Name: _____

Student ID: _____

Signature: _____

CITY UNIVERSITY OF HONG KONG

Semester B 2013/2014

EE3210: Signals and Systems

Quiz 1

1. Time allowed: One hour
2. Total number of problems: 3
3. Total marks available: 25
4. This paper may not be retained by candidates

Special Instructions

5. This is a closed book exam
   - A list of possibly relevant equations is attached at the end of this paper
6. Attempt all questions from each problem
7. Show all equations, calculations involved in your solutions
   - If you just provide the final answer, you won't receive full marks even if it is correct
   - If you provide intermediate steps and they are correct, you will receive partial marks even if the final answer is incorrect

Problem 1: (10 marks)

Consider the discrete-time system whose input $x[n]$ and output $y[n]$ are related by

$$y[n] = \cos[\pi(n-1)]x[n].$$

Determine which of the following properties hold for this system:

(a) Memoryless

(b) Invertible

(c) Causal

(d) Stable

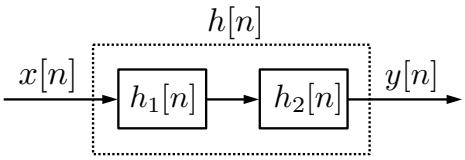
(e) Time invariant

(f) Linear

Justify your answers.

Problem 2: (7 marks)

Consider a series interconnection of two discrete-time LTI systems as shown in the figure below.



The unit impulse response of the two systems is given by

$$h_1[n] = \begin{cases} -1, & n = 0 \\ 1, & n = 1 \\ 0, & \text{elsewhere} \end{cases}$$

and

$$h_2[n] = 0.5^n u[n]$$

respectively. Derive the unit impulse response $h[n]$ of the overall system.

Problem 3: (8 marks)

Consider a continuous-time LTI system with unit impulse response $h(t) = u(t)$. Use the convolution integral to find the response $y(t)$ of the system to the input $x(t) = u(t)$.

Appendix – A list of possibly relevant equations

- Complex number:
  - Euler's formula: $e^{j\theta} = \cos\theta + j\sin\theta$
- Fundamental period of a periodic signal:
  - Continuous-time sinusoidal: $T_0 = 2\pi/\omega_0$
  - Discrete-time sinusoidal: $N_0 = 2\pi k/\Omega_0$ if N_0 and k have no factors in common.
- Convolution sum: $x[n] * h[n] = \sum_{k=-\infty}^{+\infty} x[k]h[n-k]$
  - Commutative property: $x[n] * h[n] = h[n] * x[n]$
  - Distributive property: $x[n] * (h_1[n] + h_2[n]) = x[n] * h_1[n] + x[n] * h_2[n]$
  - Associative property: $x[n] * (h_1[n] * h_2[n]) = (x[n] * h_1[n]) * h_2[n]$
- Convolution integral: $x(t) * h(t) = \int_{-\infty}^{+\infty} x(\tau)h(t-\tau)d\tau$
  - Commutative property: $x(t) * h(t) = h(t) * x(t)$
  - Distributive property: $x(t) * [h_1(t) + h_2(t)] = x(t) * h_1(t) + x(t) * h_2(t)$
  - Associative property: $x(t) * [h_1(t) * h_2(t)] = [x(t) * h_1(t)] * h_2(t)$

— End of Paper —