Fall 2018 EE 313 Linear Systems and Signals Prof. Evans

Homework #4

# Finite Impulse Response (FIR) Filters

Assigned on Friday, October 5, 2018

Due on Friday, October 12, 2017, by 5:00 pm via Canvas submission

*Late homework is subject to a late penalty of two points per minute late*.

***Reading***: McClellan, Schafer and Yoder, *Signal Processing First*, 2003, Chapter 5 (all).

Companion Web site with demos and other supplemental information: <http://dspfirst.gatech.edu/>

Web site contains solutions to selected homework problems from *DSP First*.

The e-mail address for Mr. Houshang Salimian (TA) is [salimian.houshang@gmail.com](mailto:salimian.houshang@gmail.com).

Office hours for Mr. Salimian and Prof. Evans follow:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Time Slot*** | ***Monday*** | ***Tuesday*** | ***Wednesday*** | ***Thursday*** | ***Friday*** |
| **11:00 am** |  | **Salimian (EER 0.814 Table #4)** |  | **Salimian (EER 0.814A)** | **Salimian (EER 0.814D)** |
| **11:30 am** |  | **Salimian (EER 0.814 Table #4)** |  | **Salimian (EER 0.814A)** | **Salimian (EER 0.814D)** |
| **12:00 pm** |  | **Salimian (EER 0.814 Table #4)** |  | **Salimian (EER 0.814A)** | **Salimian (EER 0.814D)** |
| **12:30 pm** |  | Evans (EER 1.516) |  | Evans (EER 1.516) | **Salimian (EER 0.814D)** |
| **1:00 pm** |  | Evans (EER 1.516) |  | Evans (EER 1.516) |  |
| **1:30 pm** |  | Evans (EER 1.516) |  | Evans (EER 1.516) |  |
| **2:00 pm** |  | Evans (EER 6.882) |  | Evans (EER 6.882) |  |
| **2:30 pm** |  | Evans (EER 6.882) |  | Evans (EER 6.882) |  |
| **3:00 pm** |  | Evans (EER 6.882) | **Salimian (EER 1.810)** | Evans (EER 6.882) |  |
| **3:30 pm** |  |  | **Salimian (EER 1.810)** |  |  |
| **4:00 pm** |  |  | **Salimian (EER 1.810)** |  |  |
| **4:30 pm** |  |  |  |  |  |

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

EE 313 tutoring is available on Sundays through Thursdays from 7:00pm to 10:00pm in EER 0.814:

[http://www.ece.utexas.edu/undergraduate/tutoring](http://www.ece.utexas.edu/undergraduate/tutoring" \t "_blank)

1. **Mathematical Review. 18 points**

The mathematical operations in parts (a) and (b) below were important on midterm #1 and will continue to be important. The mathematical operations in part (c) will be needed for discrete-time linear systems.

1. Binomial expansions.
   1. Expand (*a* + *b*)3.
   2. Use the binomial expansion in part i. to compute cos3(2  *f*0 *t*) after rewriting cos(2  *f*0 *t*) using the inverse Euler form of . Plot the spectrum.
2. Integration.
   1. Compute the integral
   2. Compute the integral where
3. Summations.
   1. Compute . Give the condition on the complex-valued scalar *a* for the summation to converge.
   2. Compute for a positive, finite integer *N*.

**2. Finite Impulse Response (FIR) Filter. 27 points.**

*Signal Processing First*, problem P-5.3, page 126.

**3. System Properties. 28 points.**

*Signal Processing First*, problem P-5.6, page 127.

**4. Deconvolution. 27 points.**

*Signal Processing First*, problem P-5.15, page 129.

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.