EE301 Signals and Systems — In-Class Exam
Exam 1 — Thursday, Feb. 15, 2007

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 linear and time-invariant system described by the input-output relationship:

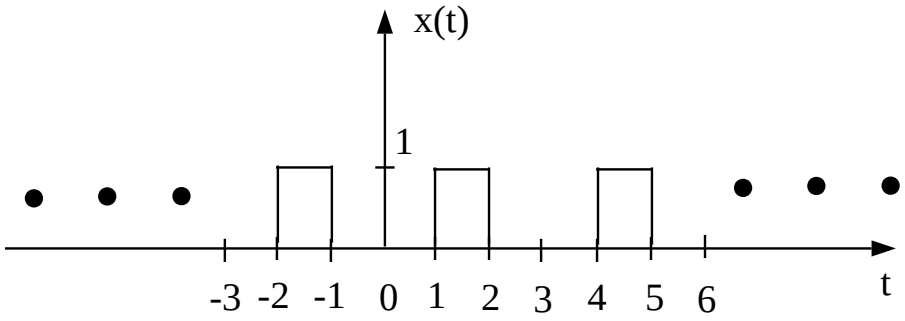
$$y(t) = \int_{t-1}^{t} x(\tau)d\tau$$

(a) Determine and plot the impulse response $h(t)$ of this system.

(b) Is this system causal? You must use $h(t)$ to justify your answer.

(c) Is this system stable? You must use $h(t)$ to justify your answer.

(d) 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.)

(e) (i) Plot several periods of the output of the system $y(t) = \int_{t-1}^{t} x(\tau)d\tau$ to the input signal $x(t)$ above.

(ii) Determine the Fourier Series coefficients, denoted b_k, $-\infty < k < \infty$, for $y(t)$. Express answer for b_k as a closed-form function of k.

(ii) Is b_k real-valued for all k? Explain either why they are real-valued OR why they are not real-valued.

(f) Considerthe signal

$$w(t) = x(t)\cos\left(\frac{2\pi}{3}t\right)$$

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 linear and time-invariant system described by the input-output relationship:

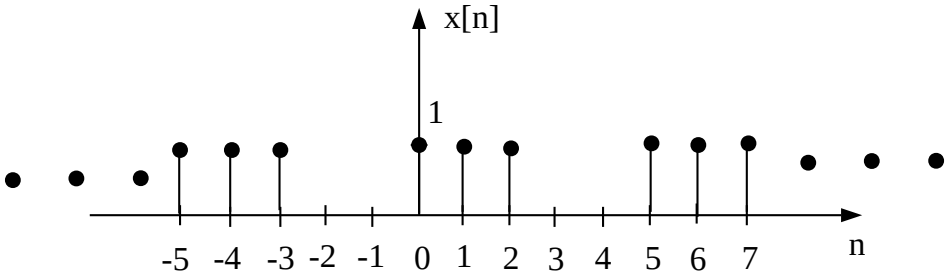
$$y[n] = \sum_{k=n-2}^{n} x[k]$$

(a) Determine and plot the impulse response $h[n]$ of this system.

(b) Is this system causal? Use $h[n]$ to justify your answer.

(c) Is this system stable? Use $h[n]$ to justify your answer.

(d) 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.

(e) (i) Plot several periods of the output of the system $y[n] = \sum_{k=n-2}^{n} x[k]$ to the input signal $x[n]$ above. **Hint** : you might want to solve part (f) below first.

(ii) Determine the Fourier Series coefficients, denoted b_k, $-\infty < k < \infty$, for $y[n]$. Express answer for b_k as a closed-form function of k.

(iii) Is b_k real-valued for all k? Explain either why they are real-valued OR why they are not real-valued.

(f) Consider the signal $w[n] = y[n] - y[n-1]$, where $y[n]$ is the output signal $y[n]$. 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.