Department of Electrical Engineering
Mid term exam
Date: 19/08/2020

Course Details

Course Title: Signals & Systems   **Module:** 04

Instructor: Engr. Mujtaba Ihsan   **Total Marks:** 30

Student Details

Name: FAWAD AHMAD   **Student ID:** 13204

Q1.	(a)	**Differentiate** between systems with & without memory using examples.	Marks 05+04
	(b)	**Identify** the basic difference between a deterministic and a random signal.	CLO 1
Q2.	(a)	**Sketch** the transformed versions for the signal x (t) mentioned in i. and ii.	Marks 08+06
			CLO 1
	i.	$x(t+4)$ and $x(2t)$	
	ii.	$x(\Box/5)$ and $x(t-3)$	
	(b)	**Outline** the given system as invertible or non-invertible, linear or non-linear, causal or non-causal. Give the reason for you answers too.	
	i.	$y[n] = x^2[n]$	
	ii.	$y[n] = x[n+2]$	
Q3.		Let x[n] be a signal with x [n] = 0 for n < 1 and n>4. For the signal given below, **determine** value of "n" for which the signal is guaranteed to be zero.	Marks 04
			CLO 1
	i.	x[n+5]	

Q4.		**State** the correct answer. If a time shift in the input signal does not result in an identical time shift in the output signal, the system is said to be _____	Marks 03
			CLO 1

Que # 01 (a)

Answer

System with Memory:

memory in a System Corresponds to the Presence of a mechanism in the System that retains or Stores information about input values at times other than the Current time.

Example

* Accumulator or Summer :-

Accumulator or Summer is a discrete time System with memory

$$y[n] = \sum_{k=-\infty}^{n} x[k]$$

An Accumulator must remember or Store the information about Past inputs. The Accumulator computes the running Sum of all input upto the Current time and thus at each instant of time.

2) Memory Less System:-

A system is said to be memory less if its output for each value of the independent variable at a given time is dependendent only on the input at that same time.

* Examples:

① $y[n] = 2(x[n] - x^2[n])^2$

The Above System is a memory less System as the value of $y[n]$ at any particular time no depends only on the value of $x[n]$ at that time.

② A Resistor Is A memoryless System:-

Let $x(t) =$ Input taken as the Current
$y(t) =$ Voltage taken as output
The input-output relation of Resistor is

$$y(t) = Rx(t)$$

Que # 01 (B)

Answer :-

Deterministic and Random Signal :-

A Signal is deterministic is it is Completely Known and Can be described mathematically.

* Random Signal Can only be described by means of Probablistic description.

Eg mean, Variance, Standard Derivation

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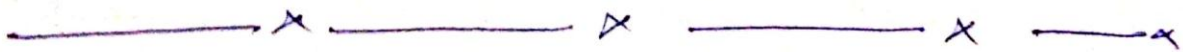
Que #2 (A)

(i) $x(t+4)$ and $x(2t)$

* $x(t+4)$

At $t=3$, $x(t)=1$

$t+4=3$, $x(t+4)=1$

$t=3-4$

$t=-1$
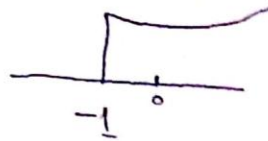
* $x(2t)$

At $t=3$, $x(t)=1$

$2t=3$, $x(2t)=1$

$t=\frac{3}{2}$ $\boxed{t=1.5}$
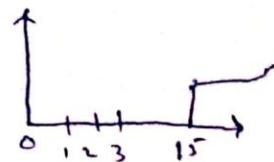

(ii) $x(t/5)$

At $t=3$, $x(t)=1$

$\frac{t}{5}=3$, $x\left(\frac{t}{5}\right)=1$

$t=15$
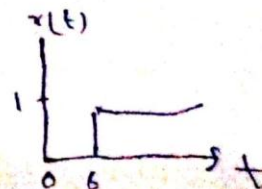

* $x(t-3)$

At $t=3$, $x(t)=1$

$t-3=3$, $x(t-3)=1$

$\boxed{t=6}$

Q2 (B)

(i) $y[n] = x^2[n] \longrightarrow$ (Non Linear)

→ Reason.

Let $x_1(n)$ be an input to the giving System

$$y_1(n) = x^2_1(n)$$

Another input $x_1(n)$ to the System will give

$$y_2(n) = x^2_2(n)$$

Let $x_3(n)$ be the Sum of $x_1(n)$ and $x_2(n)$

Such that

$$x_3(n) = a x_1(n) + b x_2(n)$$

This will give $y_3(n) = x^2_3(n)$

$$y_3(n) = \left[a x_1(n) + b x_2(n) \right]^2$$

$$y_3(n) = a^2 x^2_1(n) + b^2 x^2_2(n) + 2ab \, x_1(n) \, x_2(n)$$

It is obvious that the Superposition does not apply here.

Hence the given System is Non Linear.

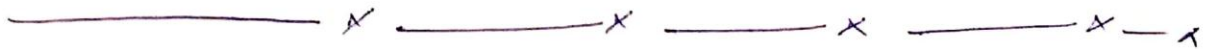(ii) $y[n] = x[n+2]$

→ Non Casual

=> Reason :-

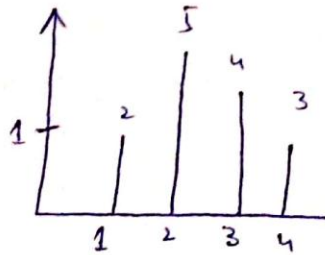A System is Said to be Non Causal if it anticipates the Future Value of The input.

$y[n] = x[n+2]$

———————×———————×————×————×—×

Que # 3

Answer :-

$$x[n] = 0 \quad, \text{ for } n < 1 \text{ and } n > 4$$

$x[n+5]$

Sol :- (a)

$x[n+5]$

This Signal can be shown as

At $n = 1$, $x(n) = 2$

At $n+5 = 1$, $x(n+5) = 2$

$$n = -5 - 1$$

$$\boxed{n = -6}$$

Similarly

At $n = 4$, $x[n] = 3$

At $n+5 = 4$, $x(n+5) = 3$

At $n+5 = 4$ The Signal is guaranteed

$$n = -5 - 4$$ to be zero for $n < -6$ and

$$\boxed{n = -9}$$ $n < -9$
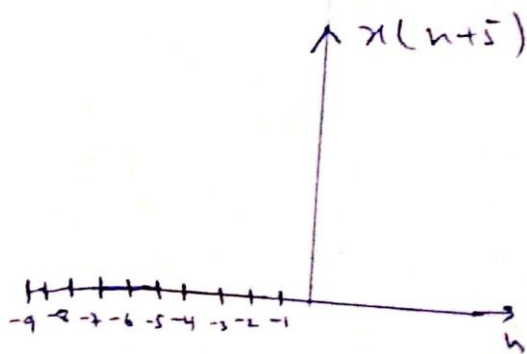
Que # 04

Answer:-

If a time shift in the input signal does not result in an identical time shift in the output signal the system is said to be Time Variant