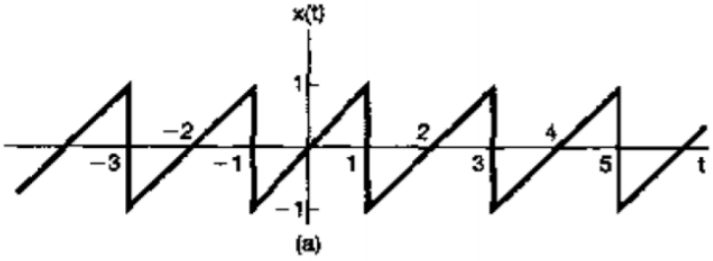
Homework 3: Signal Processing

Version: 2020 Fall

1. Consider a period T of the continuous-time signal $x(t)$ with Fourier series representation is

$$x(t) = \sum_{-\infty}^{+\infty} a_k e^{jk(2\pi/T)t}$$

Find the continous-time Fourier series coefficient ak of the following signals:
(a) (10%) $x(t)$ in Figure (a).



(b) (15%) $x(t)$ with period 4 and

$$x(t) = \begin{cases} \sin \pi t, & 0 <= t <= 2 \\ 0, & 2 < t <= 4 \end{cases}$$

2. Consider a period N of the discrete-time signal $x[n]$ with Fourier series representation is

$$x[n] = \sum_{k=<N>} a_k e^{jk(2\pi/N)n}$$

Find the discrete-time Fourier series coefficient a_k of the following signals:
(a) (10%)

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

(b) (20%)

$$x[n] = \begin{cases} 1, & -N_1 <= n - kN <= N_1, \ for\ all\ \text{integer}\ k\ \&\ N > 2N_1 + 1 \\ 0, & else \end{cases}$$

3. Consider a period N of the discrete-time signal $x[n]$ with Fourier series representation is

$$x[n] = \sum_{k=<N>} a_k e^{jk(2\pi/N)n}$$

Derive the Fourier series coefficient ak' of the following $y[n]$ in terms of ak.
(a) (10%)

$$y[n] = x[n]\cos(\frac{8\pi n}{N})$$

(b) (15%)

$$y[n] = \begin{cases} 2x[n], n \in even \\ 0, \quad n \in odd \end{cases} (Assume \text{ that N is an even number.})$$

4. (20%) Suppose that we are given the following information about the periodic discrete-time signal $x[n]$:
(1) The period N = 6
(2) $x[-2] + x[-1] + x[0] + x[1] + x[2] + x[3] = 3$
(3) $\sum_{n=0}^{s} (-1)^{n+6} x[n] = 1$

Please determine the signal $x[n]$ with minimum power in a single period among the set of periodic discrete-time signal satisfying the above properties.

The End of Homework