become familar with the layout of the controls and their function. In particular, notice the changing functions of the soft keys beneath the display.

4.1.4 Function Generator

What are the maximum rates of change in a 10 Vpp signal at 100 kHz, if the waveform is a) sinusoidal, b) triangular, c) square, as produced by a system having a 20 MHz bandwidth?

5 Explorations

Using sine wave signals of appropriate frequencies, characterize the operation of each of the simple RC circuits shown in Fig. 1. Make (square) log-log plots of the ratio of the output voltage to input voltage (i.e. the "attenuation") showing the "fall off" at high and/or low frequencies as appropriate for each circuit. The vertical scale of these attenuation plots should be in db. Also plot the phase shift of v_o relative to v_i as a function of the logarithm of frequency for each of these circuits. Use square wave input signals and show how you can extract the same information about the behavior of these circuits from the square wave response.

6 Report

Discuss briefly the behavior of each of the circuits. In addition to the frequency response plots (attenuation and phase shift) for each circuit, sketch relevant square wave response waveforms. Briefly describe the behavior of each circuit in words.