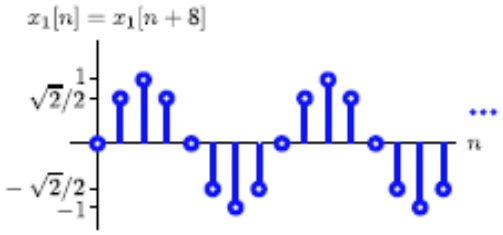
Signals and Systems

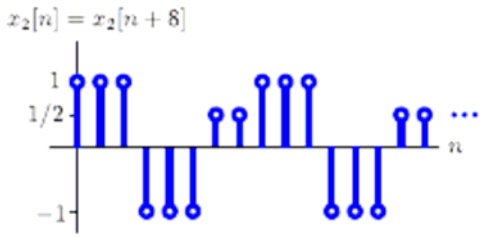
Homework Assignment #3

Problem 1. Determine the Fourier Series coefficients a_k for each of the following DT signals, which are periodic in N = 8.

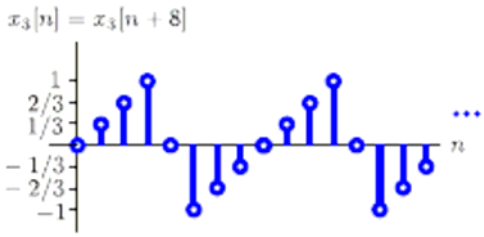
a.



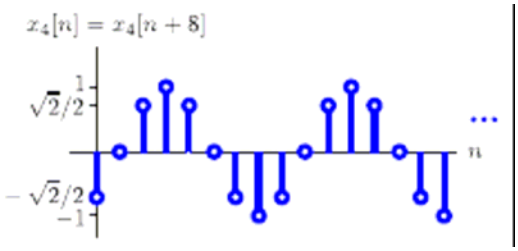
b.



c.

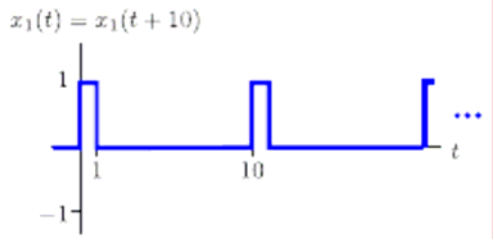


d.

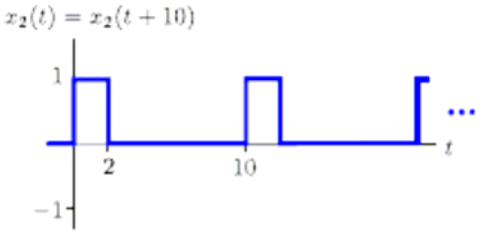


Problem 2. Determine the Fourier Series coefficients a_k for each of the following CT signals, which are periodic in T = 10.

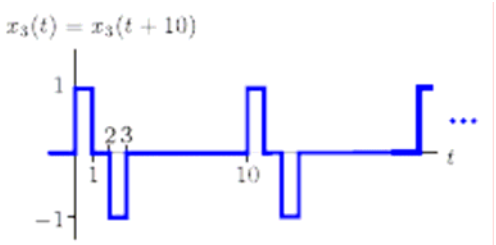
a.



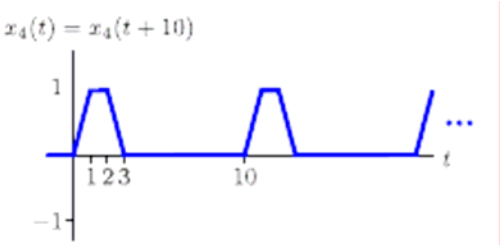
b.



c.

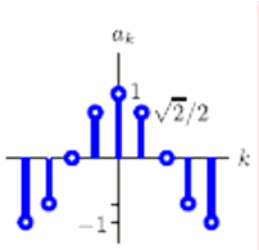


d.

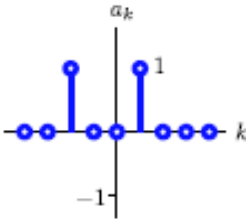


Problem 3. Determine the DT signals that have the following Fourier Series coefficients a_k. Assume that the signals are periodic in N = 8. Sketch the signals.

a.



b.



Problem 4. Let a_k represent the Fourier Series coefficients of a CT signal $x(t)$ with a fundamental period of $T = 1$. Determine expressions for the Fourier Series coefficients b_k of the following signals in terms of a_k.

a. $y_1(t) = x(t - 0.5)$

b. $y_2(t)$ = odd part of $x(t)$
c. $y_3(t) = x(t) + dx(t)/dt + 7$
d. $y_4(t) = x(2t)$
e. $y_5(t) = x_2(t)$

Problem 5. The input $x(t)$ and output $y(t)$ of a system are related by the following differential equation,

$$y(t) + 0.1\frac{dy(t)}{dt} = x(t)$$

a. Show that if the system has no initial conditions and the input signal $x(t)$ is periodic in T, then the output signal $y(t)$ is also periodic in T.

b. Determine the Fourier Series coefficients for the output signal $y(t)$ when the input signal $x(t) = u(t) - u(t - 5)$ for $0 < t < 10$ and is also periodic in $T = 10$.