

Homework #8

Continuous-Time Frequency Response and Intro to Fourier Transform

Assigned on Wednesday, November 17, 2021

Due on Tuesday, November 23, 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, Sections 10.1-11.4.
 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:

<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 EER café.

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

1. Ideal Delay. 18 points.

Signal Processing First, problem P-10.1, page 302.

2. Continuous-Time Frequency Response. 48 points.

Signal Processing First, problem P-10.9, page 305. In addition, for each of the seven filters given, describe the frequency selectivity in the magnitude response as lowpass, highpass, bandpass, bandstop, allpass, or notch.

Same as Homework Problem 9.1 from Fall 2018.

3. Forward Continuous-Time Fourier Transform. 34 points.

Compute the continuous-time Fourier transform $X(j\omega)$ for continuous-time signal $x(t)$ using the definition in *Signal Processing First* in equation (11.1)

$$X(j\omega) = \int_{-\infty}^{\infty} x(t) e^{-j\omega t} dt$$

for the following time-domain signals $x(t)$:

(a) $\delta(t)$

(b) Rectangular pulse of unit amplitude that lasts from $-\frac{T}{2}$ to $\frac{T}{2}$ seconds.

(c) $e^{-a t} u(t)$ for positive and real-valued a

(d) $e^{b t} u(-t)$ for positive and real-valued b

(e) $e^{-a |t|}$ for $-\infty < t < \infty$ for positive and real-valued a .

Hint: You can reuse results from parts (c) and (d).

Signal Processing First Section 11.4 covers examples (a)-(d). You can check your answers using continuous-time Fourier transform pairs in Table 11-2 of on page 338 in *Signal Processing First*.

In addition, for each part, describe the frequency selectivity of the magnitude response as lowpass, highpass, bandpass, bandstop, allpass, or notch.

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](#).