FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGERIA
SCHOOL OF ELECTRICAL ENGINEERING AND TECHNOLOGY
DEPARTMENT OF MECHATRONICS ENGINEERING
SECOND SEMESTER 2018/2019 B.Eng. DEGREE MID-SEMESTER EXAMINATION
COURSE: MCE 325(Signal Processing and Communication)
INSTRUCTION: Attempt All Questions
TIME ALLOWED: 2 Hours.

Question 1 (15 Marks)

Given the sequence of the two signals, $x[n]$ and $h[n]$, perform convolution on the given signals,

$x[n] = \left[0\ 0\ 0\ \underset{\sim}{-\mathbf{2}}\ 0\ 1\ -1\ \ 3\ 0\ 0\right]$, $h[n] = \left[0\ 0\ 0\ \underset{\smile}{\mathbf{1}}\ 2\ 0\ -1\ 0\ 0\ 0\right]$, For n ≤ 7

i. Using graphical method with appropriate equations and graphs. [8 Marks]

ii. Using tabular method and plot all the necessary graphs. [7 Marks]

Question 2 (15 Marks)

Table 1 shows the data sequence obtained from a sensor, use the data to answer questions (i) to (iii)

Table 1:

N	0	1	2	3	4	5	6	7	8	9
x(n)	3	2	3	4	4	3	2	4	4	3

a) Use the data to compute the output of a system given by

i. $y(n) = 0.2x(n) - 0.25x(n-1) - 0.5x(n-2)$ [3 Marks]

ii. $y(n) = 0.1y(n-1) - 0.03x(n-1) - 0.3x(n)$ [3 Marks]

iii. $y(n) = 0.1y(n-1) - 0.2y(n-2) - 0.3x(n) - 0.2x(n-1)$ [3 Marks]

b) Plot $y(n)$ for each of the equations. [3 Marks]

c) Draw the schematic Diagram for each of the equations. [3 Marks]

Question 3 (15 Marks)

a. Given

$$x(n) = \left(\frac{1}{5}\right)^n [u(n) - u(n-3)]$$

Determine X (z) and its ROC [6 Marks]

b. The system characteristic equation is given by the difference equation

$$y(n) = 3.5y(n-1) - 1.5y(n-2) + x(n) - 5x(n-1) + 6x(n-2)$$

i) Determine the system transfer function. [3 Marks]

ii) Determine the unit sample response of the system. [3 Marks]

iii) Determine the response of the system to $x(n) = \partial(n) - 0.5\partial(n-1)$ [3 Marks]

Question 4 (15 Marks)

a. You are to design a causal discrete-time LTI system with the property that input is $x(n) = \left(\frac{1}{2}\right)^n u(n) - \frac{1}{4}(\frac{1}{2})^{n-1}u(n-1)$ and the output is $y(n) = (\frac{1}{3})^n u(n)$

i. Determine the impulse $h(n)$ and the system function $H(z)$ of a system that satisfies the design conditions. [3 Marks]

ii. Find the difference equation that characterizes this system. [3 Marks]

iii. Determine a realization of the system that requires the minimum possible amount of memory. [3 Marks]

iv. Determine if the system is stable [2 Marks]

b. Determine the zero-state response of the system $y(n) = \frac{1}{2}y(n-1) + 4x(n) + 3x(n-1)$ to the input $x(n) = e^{jw_0 n}u(n)$. What is the steady-state response of the system? [4 Marks]