FINAL EXAMINATION
DIGITAL SIGNAL PROCESSING
Dated: June 24th 2020 - Class IU-2017
Timed allowed: 120 minutes

DIGITAL SIGNAL PROCESSING	
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INSTRUCTION:

1. One A4 page of notes is allowed in the exam
2. Answer all questions

Question 1: (20 Marks)

A linear time-invariant (LTI) system is characterized by the system function

$$H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$

Sketch the Pole/Zero Pattern then specify the ROC of H(z) and determine the inverse Z-tranform of H(Z) for the following conditions:

a. The system is stable
b. The system is causal
c. The system is anticausal.

Question 2: (20 Marks)

The input $x(n) = 2^n[u(n)-3u(n-1)]$ to an LTI system produces the output $y(n)=(3^n-2^n)u(n)$.

a. Find the Z-transforms of the x(n) and y(n)?
b. What are the ROCs of X(z) and Y(z)?
c. Determine the transfer function of H(z) of the system and its ROC? Then specify the possible impulse response h(n) of the system.
d. What the h(n) if the system is unstable?
e. What the h(n) if the system is causal?

Question 3: (20 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: (20 Marks)

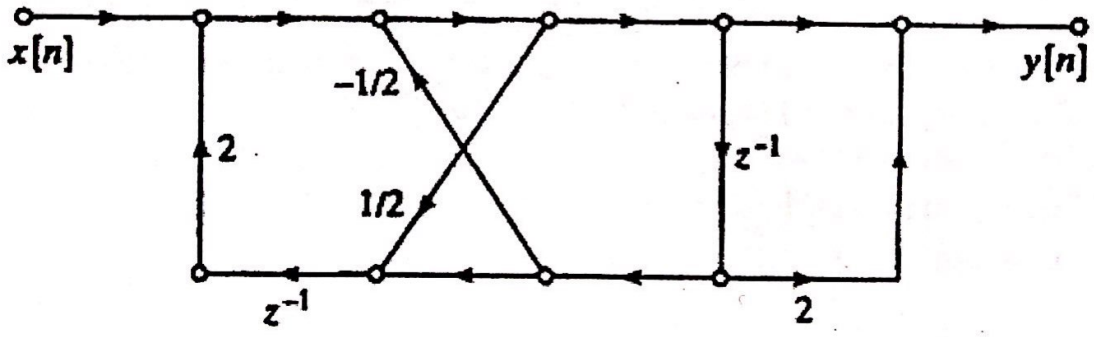
The 2-sided z-transform of transfer function x(n) of a system is given by

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

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: (20 Marks)

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



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

Good lucks!