GPGN 404
1st Midterm Exam
October 1, 2010 **Name:** _____

Question:	1	2	3	4	Total
Points:	10	10	15	15	50
Score:					

Question 1 ..... (10 points)

Consider each of the following sampled sequences. Determine whether or not the sequence is periodic. If so, specify the period N.

(a) e^{jn}

(b) $e^{j\pi n}$

(c) $n\, e^{j\pi n}$

(d) $\sin(\pi n/19)$

(e) $\sin(3\pi n/19)$

Question 2 ..... (10 points)

Consider the following systems $y[n] = T\{x[n]\}$. For each system, specify whether or not it is linear (L), time-invariant (TI), and/or stable (S).

(a) $y[n] = x[n] - 3$

(b) $y[n] = x[n-3]$

(c) $y[n] = x[3n]$

(d) $y[n] = 3x[n]$

(e) $y[n] = n\, x[n]$

Question 3 ..... (15 points)

Consider a linear time-invariant system with impulse response

$$h[n] = \delta[n-1] + 2\delta[n] + \delta[n+1].$$

(a) Sketch the impulse response $h[n]$ for this system.

(b) Express the output $y[n]$ of this system in terms of the input $x[n]$.

(c) For the input $x[n] = u[n]$ (the unit-step sequence), sketch the output $y[n]$.

(d) What is the real-valued (no complex values) frequency response $H(\omega)$ of this system?

(e) Is this system stable? If so, express the bound B_y on the output in terms of the bound B_x on the input. If not, why not?

(f) How could you modify this system so that the DC (zero-frequency) response $H(0) = 1$, while preserving the shape of its impulse response $h[n]$?

Question 4 ..... (15 points)

Consider a causal linear time-invariant system with frequency response

$$H(\omega) = 2\frac{1 - e^{-j\omega}}{1 + e^{-j\omega}}.$$

(a) Write simple expressions for $H(-\frac{\pi}{2})$, $H(0)$, and $H(\frac{\pi}{2})$.

(b) For the input $x[n] = \cos(\frac{\pi}{2}n)$, what is the output $y[n]$? Your answer should be a real-valued sequence (one with no complex values).

(c) Write the linear constant-coefficient difference equation that represents this system.

(d) Sketch the impulse response $h[n]$ for this system.

(e) Is this system stable? If so, express the bound B_y on the output in terms of the bound B_x on the input. If not, why not?

(f) Write a computer program fragment that computes the output sequence `y[n]` from an input sequence `x[n]` for `n = 0, 1, ..., nt-1`.