

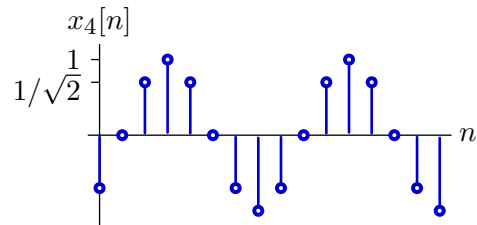
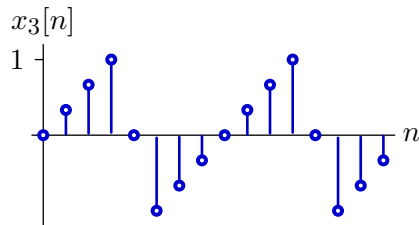
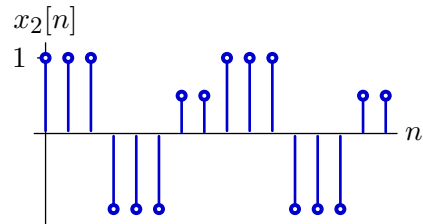
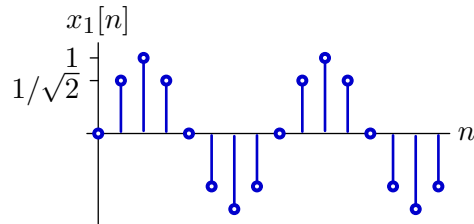
# 6.003 Homework #10

*This homework assignment will not be collected. Solutions will be posted.*

## Problems

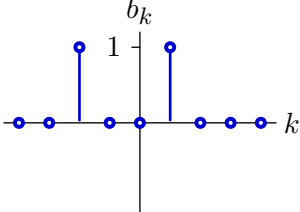
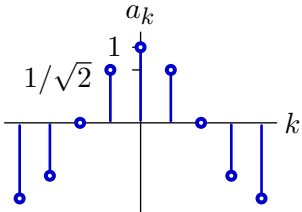
### 1. DT Fourier Series

Determine the Fourier Series coefficients for each of the following DT signals, which are periodic in  $N = 8$ .



2. Inverse DT Fourier Series

Determine the DT signals with the following Fourier series coefficients. Assume that the signals are periodic in  $N = 8$ .



**3. Impulsive Input**

Let the following periodic signal

$$x(t) = \sum_{m=-\infty}^{\infty} \delta(t - 3m) + \delta(t - 1 - 3m) - \delta(t - 2 - 3m)$$

be the input to an LTI system with system function

$$H(s) = e^{s/4} - e^{-s/4}.$$

Let  $b_k$  represent the Fourier series coefficients of the resulting output signal  $y(t)$ . Determine  $b_3$ .

**4. Fourier transform**

**Part a.** Find the Fourier transform of

$$x_1(t) = e^{-|t|}.$$

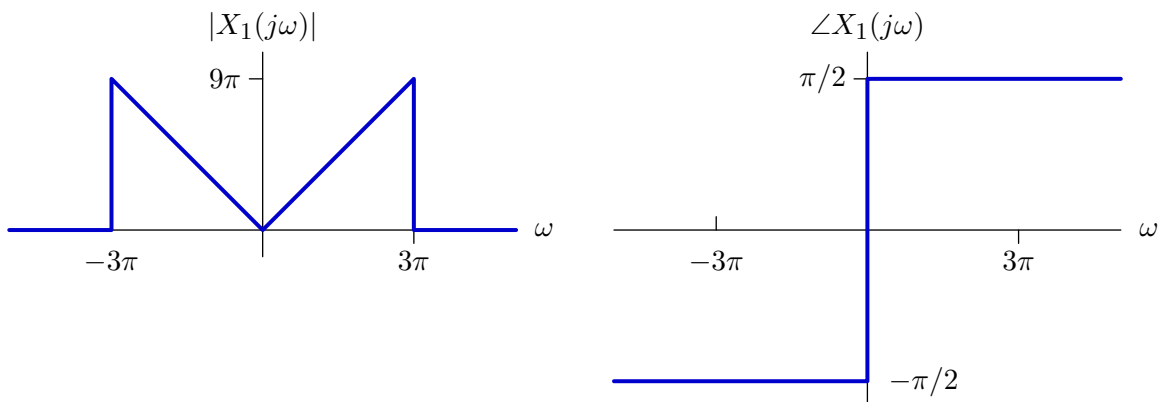
**Part b.** Find the Fourier transform of

$$x_2(t) = \frac{1}{1+t^2}.$$

Hint: Try duality.

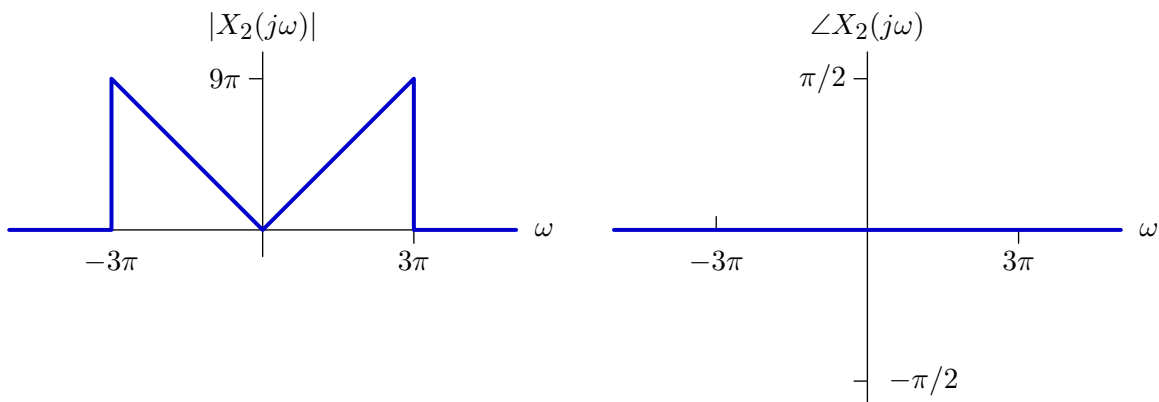
## 5. Fourier transform

**Part a.** Determine  $x_1(t)$ , whose Fourier transform  $X_1(j\omega)$  has the following magnitude and angle.



Express  $x_1(t)$  as a closed-form and sketch this function of time.

**Part b.** Determine  $x_2(t)$ , whose Fourier transform  $X_2(j\omega)$  has the following magnitude and angle.

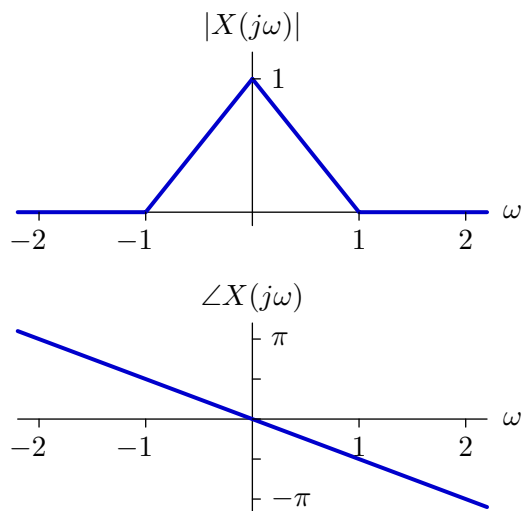


Express  $x_2(t)$  as a closed-form and sketch this function of time.

**Part c.** What are important similarities and differences between  $x_1(t)$  and  $x_2(t)$ ? How do those similarities and differences manifest in their Fourier transforms?

## 6. Fourier Transforms

The magnitude and angle of the Fourier transform of a signal  $x(t)$  are given in the following plots.



Five signals are derived from  $x(t)$  as shown in the left column of the following table. Six magnitude plots (M1-M6) and six angle plots (A1-A6) are shown on the next page. Determine which of these plots is associated with each of the derived signals and place the appropriate label (e.g., M1 or A3) in the following table. Note that more than one derived signal could have the same magnitude or angle.

signal	magnitude	angle
$\frac{dx(t)}{dt}$		
$(x * x)(t)$		
$x\left(t - \frac{\pi}{2}\right)$		
$x(2t)$		
$x^2(t)$		

