

December 10, 1998

Final Exam

# EE 3302: Signals and Systems

NOTE: Please, complete the following table and keep record of your assignment number.

First Name	
Last Name	
Student ID	
Assignment #	0

**Exercise 1.** A Linear and Time Invariant (LTI) system has the input and output signals related by the differential equation

$$\frac{d^2 y(t)}{dt^2} + 10 \frac{d y(t)}{dt} + 21 y(t) = \frac{d x(t)}{dt} + 11 x(t)$$

A) Determine the frequency response of the system [pt. 10], the impulse response of the system [pt. 10], and the differential equation that relates the input and output signals of the inverse system [pt. 5].

**Exercise 2.** Consider the continuous-time signal

$$x(t) = \frac{\sin(\alpha t)}{\pi t}$$

where  $\alpha$  is a positive finite value. This signal is sampled using a train of impulses with periodicity  $T$ ,

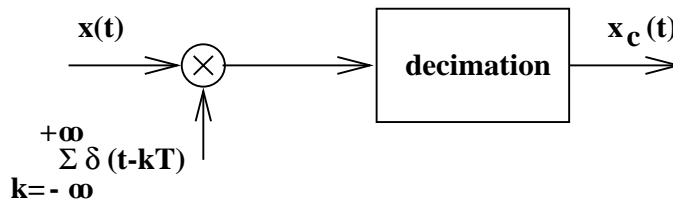


Figure 1: Sampling system.

$\sum_{k=-\infty}^{+\infty} \delta(t - kT)$ , as shown in Fig. 1. The resulting train of impulses is then decimated removing all the impulses at odd multiples of  $T$ , i.e.,  $t = 2kT + 1$  for any integer  $k$ . Let the decimated train of impulses be  $x_c(t)$ .

A) Determine the range of values for  $T$  that allow complete recovery of  $x(t)$  from  $x_c(t)$  [pt. 15].

**Exercise 3.** Consider the discrete-time sequence

$$x[n] = n^2 \alpha^{n+1} u[n]$$

where  $\alpha$  is a constant value and  $u[n]$  is the causal unit step function.

A) Evaluate the z-transform of  $x[n]$  [pt. 30].

**Exercise 4.** Consider the z-transform

$$X(z) = -\frac{1}{z-1}, \quad |z| < 1$$

A) Derive the discrete-time sequence  $x[n]$  associated with  $X(z)$  [pt. 30].