Fall 2025 EE 313 Linear Systems and Signals Prof. Evans

Homework #9

Fourier Transforms

Assigned on November 28, 2025, at 11:00 am
Due on Friday, December 5, 2025, 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.

Time Slot	*Monday*	*Tuesday*	*Wednesday*	*Thursday*	*Friday*
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		**Jacobellis (EER 1.810)**			
1:00 pm		**Jacobellis (EER 1.810)**			
1:30 pm		**Jacobellis (EER 1.810)**			
2:00 pm	**Evans (EER 6.882)**	**Jacobellis (EER 1.810)**			
2:30 pm	**Evans (EER 6.882)**				
3:00 pm	**Evans (EER 6.882)**			**Jacobellis (Zoom)**	
3:30 pm			**Evans (EER 6.882)**	**Jacobellis (Zoom)**	
4:00 pm			**Evans (EER 6.882)**	**Jacobellis (Zoom)**	
4:30 pm			**Evans (EER 6.882)**	**Jacobellis (Zoom)**	
5:00 pm				**Jacobellis (Zoom)**	**Jacobellis (EER 1.810)**
5:30 pm					**Jacobellis (EER 1.810)**
6:00 pm					**Jacobellis (EER 1.810)**

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

Please read the homework guidelines and homework hints.

ECE tutoring for ECE 313 is available on Sundays, Tuesdays, and Thursdays 7-10pm EER 0.814, from Dec. 1st to Dec. 7th.

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 9.1 in Fall 2024.

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)

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

   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 9.2 in Fall 2024.

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 9.3 from Fall 2024.

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

Please read the homework guidelines and homework hints.