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

Homework 7

This homework is due on **Friday**, March 7th, 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 [6pts]: Determine the Fourier transform of each of the following periodic signals:

a) $x_1(t) = \sin\left(\pi t + \frac{\pi}{4}\right)$
b) $x_2(t) = 1 + \cos\left(3\pi t + \frac{\pi}{6}\right)$

Problem 2 [14pts]: Let $s(t) = \sum_{k=-\infty}^{k=\infty} \delta(t - kT)$ be the impulse train. Then its Fourier transform is given by,

$$S(j\Omega) = \frac{2\pi}{T} \sum_{k=-\infty}^{\infty} \delta\left(\Omega - \frac{2\pi k}{T}\right).$$

Let $x(t)$ be a continuous time domain signal with the following Fourier transform

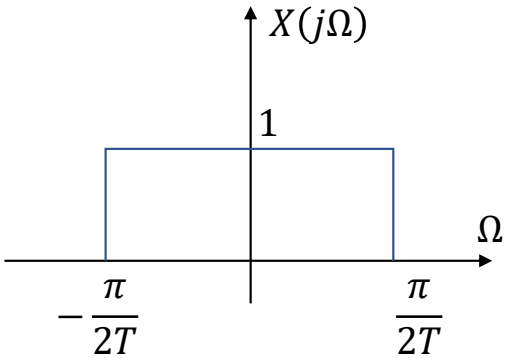

Figure 1: Plot of $X(j\Omega)$

Answer the following questions.

a) Compute $x(t)$ and plot it from $t = -4T$ to $T = 4T$. Carefully mark the points at which $x(t)$ becomes zero.

b) Now plot the signal, $y_1(t) = x(t)s(t)$, which is the multiplication of $x(t)$ with the impulse train. Carefully mark the points of the impulse train, and the amplitude it takes at those points.

c) Next, compute the CTFT of $y_1(t)$, $Y_1(j\Omega)$ and plot it for $\Omega = \frac{-4\pi}{T}$ to $\omega = \frac{4\pi}{T}$. Carefully mark all the relevant points on the Ω axis. **Hint:** You need to use the multiplication property of CTFT.

d) Now change the sampling function to $s(t) = \sum_{k=-\infty}^{k=\infty} \delta(t-2kT)$, where the period has increased from T to $2T$. Hence the Fourier transform changes to $S(j\Omega) = \frac{\pi}{T} \sum_{k=-\infty}^{\infty} \delta\left(\Omega - \frac{\pi k}{T}\right)$. Repeat parts (a), (b), and (c) again for this new impulse train. How do the two cases differ?