GPGN 404
1st Midterm Exam
February 24, 2005

Name: _____

Question:	1	2	3	Total
Points:	19	11	20	50
Score:				

Question 1..(19 points)

Let $h[n] = u[n]$ (the unit-step function) be the impulse response of an LTI system.

(a) [1 point] Is this system causal?

(b) [1 point] Is this system stable?

(c) [2 points] What is the Z–transform $H(z)$ of this system?

(d) [2 points] What is the region-of-convergence (ROC) for $H(z)$?

(e) [1 point] Where in the complex Z–plane is the (one) pole?

(f) [1 point] Where in the complex Z–plane is the (one) zero?

(g) [1 point] Write the linear constant-coefficient difference equation corresponding to this system, for an input sequence $x[n]$ and output sequence $y[n]$.

(h) [2 points] Consider the frequency response $H(e^{j\omega})$ of this LTI system. Assuming an input sequence $x[n] = cos(\omega n)$, for what frequency ω is the output of this system unbounded?

(i) [4 points] Given the input $x[n] = u[n]$, what is the output $y[n] = h[n] * x[n]$ of this system?

(j) [4 points] What is the Z–transform $Y(z)$ of the output sequence $y[n]$? (Include the ROC.)

Question 2. . . . . (11 points)

Let $h[n] = \frac{1}{3}(u[n + 1] - u[n - 2])$ be the impulse response of an LTI system.

(a) [1 point] Sketch this impulse response $h[n]$.

(b) [1 point] Is this system causal?

(c) [1 point] Is this system stable?

(d) [2 points] What is the Z–transform $H(z)$ of this system?

(e) [2 points] What is the region-of-convergence (ROC) for $H(z)$?

(f) [1 point] Where in the complex Z–plane is the one pole?

(g) [1 point] Where in the complex Z–plane is the one zero?

(h) [2 points] Qualitatively, in words, what does this LTI system (filter) do to any input sequence $x[n]$?

Question 3 . . . . (20 points)

Consider the *anti-causal* LTI system with Z–transform

$$H_1(z) = \frac{-1}{1 - 2z^{-1}}$$

and the *causal* LTI system with Z–transform

$$H_2(z) = -1 + 2z^{-1}.$$

(a) [1 point] Where in the complex Z–plane is the one pole of $H_1(z)$?

(b) [1 point] Where in the complex Z–plane is the one zero of $H_1(z)$?

(c) [2 points] What is the region-of-convergence (ROC) for $H_1(z)$?

(d) [1 point] Is the anti-causal system defined by $H_1(z)$ stable?

(e) [4 points] Sketch the impulse response $h_1[n]$.

(f) [1 point] Where in the complex Z–plane is the one pole of $H_2(z)$?

(g) [1 point] Where in the complex Z–plane is the one zero of $H_2(z)$?

(h) [2 points] What is the region-of-convergence (ROC) for $H_2(z)$?

(i) [2 points] Sketch the impulse response $h_2[n]$.

(j) [2 points] Sketch the impulse response $h[n] = h_1[n] * h_2[n]$ of the composite system obtained by convolving $h_1[n]$ with $h_2[n]$.

(k) [2 points] What is the Z–transform $H(z)$ of the composite system with impulse response $h[n] = h_1[n] * h_2[n]$?

(l) [1 point] What is the region-of-convergence (ROC) for $H(z)$?