Fall 2023 EE 313 Linear Systems and Signals Prof. Evans

Homework #9

# Fourier and Laplace Transforms

Assigned on Saturday, November 11, 2023

Due on Friday, December 1, 2023, 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 and  
Supplemental Chapter on [The Laplace Transform](https://utexas.instructure.com/files/60800285/download?download_frd=1).

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. Balti ([ebalti@utexas.edu)](mailto:ebalti@utexas.edu)a) and Prof. Evans follow.

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| ***Office Hours*** | ***Monday*** | ***Tuesday*** | ***Wednesday*** | ***Thursday*** | ***Friday*** |
| **11:00 am** |  | **Evans (ECJ 2.104)** |  | **Evans (ECJ 2.104)** |  |
| **11:30 am** |  | **Evans (ECJ 2.104)** |  | **Evans (ECJ 2.104)** |  |
| **12:00 pm** |  | **Evans (ECJ 2.104)** |  | **Evans (ECJ 2.104)** |  |
| **12:30 pm** |  |  |  |  |  |
| **1:00 pm** |  |  |  |  |  |
| **1:30 pm** |  |  |  |  |  |
| **2:00 pm** |  |  | **Evans (EER 6.882 and** [**Zoom**](https://utexas.zoom.us/j/98716557005)**)** | **Evans (EER 6.882 and** [**Zoom**](https://utexas.zoom.us/j/98716557005)**)** | **Balti**  **(EER 3.648)** |
| **2:30 pm** |  |  | **Evans (EER 6.882 and** [**Zoom**](https://utexas.zoom.us/j/98716557005)**)** | **Evans (EER 6.882 and** [**Zoom**](https://utexas.zoom.us/j/98716557005)**)** | **Balti**  **(EER 3.648)** |
| **3:00 pm** |  |  | **Evans (EER 6.882 and** [**Zoom**](https://utexas.zoom.us/j/98716557005)**)** | **Evans (EER 6.882 and** [**Zoom**](https://utexas.zoom.us/j/98716557005)**)** | **Balti**  **(EER 3.648)** |
| **3:30 pm** |  | **Balti**  **(EER 3.648)** |  |  |  |
| **4:00 pm** |  | **Balti**  **(EER 3.648)** |  |  |  |
| **4:30 pm** |  | **Balti**  **(EER 3.648)** |  |  |  |
| **5:00 pm** |  |  |  | **Balti**  **(EER 3.648)** |  |
| **5:30 pm** |  |  |  | **Balti**  **(EER 3.648)** |  |
| **6:00 pm** |  |  |  | **Balti**  **(EER 3.648)** |  |

\*\* 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 7-10pm on Sundays through Thursdays online.

1. **Forward Continuous-Time Fourier Transform. *45 points.***

Compute the continuous-time Fourier transform for continuous-time signal using the definition in *Signal Processing First* in equation (11.1)

for the following time-domain signals : *6 points for each.*

1. Rectangular pulse of unit amplitude that lasts from to seconds.
2. for positive and real-valued
3. for positive and real-valued
4. for for positive and real-valued .  
   *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 8.3 in Fall 2021.*

1. **Continuous-Time Fourier Transforms Using Transform Properties and Pairs. *28 points.***

*Signal Processing First*, problem P-11.8, page 343. *7 points for each part*.

*Same as Homework Problem 9.1 from Fall 2021.*

1. **Laplace Transforms. *27 points*.**

Plot each signal in the time domain for -1 < *t* < 1, compute the Laplace transform including the region of convergence.

1. . *6 points*.
2. . *6 points*.
3. . *6 points*.

For each part, what is the frequency content— lowpass, highpass, bandpass, bandstop, allpass or notch? *2 points for each part.*

*Similar to Homework Problem 9.2 from Fall 2021.*

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