Fall 2021 EE 313 Linear Systems and Signals Prof. Evans

Homework #6

# Frequency Responses and Z-Transforms

Assigned on Thursday, October 14, 2021

Due on Friday, October 22, 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, Chapters 6 and 7.

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. Tabbara and Prof. Evans follow:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Time Slot*** | ***Monday*** | ***Tuesday*** | ***Wednesday*** | ***Thursday*** | ***Friday*** |
| **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](http://www.ece.utexas.edu/academics/tutoring) is available 7-10pm on Sundays through Thursdays online.

**1. Frequency and Step Responses. 36 points.**

For each of the following linear time-invariant (LTI) systems, determine the impulse response, step response, and frequency response. Plot the magnitude and phase of the frequency response using freqz:

1. First-order unnormalized averaging filter (lowpass filter): and the initial condition
2. First-order difference filter (highpass filter): and the initial condition
3. Second-order difference filter (highpass filter): and the initial condition

**2. Cascade of Three Systems. 28 points.**

*Signal Processing First*, problem P-6.13, page 159.

**3. Transfer Functions in the *z* domain. 36 points.**

For each of the following linear time-invariant (LTI) systems, derive the transfer function, compute the poles and zeros, and plot the poles and zeros using zplane:

1. First-order unnormalized averaging filter (lowpass filter): and the initial condition
2. First-order difference filter (highpass filter): and the initial condition
3. Second-order difference filter (highpass filter): and the initial condition

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.

Please read the [homework guidelines](http://users.ece.utexas.edu/~bevans/courses/signals/homework/index.html).