

Homework #6

Frequency Responses

Assigned on Friday, Oct. 16, 2026, and due Friday, Oct. 23, 2026, by 11:59 pm via Gradescope

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 Ms. Alice Liu (TA) is alicieliu98@utexas.edu. Please consider posting questions on the class [Ed Discussion site](#), which can be answered by anyone in the class. You can post anonymously to the other students and to the instructors.

<i>Time Slot</i>	<i>Monday</i>	<i>Tuesday</i>	<i>Wednesday</i>	<i>Thursday</i>	<i>Friday</i>
11:00 am		Evans (ECJ 1.214)		Evans (ECJ 1.214)	
11:30 am		Evans (ECJ 1.214)		Evans (ECJ 1.214)	
12:00 pm		Evans (ECJ 1.214)		Evans (ECJ 1.214)	
12:30 pm					
1:00 pm					
1:30 pm					
2:00 pm		Evans (EER 6.882 and Zoom)			Liu (EER 6.702 and Zoom)
2:30 pm		Evans (EER 6.882 and Zoom)			Liu (EER 6.702 and Zoom)
3:00 pm		Evans (EER 6.882 and Zoom)	Liu (EER 5.704 and Zoom)	Liu (EER 5.704 and Zoom)	Liu (EER 6.702 and Zoom)
3:30 pm		Evans (EER 6.882 and Zoom)	Liu (EER 5.704 and Zoom)	Liu (EER 5.704 and Zoom)	Liu (EER 6.702 and Zoom)
4:00 pm			Liu (EER 5.704 and Zoom)	Liu (EER 5.704 and Zoom)	
4:30 pm			Liu (EER 5.704 and Zoom)	Liu (EER 5.704 and Zoom)	

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

[EE 313 tutoring](#) is available on Mondays, Tuesdays, and Wednesdays 7-10pm in person in EER 0.814.

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`.

- First-order unnormalized averaging filter (lowpass filter): $y[n] = x[n] + x[n - 1]$ for $n \geq 0$ and the initial condition $x[-1] = 0$ as a necessary condition for LTI properties to hold. *Note: The phase of the frequency response is linear.*
- First-order difference filter (highpass filter): $y[n] = x[n] - x[n - 1]$ for $n \geq 0$ and the initial condition $x[-1] = 0$ as a necessary condition for LTI properties to hold. *Note: The phase of the frequency response is linear.*
- Second-order difference filter (highpass filter): $y[n] = x[n] - 2x[n - 1] + x[n - 2]$ for $n \geq 0$ and the initial conditions $x[-1] = 0$ and $x[-2] = 0$ 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](#).