EE301 Signals and Systems **In-Class Exam**
Exam 1 **Tuesday, Feb. 24, 2004**

Cover Sheet

Test Duration: 70 minutes.
Coverage: Chaps. 1,2,3
Open Book but Closed Notes.
Calculators NOT allowed.
This test contains **two** problems.
All work should be done in the blue books provided.
You must show all work for each problem to receive full credit.
Do **not** return this test sheet, just return the blue books.

Prob. No.	**Topic(s)**	**Points**
1.	Continuous Time System Properties and Continuous Time Fourier Series	50
2.	Discrete Time System Properties and Discrete Time Fourier Series	50

Problem 1. [50 points]

Consider the continuous-time system described by the input-output relationship:

$$y(t) = \int_{t-1}^{t+1} x(\tau) d\tau$$

(a) Is this system linear? Substantiate your answer.

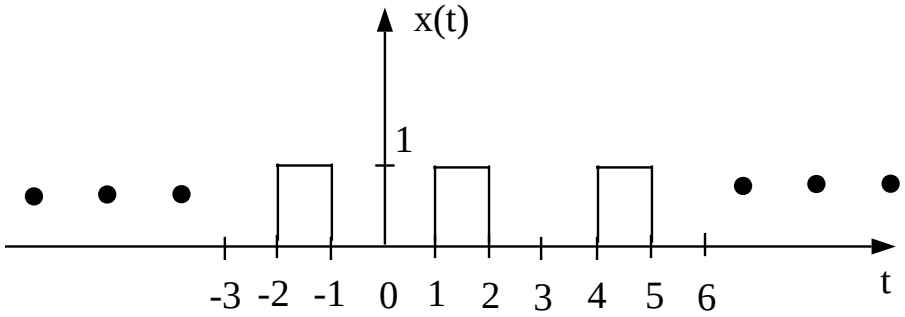
(b) Is this system time-invariant? Substantiate your answer.

(c) Is this system causal? Substantiate your answer.

(d) Is this system stable? Substantiate your answer.

(e) Determine and plot the impulse response of this system.

(f) Consider that the input to this system is the periodic signal $x(t)$ below with period $T = 3$.



Determine the Fourier Series coefficients, denoted a_k, $-\infty < k < \infty$, for $x(t)$. Express your final answer for a_k as a closed-form function of k that works for all k (like we've done in class many times.)

(g) Determine and plot several periods of the output, $y(t)$ of the system $y(t) = \int_{t-1}^{t+1} x(\tau) d\tau$ to the periodic signal $x(t)$ above. **ALSO:** Determine the Fourier Series coefficients, denoted b_k, $-\infty < k < \infty$, for $y(t)$. Express your final answer for b_k as a closed-form function of k that works for all k (like we've done in class many times.)

(h) Considerthe signal $w(t) = x(2t)$. What is the period of $w(t)$? Determine the Fourier Series coefficients, denoted c_k, $-\infty < k < \infty$, for $w(t)$. Express your final answer for c_k as a closed-form function of k that works for all k.

Problem 2. [50 points]

Consider the discrete-time system described by the input-output relationship:

$$y[n] = x[n-1] + x[n] + x[n+1]$$

(a) Is this system linear? Substantiate your answer.

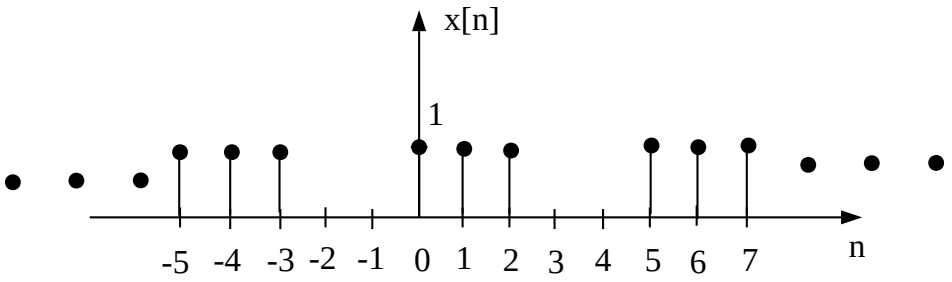
(b) Is this system time-invariant? Substantiate your answer.

(c) Is this system causal? Substantiate your answer.

(d) Is this system stable? Substantiate your answer.

(e) Determine and plot the impulse response of this system.

(f) Consider that the input to this system is the periodic signal $x[n]$ below with period $N = 5$.



Determine the Fourier Series coefficients, denoted a_k, $0 < k < 4$, for $x(t)$. Express your final answer for a_k as a closed-form function of k that works for all k (like we've done in class many times.)

(g) Determine and plot several periods of the output, $y[n]$ of the system $y[n] = x[n-1] + x[n] + x[n+1]$ to the periodic signal $x[n]$ above. **ALSO:** Determine the Fourier Series coefficients, denoted b_k, $0 \leq k \leq 4$, for $y[n]$. Express your final answer for b_k as a closed-form function of k that works for all k (like we've done in class many times.)

(h) Consider the signal $w[n] = x[n] - x[n-1]$, where $x[n]$ is the periodic signal plotted above. Determine the Fourier Series coefficients, denoted c_k, $0 \leq k \leq 4$, for $w[n]$. Express your final answer as c_k as a closed-form function of k that works for all k.