

Homework #9

Fourier Transforms

Assigned on November 30, 2024, at 1:00 pm

Due on Friday, December 6, 2024, 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, Ch. 11

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 Prof. Evans follow.

<i>Time Slot</i>	<i>Monday</i>	<i>Tuesday</i>	<i>Wednesday</i>	<i>Thursday</i>	<i>Friday</i>
11:00am – 12:30pm		Evans (ECJ 1.204)		Evans (ECJ 1.204)	
12:30pm – 2:00pm					
2:00pm – 3:30pm	Evans (EER 6.882; Zoom)		Evans (EER 6.882; Zoom)		
3:30pm – 5:00pm			Evans (EER 6.882; Zoom)		
5:00pm-6:30pm					
7:00pm-8:30pm	Tutoring in EER 0.814			Tutoring in EER 0.814	
8:30pm-10:00pm	Tutoring in EER 0.814			Tutoring in EER 0.814	

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

1. Continuous-Time Frequency Response. 31 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 8.3 in Fall 2023.

2. Forward Continuous-Time Fourier Transform. 45 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)

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

Please read the [homework guidelines](#) and [homework hints](#).

for the following time-domain signals $x(t)$: 6 points for each.

(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. 3 points for each.

Same as Homework Problem 9.1 in Fall 2023.

3. Continuous-Time Fourier Transforms Using Transform Properties and Pairs. 24 points.

Signal Processing First, problem P-11.8, page 343. 6 points for each part.

Same as Homework Problem 9.2 from Fall 2023.

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