EE395: Introduction to Digital Signal Processing

Midterm #1

September 29, 2007

You are allowed to use a dumb calculator (of the type specified in the syllabus) on this test and *one* 8.5x11" notesheet (both sides may be written on). You are not allowed to use the textbook, homework solutions, or any other references. Your answers must be written in the space provided on the exam sheets, but you may attach additional sheets containing your work if necessary. Do not talk during the test: if you have questions, ask the exam proctor. Show your work (including intermediate steps) unless otherwise notes in the problem. You may use properties but you **must** state which property you are using when you use it.

Name:_____

Problem Number	***Max Points***	***Points***
1	20	
2	25	
3	30	
4	25	
Total	100	

1. (20 pts) True or False

a) A system will be linear and shift/time invariant only if it can be described by an impulse response of finite length:_____

b) A homogeneous solution to a linear constant coefficient difference equation (LCCDE) will not exist if the system described by this equaition is not BIBO stable:_____

c) To calculate the impulse response from the LCCDE, one assumes that the particular solution is zero:_____

d) The discrete-time Fourier transform (DTFT) is a continuous function of a real variable ω:_____

e) The DTFT of the ideal lowpass filter does not converge uniformly:_____

f) If a sequence is odd, then its DTFT will be entirely imaginary:_____

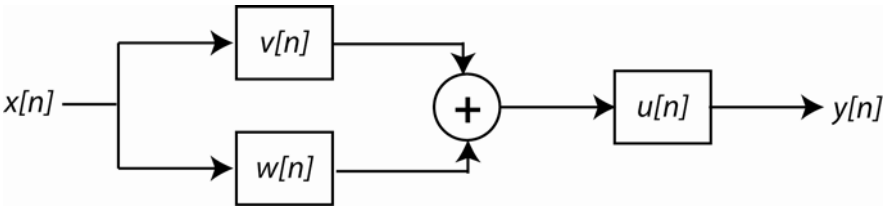
g) If the DTFT of a sequence is conjugate symmetric, then that sequence must be entirely imaginary:_____

h) The DTFT exists for every discrete-time sequence:_____

i) It is not possible to calculate the DTFT for left-sided or two-sided sequences:_____

j) The DTFT of a sequence cannot be entirely real if that sequence is complex:_____

2. (25 pts) Given the following system:



where $v[n] = \delta[n] + \delta[n-1]$, $w[n] = 2\delta[n] + 2\delta[n+1]$, and $u[n] = \alpha^{n-1}\mu[n+1]$.

a) (15 pts) Find the impulse response $h[n]$ of the complete system: i.e, where $y[n] = h[n] * x[n]$ ('*' denotes linear convolution here). The solution must be in a closed-form (i.e., no summations).

b) (5 pts) Under what condition(s) is the complete system represented by impulse response $h[n]$ BIBO stable? Justify your answer.

c) (5 pts) Is the complete system represented by impulse response $h[n]$ causal? Justify your answer

3. (30 pts) Given the linear constant coefficient difference equation (LCCDE)

$$y[n] + 0.75y[n-1] - 0.625y[n-2] = x[n] - 2x[n-1]$$

a) (5 pts) Is this system causal? Justify your answer.

a) (20 pts) Determine the impulse response of this system. ***Is it FIR or IIR?***

b) (5 pts) Is this system BIBO stable? Justify your answer

4. (25 pts) Discrete-time Fourier Transform (DTFT). Clearly state which properties (if any) you have used.

a) (10 pts) Determine the DTFT of the following sequence: $x[n] = \alpha^{n+1}\mu[-n+1]$

Define the range of α for which this DTFT will exist.

b) (10 pts) Determine the inverse DTFT *h[n]* of $H(e^{j\omega}) = \dfrac{2e^{j4\omega}}{1+0.75e^{-j\omega}}$.

c) (5 pts) Let the *h[n]* found in part b) corresponds to the impulse response of a system. Given that the system is clearly right-sided, determine whether or not it is also BIBO stable. Justify your answer.