University of California Riverside, Department of ECE
EE110A: Signals and Systems
Prof. Vishwanath Saragadam — Winter 2025

Homework 5

This homework is due on **Friday**, February 21st, 11:59PM.

Instructions: Please upload the homework by 11:59 PM (Pacific Time) on Canvas on the day of the deadline. If you are unable to upload it on Canvas, please hand over the homework to the TA (Xunyu Li) between 2:00 PM and 3:00 PM (Pacific Time) during TA office hours.

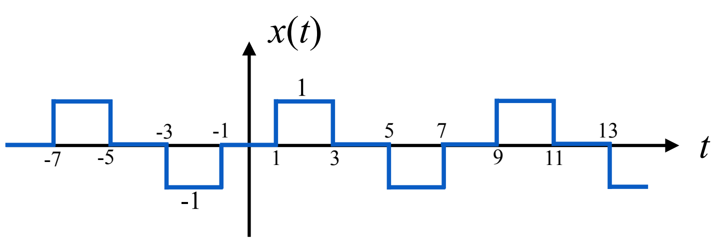
Problem 1 [7pts]: For the continuous-time periodic signal,

$$x(t) = 2 + \cos\left(\frac{2\pi}{3}t\right) + 4\sin\left(\frac{5\pi}{3}t\right),$$

determine the fundamental frequency Ω_0 and the Fourier series coefficients a_k such that,

$$x(t) = \sum_{k=-\infty}^{\infty} a_k e^{jk\Omega_0 t}$$

Problem 2 [7pts]: Let the periodic signal $x(t)$ be as shown below.



Find the continuous-time Fourier series (CTFS) coefficients a_k. Simplify the expression as much as possible. You might want to use the fact that $e^{-j\pi} = -1$, $e^{-j\pi/2} = -j$, $e^{-j3\pi/2} = j$, and $e^{-j2\pi} = 1$. Also, taking the expression into $e^{-jk\pi/4}$ parenthesis will help.

Problem 3 [6pts]: (continuation of Problem 2) Using MATLAB or any other software, plot the approximation to $x(t)$ from problem 2, given by a truncated CTFS expansion

$$\tilde{x}(t) = \sum_{k=-N}^{N} a_k e^{jk\Omega_0 t}$$

Although the above expression seemingly yields a complex number for each t, rest assured that the resultant $\tilde{x}(t)$ will be real. In your approximation, try $N = 1$, $N = 3$, $N = 10$, and $N = 100$ and plot each result separately. Since you will be using a computer (which is a discrete machine), you must inevitably discretize t as well. When N is high, to observe the oscillations near the discontinuities (i.e., the Gibbs phenomenon), you must choose a small enough step size in your discretization. For example, you might want to try plotting $\tilde{x}(t)$ between $t = -16$ and $t = 16$ with a step size of $\Delta = 0.00001$ or lower.