Midterm Examination – EE092IU

Date: April 17th, 2019

Duration: 90 minutes

SUBJECT: DIGITAL SIGNAL PROCESSING – EE092IU	
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INSTRUCTION:

- One A4 page of notes is allowed in the exam
- Answer 4 from 5 following questions

Question 1: (25 Marks)

Compute the convolution x(n)*h(n) for the x(n) and h(n) below:

a. $x(n)=(-4)^{-n}\,u(n)$, $h(n)=\{1,2,-3\}$
b. $x(n)=(-1)^{-n}\,u(n)$ and $h(n)=e^{-n}\,u(n)$
c. $x(n)=u(-n)$, $h(n)=n(u(n)-u(n-3))$

Question 2: (25 Marks)

The Impulse response h(n) of a filter is non zero over the index range of n be [5,8]. The input signal x(n) to this filter is non zero over the index range of n be [7,12]. Consider the direct and LTI forms of convolution

$$y(n)=\sum_m h(m)x(n-m)=\sum_m x(m)h(n-m)$$

a. Determine the overall index range n for the output y(n). For each n, determine the corresponding summation range over m, for both the direct and LTI forms.
b. Assume h(n) = 0.4n and x(n) = 1 over their respective index ranges. Calculate and sketch the output y(n). Identify (with an explanation) the input on/off transient and steady state parts of y(n).

Question 3: (25 Marks)

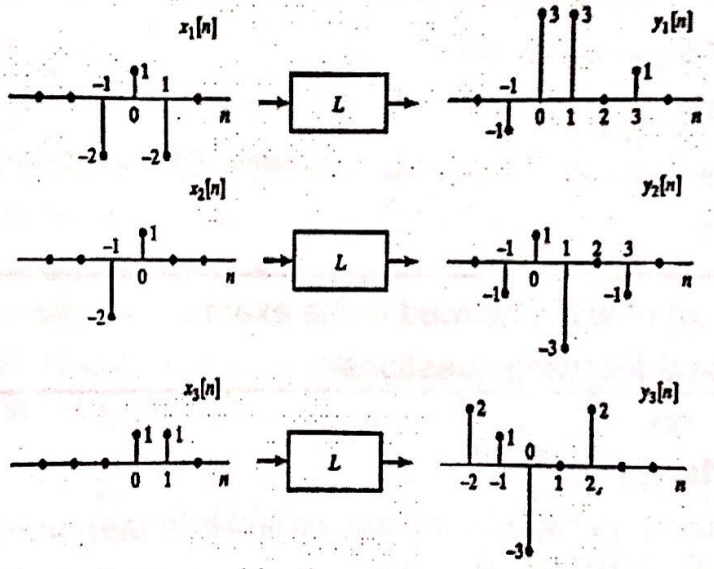
Given a signal

$$x(n)=\begin{cases}1+\frac{n}{3} & với\ -3\le n\le -1\\ 1 & với\ 0\le n\le 3\\ 0 & với\ n\ khác\end{cases}$$

a. Write the vector form and sketch the signal y(n) = x(-n+4)
b. Express the x(n) as a linear combination of the delay step functions u(n)?

Question 4: (25 Marks)

The system L in the figure is known to be linear. Show are three output signals $y_1(n)$, $y_2(n)$, $y_3(n)$ in response to three input signals $x_1(n)$, $x_2(n)$ and $x_3(n)$, respectively.



a. Write the δ(n) as a linear combination of three signals $x_1(n)$, $x_2(n)$ and $x_3(n)$?
b. Write the δ(n-1) as a linear combination of three signals $x_1(n)$, $x_2(n)$ and $x_3(n)$?
c. Is this system Time-invariant? Prove it?
d. Find the possible impulse response of the system?

Question 5: (25 Marks)

Consider a 4-bit successive approximation AD converter with full scale range of 5volts. Using the rounding technique, determine the 4-bit codes of the voltage values x = 2.3; −1.4; 0.76; -0.4; 2.19; -0.91 volts, for the following types of converters:

a. Write the code table for converting the samples of full scale range of 5 volts with the natural binary, the offset and the two's complement codes.
b. Write a table for converting the values of x into the Natural binary codes, the offset and the two's complement codes

Good lucks!