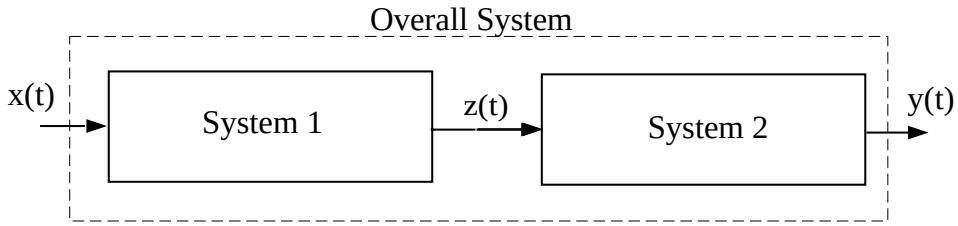
EE301 Signals and Systems **In-Class Exam**
Exam 1 **Thursday, Feb. 17, 2005**

Cover Sheet

Test Duration: 75 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 system above characterized by the following two input-output relationships:

$$\text{System 1:} \quad z(t) = \int_{t-2}^{t} x(\tau)d\tau$$
$$\text{System 2:} \quad y(t) = \int_{t-4}^{t} z(\tau)d\tau$$

(a) Is the overall system linear? Substantiate your answer.

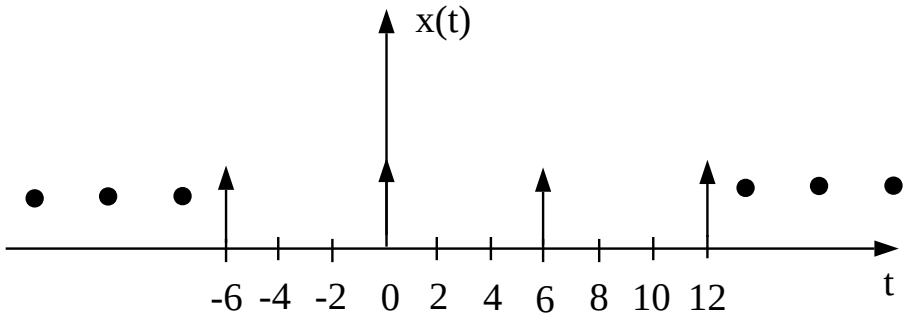
(b) Is the overall system time-invariant? Substantiate your answer.

(c) Determine and plot the impulse response of the overall system.

(d) Is the overall system causal? Substantiate your answer.

(e) Is the overall system stable? Substantiate your answer.

(f) Consider that the input to this system is the periodic signal $x(t) = \sum_{k=-\infty}^{\infty} \delta(t - k6)$.

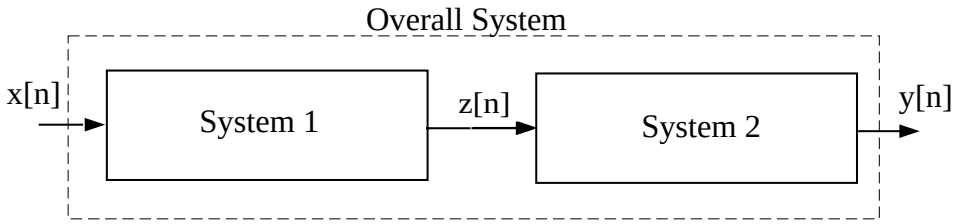


Determine the Fourier Series coefficients, denoted a_k, $-\infty < k < \infty$, for $x(t)$. Express your final answer for a_k as a closed-form function of k that works for all k (like we've done in class many times.)

(g) Determine and plot several periods of the output, $y(t)$, of the overall system above 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.

(h) Consider the signal $w(t) = y(3t)$, where $y(t)$ is the periodic output defined in part (g). What is the period of $w(t)$? Determine the Fourier Series coefficients, denoted c_k, $-\infty < k < \infty$, for $w(t)$. Express your answer for c_k as a closed-form function of k.

Problem 2. [50 points]



Consider the discrete-time system above characterized by by the following two input-output relationships:

$$\text{System 1:} \quad z[n] = x[n-1] + x[n] + x[n+1]$$
$$\text{System 2:} \quad y[n] = z[n-1] + z[n] + z[n+1]$$

(a) Is the overall system linear? Substantiate your answer.

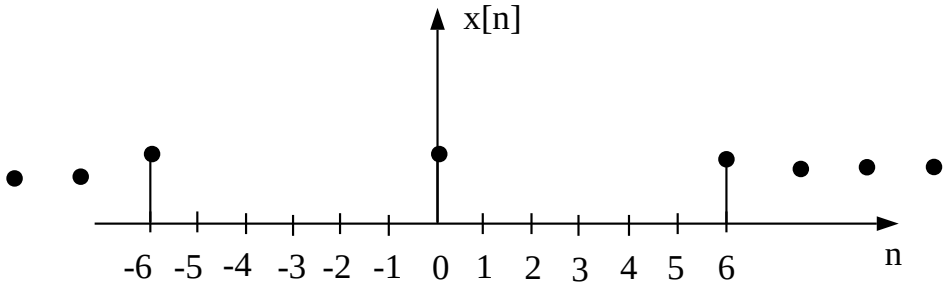
(b) Is the overall system time-invariant? Substantiate your answer.

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

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

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

(f) Consider that the input to this system is the periodic signal $x[n] = \sum_{k=-\infty}^{\infty} \delta[n - k6]$.



Determine the Fourier Series coefficients, denoted a_k, for $x[n]$. Express your final answer for a_k as a closed-form function of k that works for all k.

(g) Determine and plot several periods of the output, $y[n]$, of the overall system above to the periodic signal $x[n]$ above. **ALSO:** Determine the Fourier Series coefficients, denoted b_k, 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 $w[n] = y[n] - y[n-1]$, where $y[n]$ is the periodic output signal determined in part (g). Determine the Fourier Series coefficients, denoted c_k, for $w[n]$. Express your final answer as c_k as a closed-form function of k that works for all k.