Fall 2024 EE 313 Linear Systems and Signals Prof. Evans

Homework #6

# Frequency Responses

Assigned on Saturday, October 19, 2024, and Reassigned on Thursday, October 24, 2024

Due on Friday, October 25, 2024, by 11:59 pm via Gradescope 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*.

E-mail address for Mr. Elyes Balti (TA) is [ebalti@utexas.edu](mailto:ebalti@utexas.edu). Please consider posting questions on [Ed Discussion](https://edstem.org/us/courses/62862/discussion/)., which can be answered by anyone in the class. You can post anonymously. Lecture and office hours follow. Prof. Evans is also available immediately after lecture

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Time Slot*** | ***Monday*** | ***Tuesday*** | ***Wednesday*** | ***Thursday*** | ***Friday*** |
| **11:00 am** |  | **Evans (ECJ 1.204)** |  | **Evans (ECJ 1.204)** |  |
| **11:30 am** |  | **Evans (ECJ 1.204)** |  | **Evans (ECJ 1.204)** |  |
| **12:00 pm** |  | **Evans (ECJ 1.204)** |  | **Evans (ECJ 1.204)** |  |
| **12:30 pm** |  |  |  |  |  |
| **1:00 pm** |  |  | **Balti (EER 5.652)** |  |  |
| **1:30 pm** |  |  | **Balti (EER 5.652)** |  |  |
| **2:00 pm** | **Evans (EER 6.882;** [**Zoom**](https://utexas.zoom.us/j/96309736592)**)** |  | **Balti (EER 5.652)** |  | **Balti (EER 4.650)** |
| **2:30 pm** | **Evans (EER 6.882;** [**Zoom**](https://utexas.zoom.us/j/96309736592)**)** |  | **Balti (EER 5.652)** |  | **Balti (EER 4.650)** |
| **3:00 pm** | **Evans (EER 6.882;** [**Zoom**](https://utexas.zoom.us/j/96309736592)**)** |  |  |  | **Balti (EER 4.650)** |
| **3:30 pm** |  |  | **Evans (EER 6.882;** [**Zoom**](https://utexas.zoom.us/j/92870569775)**)** |  | **Balti (EER 4.650)** |
| **4:00 pm** |  |  | **Evans (EER 6.882;** [**Zoom**](https://utexas.zoom.us/j/92870569775)**)** |  |  |
| **4:30 pm** |  |  | **Evans (EER 6.882;** [**Zoom**](https://utexas.zoom.us/j/92870569775)**)** |  |  |
| **5:00 pm** |  |  |  | **Balti (EER 4.702)** |  |
| **5:30 pm** |  |  |  | **Balti (EER 4.702)** |  |
| **6:00 pm** |  |  |  | **Balti (EER 4.702)** |  |
| **6:30 pm** |  |  |  | **Balti (EER 4.702)** |  |

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

[EE 313 tutoring](http://www.ece.utexas.edu/academics/tutoring) is available on Mondays and Thursdays 7-10pm in person.

**1. Frequency and Step Responses. 60 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 *Note: The phase of the frequency response is linear*.
2. First-order difference filter (highpass filter): and the initial condition . *Note: The phase of the frequency response is linear.*
3. Second-order difference filter (highpass filter): and the initial conditions as necessary conditions for LTI properties to hold. *Note: The phase of the frequency response is linear.*

**2. Cascade of Three Systems. 40 points.**

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

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).