

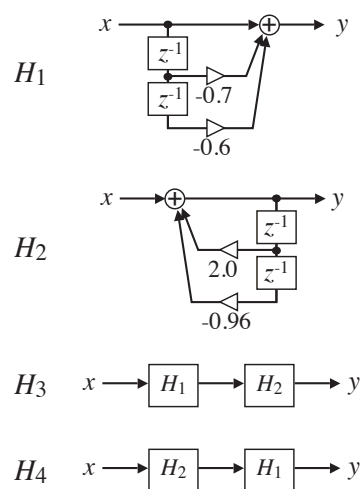
Thursday 2008-10-23 11:00-12:15 (75 min)

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*This test consists of 2 questions. Each question has equal weight.
 You have one and one quarter hours (75 minutes) to complete the test.
 This test is open-book: you are permitted to refer to your notes and textbooks during the test.
 You may use a calculator for numerical work, but not for graphing.
 You must show all your workings to get credit for an answer.
 You are on your honor to present work that is entirely your own.*

1. The figure below shows the block diagram of several discrete-time LSI systems.

- (a) Find the z -transform of systems H_1 and H_2 .
- (b) Plot the pole-zero diagrams of H_1 and H_2 .
- (c) Find the impulse responses for systems H_3 and H_4 .
- (d) Sketch the magnitude responses of H_3 and H_4 .
- (e) Discuss and contrast the stability of systems H_3 and H_4 .



2. A continuous-time signal $x_c(t)$ is defined by:

$$x_c(t) = \begin{cases} 1 & |t - r \cdot t_p| < t_w, \quad r = 0, \pm 1, \pm 2, \dots \\ 0 & \text{otherwise} \end{cases}$$

with $t_w = t_p/10$. $x_1[n]$ is obtained by sampling x_c with a sampling period $T = t_p/4$.

- (a) What is $x_1[n]$?
- (b) Find and sketch $X_1(e^{j\omega})$, the DTFT of $x_1[n]$.
- (c) $x_2[n]$ is the finite-length sequence formed by taking $x_1[n]$ for $n = 0 \dots 7$. What is its DFT, $X_2[k]$? Give all the unique values.
- (d) Find the DTFT $X_2(e^{j\omega})$ and sketch its magnitude. How does this relate to the answer to parts (b) and (c)?
- (e) We form $x_3[n] = x_1[n] \otimes h_1[n]$, where $H_1(e^{j\omega}) = 1 - e^{-2j\omega}$. Find and sketch its DTFT, $X_3(e^{j\omega})$, and the time-domain sequence $x_3[n]$.