

Homework #5

Time and Frequency Responses of FIR Filters

Assigned on Saturday, October 9, 2021

Due on Friday, October 15, 2021, by 11:59 pm via Canvas submission

Late homework is subject to a penalty of two points per minute late.

Reading: McClellan, Schafer & Yoder, *Signal Processing First*, 2003, Sec. 5.4-5.9 and 6.1-6.6.
 Companion Web site with demos and other supplemental information: <http://dspfirst.gatech.edu/>
 Web site contains solutions to selected homework problems from *DSP First*.

Office hours for Mr. Salimian and Prof. Evans follow:

| <i>Time Slot</i> | <i>Monday</i> | <i>Tuesday</i> | <i>Wednesday</i> | <i>Thursday</i> | <i>Friday</i> |
|-------------------------|----------------------|-----------------------|-------------------------|------------------------|----------------------|
| 9:30 am | | | | Evans (Zoom) | |
| 10:00 am | | | | Evans (Zoom) | |
| 10:30 am | | | | | |
| 11:00 am | | Evans (EER 1.516) | | Evans (EER 1.516) | |
| 11:30 am | | Evans (EER 1.516) | | Evans (EER 1.516) | |
| 12:00 pm | | Evans (EER 1.516) | | Evans (EER 1.516) | |
| 12:30 pm | | Evans (Zoom) | | | |
| 1:00 pm | | Evans (Zoom) | | | |
| 1:30 pm | | | | | |
| 2:00 pm | | | | | Evans (Zoom) |
| 2:30 pm | | | | | Evans (Zoom) |
| 3:00 pm | | | | | Tabbara (Zoom) |
| 3:30 pm | | | Tabbara (Zoom) | | Tabbara (Zoom) |
| 4:00 pm | | | Tabbara (Zoom) | | Tabbara (Zoom) |
| 4:30 pm | | | Tabbara (Zoom) | | |

Prof. Evans holds coffee/advising hours on Fridays 12:00-2:00pm in the EERC café.

[EE 313 tutoring](#) is available 7-10pm on Sundays through Thursdays online.

1. Averaging Filter and the Unit Step Signal. 28 points.

Signal Processing First, problem P-5.6, page 127.

2. System Properties. 24 points.

Signal Processing First, problem P-5.9, page 128. *This had originally been assigned as homework 4.3.*

3. System Properties and Deconvolution. 24 points.

Signal Processing First, problem P-5.12, page 128. When working the problem, assume that you do not know the filter coefficients. Using system properties to find the answer. This will be part (a).

For part (b), use the deconvolution formulas in homework problem 4.4(a) to manually determine the FIR filter coefficients given that the input signal is $x_1[n]$ and the output signal is $y_1[n]$ for $n \geq 0$. Check your calculations using `utdeconvolve.m` provided on the [homework hints page](#), which is a modified version of the MATLAB code from homework problem 4.4(c). When running the code, use an equal number of input and output values for vectors x and y , which is what would happen in an experimental setup that would input a test signal x and observe the output y . Please see the comments in the code for more info.

This is an interesting case where the input signal is infinite in duration and the output signal is finite in duration.

4. Frequency Response. 24 points.

Signal Processing First, problem P-6.1, page 157. Please comment on the differences between the input and output signals. What parameter(s) changed? By how much? What parameter(s) didn't change?

As stated on the course descriptor, "Discussion of homework questions is encouraged. Please be sure to submit your own independent homework solution."

NOTE: In your solutions, please put all work for problem 1 together, then all work for problem 2 together, etc. Please see additional homework guidelines on the homework page.