GPGN 404
1st Midterm Exam
October 7, 2011 **Name:** _____

Question:	1	2	3	4	5	Total
Points:	10	10	20	5	5	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) $\sin(\pi n)$

(b) $\sin(\pi n/4)$

(c) $\sin(3\pi n)$

(d) $\sin(3\pi n/4)$

(e) $\sin(3n/4)$

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) $y[n] = 2x[n]$

(b) $y[n] = 2x[n] - 2$

(c) $y[n] = x[2n]$

(d) $y[n] = x[2 - n]$

(e) $y[n] = x[n - 2]$

Question 3 ..... (20 points)

You are given two arrays `x` and `y`, both of length `nt`. The array `x` contains an input sequence of values and the output array `y` initially contains some arbitrary (not zero) random values that you will replace.

(a) Using any programming language, write a computer program fragment that implements an approximation to a derivative system $y(t) = x'(t)$.

(b) Specify the name of the programming language that you used and the type of finite-difference approximation that your system implements.

(c) For output samples near bounds of the array `y`, what values does your system assume for input samples outside bounds of the array `x`?

(d) Is your system linear? time-invariant? causal? stable? If stable, specify a bound B_y on the output in terms of a corresponding bound B_x on the input. If not stable, why not?

(e) Sketch the unit-impulse response of your system, the output $y[n] = h[n]$ for input $x[n] = \delta[n]$.

(f) Sketch the output $y[n]$ of your system for input $x[n] = u[n-3]$, where $u[n]$ denotes the unit step sequence.

(g) Sketch the output $y[n]$ of your system for input $x[n] = \delta[n-1] + u[n-4]$.

Question 4 ..... (5 points)

Let $x[n]$ and $y[n]$ denote system input and output, respectively, and consider two linear time-invariant systems with impulse responses $h_1[n] = u(n) - u(n-4)$ and $h_2(n) = h_1(-n)$.

(a) Sketch the impulse responses of these two systems.

(b) Sketch the impulse response of a composite system $y[n] = h_2[n] * h_1[n] * x[n]$.

Question 5 ..... (5 points)

Consider the linear time-invariant system with impulse response $h[n] = (2/3)^n u(n)$.

(a) Write a linear constant-coefficient difference equation that relates the system output $y[n]$ to the input $x[n]$.

(b) Show that this system is stable, by specifying the bound B_y on the output in terms of the bound B_x on the input.