Signals and Systems – Spring 2024

Problem Set 1

Issued: Feb. 29, 2024 Due: Mar. 7, 2024

Reading Assignments:

Signals and Systems (OWN), Chapter 1; Supplementary notes, Chapter 1-3

Problem 1 OWN, Problem 1.15

Problem 2 OWN, Problem 1.16

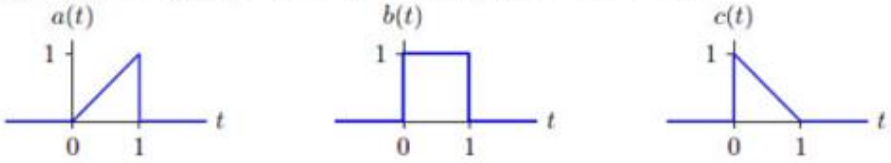
Problem 3 OWN, Problem 1.27

Problem 4 OWN, Problem 1.28(a)(c)(d)(g)

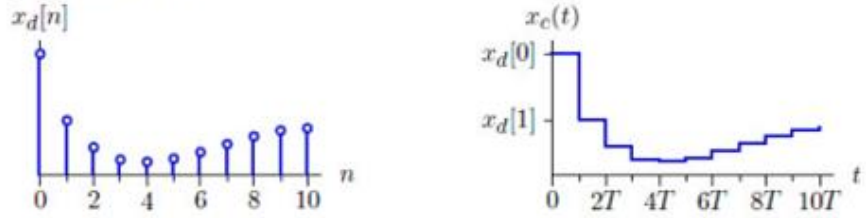
Problem 5 OWN, Problem 1.31

Problem 6 Reconstructing CT Signals from Samples

Let $a(t)$, $b(t)$, and $c(t)$ represent the following functions of time.

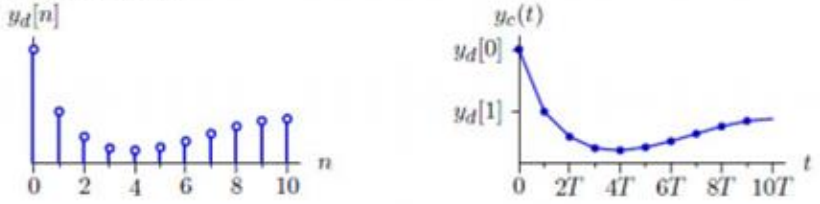


Let $x_c(t)$ represent a continuous-time signal derived from the discrete-time signal $x_d[n]$ using a zero-order hold, as illustrated below, where consecutive samples of x_d are separated by T seconds in x_c.



a. Determine an expression for $x_c(t)$ in terms of the samples $x_d[n]$ and the functions $a(t)$, $b(t)$, and $c(t)$.

Let $y_c(t)$ represent a continuous-time signal derived from the discrete-time signal $y_d[n]$ using a piecewise linear interpolator, so that sucessive samples of y_d are connected by straight line segments.

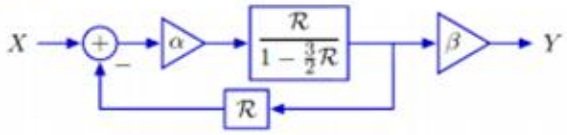


b. Determine an expression for $y_c(t)$ in terms of the samples $y_d[n]$ and the functions $a(t)$, $b(t)$, and $c(t)$.

c. Determine an expression for $\dfrac{dy_c(t)}{dt}$ in terms of the samples $y_d[n]$ and the functions $a(t)$, $b(t)$, and $c(t)$.

Problem 7 Missing Parameters

Consider the following system.



Assume that X is the unit-sample signal, $x[n] = \delta[n]$. Determine the values of α and β for which $y[n]$ is the following sequence (i.e., $y[0]$, $y[1]$, $y[2]$, ...):

$$0,\ 1,\ \frac{3}{2},\ \frac{7}{4},\ \frac{15}{8},\ \frac{31}{16},\ \cdots$$