

### Homework #3 Fourier Series and Sampling

Assigned on Wednesday, September 23, 2026

Due on Saturday, September 26, 2026, by 11:59 pm via Canvas submission

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

**Reading:** McClellan, Schafer and Yoder, *Signal Processing First*, 2003, Ch. 4. [Errata](#).  
[Companion Web site](#) with demos and other supplemental information.

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

E-mail address for Ms. Alice Liu (TA) is [aliceliu98@utexas.edu](mailto:aliceliu98@utexas.edu). Please consider posting questions on the class [Ed Discussion site](#), which can be answered by anyone in the class. You can post anonymously to the other students and to the instructors.

| <i>Time Slot</i> | <i>Monday</i> | <i>Tuesday</i>                   | <i>Wednesday</i>               | <i>Thursday</i>                | <i>Friday</i>                  |
|------------------|---------------|----------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 11:00 am         |               | Evans<br>(ECJ 1.214)             |                                | Evans<br>(ECJ 1.214)           |                                |
| 11:30 am         |               | Evans<br>(ECJ 1.214)             |                                | Evans<br>(ECJ 1.214)           |                                |
| 12:00 pm         |               | Evans<br>(ECJ 1.214)             |                                | Evans<br>(ECJ 1.214)           |                                |
| 12:30 pm         |               |                                  |                                |                                |                                |
| 1:00 pm          |               |                                  |                                |                                |                                |
| 1:30 pm          |               |                                  |                                |                                |                                |
| 2:00 pm          |               | Evans<br>(EER 6.882<br>and Zoom) |                                |                                | Liu<br>(EER 6.702<br>and Zoom) |
| 2:30 pm          |               | Evans<br>(EER 6.882<br>and Zoom) |                                |                                | Liu<br>(EER 6.702<br>and Zoom) |
| 3:00 pm          |               | Evans<br>(EER 6.882<br>and Zoom) | Liu<br>(EER 5.704<br>and Zoom) | Liu<br>(EER 5.704<br>and Zoom) | Liu<br>(EER 6.702<br>and Zoom) |
| 3:30 pm          |               | Evans<br>(EER 6.882<br>and Zoom) | Liu<br>(EER 5.704<br>and Zoom) | Liu<br>(EER 5.704<br>and Zoom) | Liu<br>(EER 6.702<br>and Zoom) |
| 4:00 pm          |               |                                  | Liu<br>(EER 5.704<br>and Zoom) | Liu<br>(EER 5.704<br>and Zoom) |                                |
| 4:30 pm          |               |                                  | Liu<br>(EER 5.704<br>and Zoom) | Liu<br>(EER 5.704<br>and Zoom) |                                |

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

Please submit all Matlab code and plots for your solution to these projects.

In your solutions, please put all work for problem 1 together, then all work for problem 2 together, etc. Please see the guidelines for writing your solutions on the homework page.

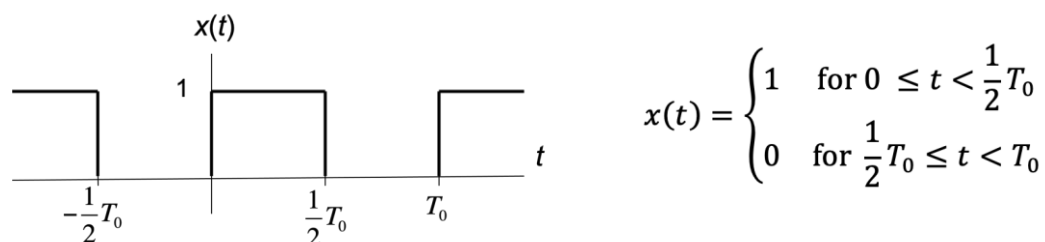
[ECE 313 tutoring](#) is available Sundays through Thursdays from 7:00pm to 10:00pm online.

Because of the amount time needed on Mini-Project #1, this assignment has been reduced from four problems to two problems. *These problems were also assigned on homework #3 in fall 2025.*

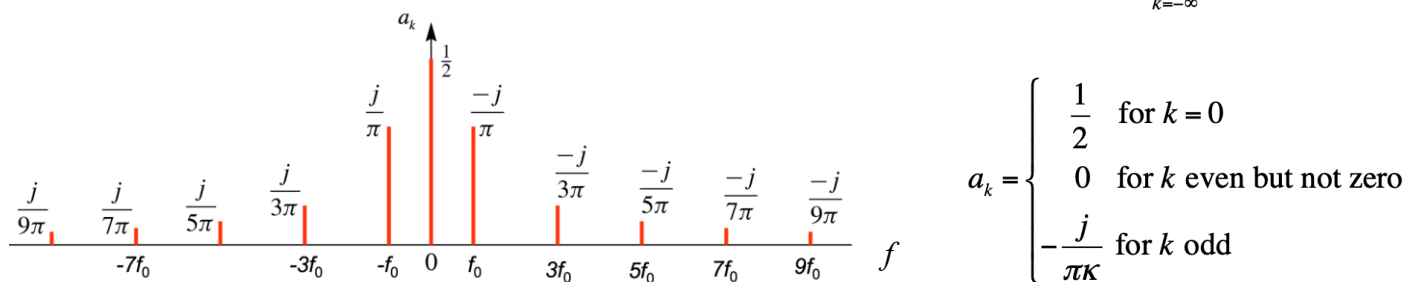
## 1. Fourier Analysis and Synthesis. 50 points.

*Signal Processing First*, problem P-3.14, page 67. In addition, please do to following parts:

(c) Below, the square wave  $x(t)$  from lecture slide 3-10 and *SP First* Sec. 3-6.1



has the following Fourier series coefficients per lecture slides 3-10 and 3-11:  $x(t) = \sum_{k=-\infty}^{\infty} a_k e^{j2\pi k f_0 t}$



Give a formula for the Fourier series coefficients  $b_k$  for  $y(t) = 2x\left(t - \frac{1}{4}T_0\right)$  by using your results from in parts (a) and (b).

(d) Validate your solution in part (c) by plotting the approximation of  $y(t)$  given by  $b_k$  for  $k \in [-10, 10]$  with  $T_0 = 1$  s. Translate your answer for  $b_k$  for  $k = 0$  as well as  $k$  positive and  $k$  negative into the MATLAB script [FourierSynthesisSquareWave.m](#). Please note that this MATLAB script will animate the contribution of each term in the Fourier series for  $y(t)$  from  $-\frac{1}{2}T_0 \leq t < \frac{1}{2}T_0$ .

## 2. Sampling. 50 points.

*Signal Processing First*, problem P-4.2, page 96. In addition, please complete the following part:

(d) What is the continuous-time period of  $x(t)$ ? What is the discrete-time period after  $x(t)$  has been sampled at  $f_s = 15$  samples/s? The course handout on [Discrete-Time Periodicity](#) might help.