

EE380 Summer 2018

Linear Systems

Determine a Transfer Function

You have been hired by a company to measure the frequency response of a system, and determine its transfer function. Design an Experiment that can be used to determine the frequency response of an unknown “black box” system. Then test and validate your Experiment.

Validation of Procedure:

To test your system design a simple RC filter made of components from the stockroom. Using your Experiment, measure the frequency response of the known system. Compare your experimental results with the ideal calculated values used to design the test system.

Once you have determined that the frequency response experiment is valid, you must now determine how to use the freq. response data to determine the transfer function of the system. Again, using the data found during your freq. response test verify that the transfer function (using Matlab) that you have obtained from the test is consistent with the transfer function you have calculated for your known system.

Once you have validated your experiment, rerun your experiment with an “UNKNOWN SYSTEM” a “BLACK BOX” can be obtained from Jeff for this portion of the project.

Submit: Hardware schematic, a picture of apparatus, Notebook, calculations, measurements, and documentation. Your documentation should include a mathematical representation of the transfer function.

Determine RLC frequency Response us Matlab and measured impulse response

Design an RLC circuit that has considerable ringing. Ask for the following:

1. Carefully measure the components including the resistance of the coil.
2. Simulate the circuit in MATLAB by writing the transfer function and plotting the impulse and frequency response.
3. Measure the frequency response by inputting sinusoids and measuring the gain over a band of frequencies.
4. Using the Tektronics AFG3021B function generator apply an approximate impulse to the circuit and look at the impulse response on an oscilloscope. Use the Save/Recall menu on the scope to save the values of the scope trace to a file on a flash drive. This file will be in CSV (comma separated values) format. You can look at this file in Excel. Its preamble gives the sample period. It also contains two columns with all of the data values. Copy these two columns to Word so that there is a value, a comma, and a second value. Save this as a txt file.
5. Read the txt file in MATLAB and plot the impulse response in time. Using MATLAB's `fft` function determine the Fourier Transform of the impulse response. This will be the frequency response of the system derived from the impulse response. Compare this to the measured frequency response and explain any discrepancies.