FINAL EXAMINATION
DIGITAL SIGNAL PROCESSING
Dated: Jan 15th 2019 - Class IU-2015
Timed allowed: 90 minutes

DIGITAL SIGNAL PROCESSING	
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INSTRUCTION:

1. One A4 page of notes is allowed in the exam
2. Answer 4 from 5 following questions
3. If answer more than 4-Qs, only four highest marks are counted

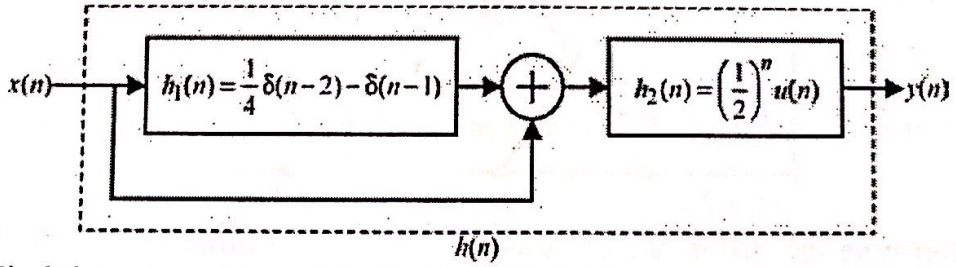
Question 1: (25 Marks)

What is the response of the LTI system with the impulse response $h(n)=\delta(n)+2\delta(n-1)$ for the input $x(n)=\{1,2,3\}$ in the two following algorithms

a. Write the I/O equation of the system
b. Find the output y(n) of the system corresponding to the input x(n) by using directly the definition of the Impulse response of a system.
c. Repeat question 3.b by using the Z-transform.

Question 2: (25 Marks)

Consider the system shown below



a. Find the z-transform of the $h_1(n)$ and $h_2(n)$?
b. Show that the impulse response, h(n), of the overall system is given by the form $h(n)=k(n)-0.5k(n-1)$. Specify the k(n)?
c. Determine the difference equation representation of overall system that relates the output y(n) to the input x(n).
d. Is this system causal? Stable? Explain clearly to receive full credit.

e. Determine the frequency response $H(e^{j\omega})$ of the overall system.
f. Realize the Block Diagram of the system.
g. What the h(n) if the system is unstable?
h. What the h(n) if the system is causal?

Question 3: (25 Marks)

A causal discrete time sequence h(n) are:

$$h(n)=-2\delta(n)+3\delta(n-1)+2\delta(n-2)+h(n-1)+h(n-2)+h(n-3).$$

a. Write the first ten number of the sequence, h(n) for n=0, 1, …,9 ?
b. Calculate the modulo-4 wrapped signal of the sequence in (a).
c. Calculate the 4-DFT of the wrapped signal in (b)
d. Calculate the 4-FFT of the sequence in (b)
e. Finally, compute the 4-point IDFT of the result and verify that you recover the mod-4 wrapped version of h(n) in question (b).

Question 4: (25 Marks)

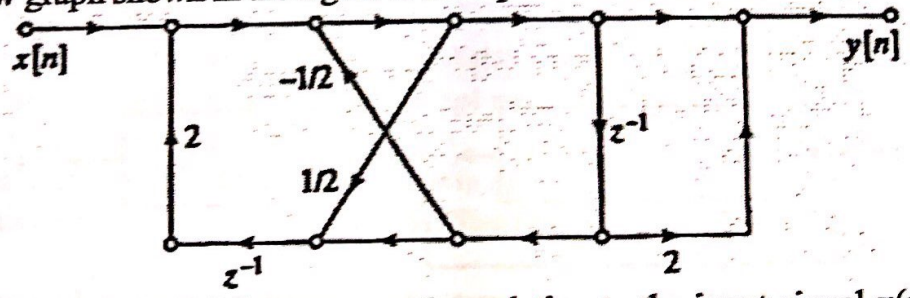
The 2-sided z-transform of transfer function x(n) of a system is given by

$$X(z)=\frac{z^{-1}}{(1-3z^{-1})(1-5z^{-1})}$$

a. Determine all possible ROCs for X(z)
b. For each ROC in (a), find x(n)
c. Discuss the stability and causality of each case.
d. Sketch the pole and zero pattern then draft the frequency response of the system.
e. Realize the canonical form of the system.

Question 5: (25 Marks)

The flow graph shown in the figure is an implementation of a causal, LTI system



a. Determine the difference equation relating to the input signal x(n) to the y(n)
b. Find and sketch the pole/zero pattern of the system. Is the system stable?
c. Realize the system in the direct and canonical form.
d. Determine y(2) if $x(n)=(1/2)^n u(n)$.

Good lucks!