Department of Electrical Engineering
Assignment Spring 2020
Date: 20/04/2020

Course Details

Course Title: Communication Systems **Module:** 10th
Instructor: DR. ENGR. SHAHID LATIF **Total Marks:** 30

Student Details

Name: Sajid Ahmad **Student ID:** 12671

Q1.	**(a)**	**What are major causes for transmission impairments? Describe using example of various degradations.**	**Marks 5**
	(b)	**Suppose the signals $k_1(t)$ and $k_2(t)$ are defined as follows:** $$k_1(t) = \begin{cases} 0, & t < 1 \\ 1, & 1 \le t \le 2 \\ 0, & 2 < t < 3 \\ 1, & 3 \le t \le 4 \\ 0, & 4 < t \end{cases}$$ and $$k_2(t) = \begin{cases} 0, & t < 0 \\ 2, & 0 \le t \le 2 \\ 0, & 2 < t \end{cases}$$ Determine $k_3(t) = k_1(t) + k_2(t)$ and $k_4(t) = k_1(t)\,k_2(t)$.	**Marks 5**
Q2.	**(a)**	**Explain how signals can be broadly classified? Describe in detail any five types of signals.**	**Marks 5**
	(b)	**Determine whether the signal $z(t) = t^3 + t^2$ is an odd signal or an even signal or neither; if it is neither, then determine the odd and even parts of it.**	**Marks 5**
Q3.		**Explain main characteristics of Sinusoidal Signals. Describe benefits and applications of Sinusoidal Signals.**	**Marks 10**

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Q 1:-
(a)

What are major causes for Transmission impairment? Describe using example of various degradiations.

Ans (a)

Transmission Impairment :-

When a Signal Transmit form one transmission medium to other, the Signal that is received may differ from the Signal that is transmitted due to various transmission impaired

Major Causes of Impairment :-

(i) Attenuation
(ii) Distortion
(iii) Noise

(i) Attenuation :-

- It means loss of energy by a signal time.
- When a Signal, simple or composite, travels through a medium, it loses some of its energy in overcoming the resistance of the medium
- Attenuation is measured in decibels (dB) Relative strengths of two Signals or one

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Signals at two different point

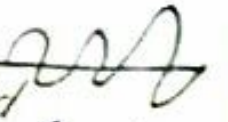
$$\text{Attenuation (dB)} = 10 \log_{10}\left(\frac{P_2}{P_1}\right)$$

- P_1 is power at sending end
- P_2 is power at receiving end.


original

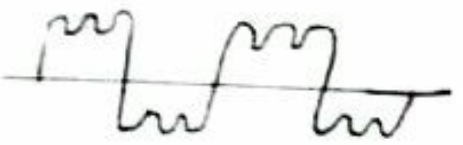

Attenuated

(ii) Distortion:-

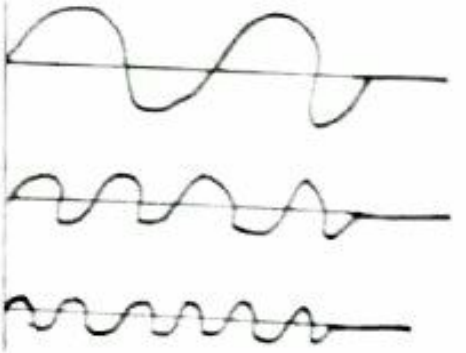

Amplified

- Distortion means Signal change its form or shape. signals.
- Each ~~Signal~~ frequency components has its ~~own~~ own ~~propert~~ propagation speed travelling through a medium, and therefore its own delay in arriving at the final Signals.

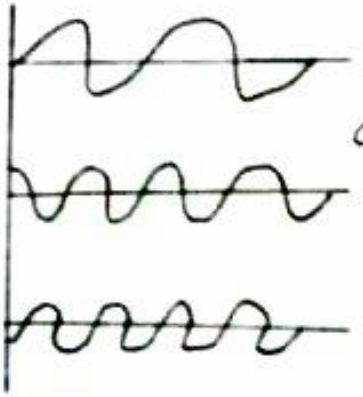
Composite signal sent



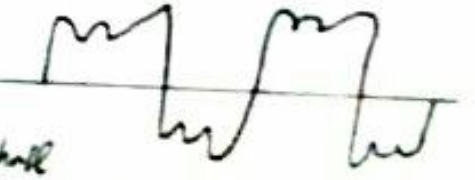
Sender



Components "signal" in phase



components out of phase



Composite Signal Recived

Receiver

(iii) Noise:-

The random or unwanted signal that mixes up with the original signal is called noise. the noise is a summation of unwanted or disturbing energy from natural and sometimes man-made sources.

1. Induced noise.
2. Thermal noise.
3. Crosstalk noise.
4. Impulse noise.

Q 1 (b)

Suppose the signals $k_1(t)$ and $k_2(t)$ are defined as follows.

$$k_1(t) = \begin{cases} 0. & t < 1 \\ 1. & 1 \le t \le 2 \\ 0. & 2 < t < 3 \\ 1. & 3 \le t \le 4 \\ 0. & 4 < t \end{cases}$$

and

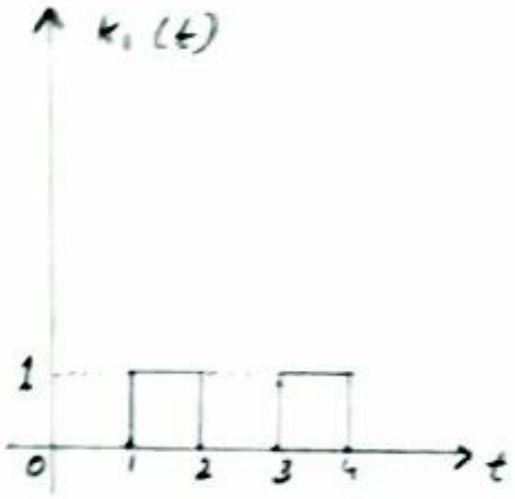
$$k_2(t) = \begin{cases} 0. & t < 0 \\ 2. & 0 \le t \le 2 \\ 0. & 2 < t \end{cases}$$

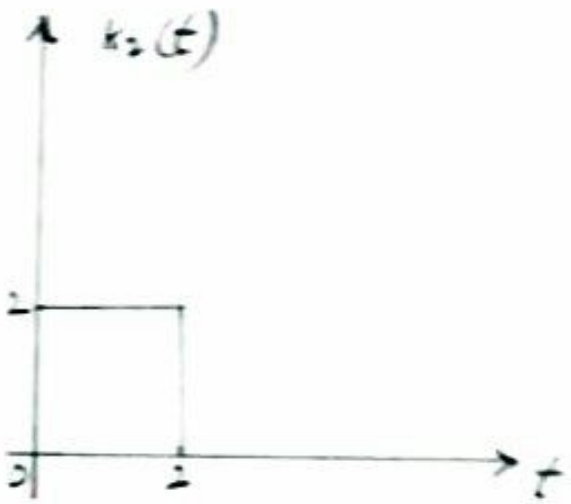
(3)

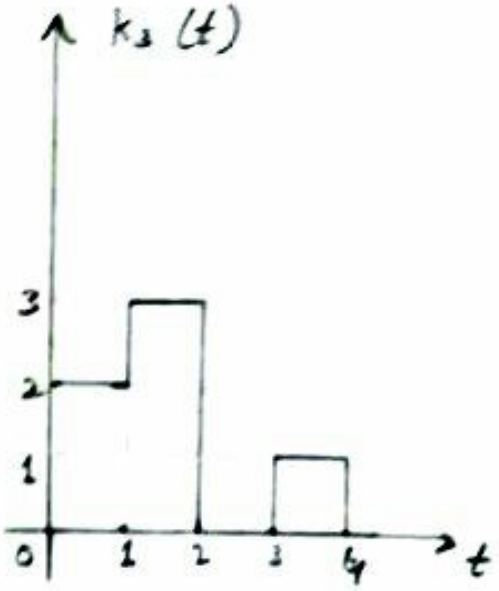
Determine $k_3(t)$ and $k_1(t)$ and $k_2(t) = k_1(t)\, k_2(t)$.

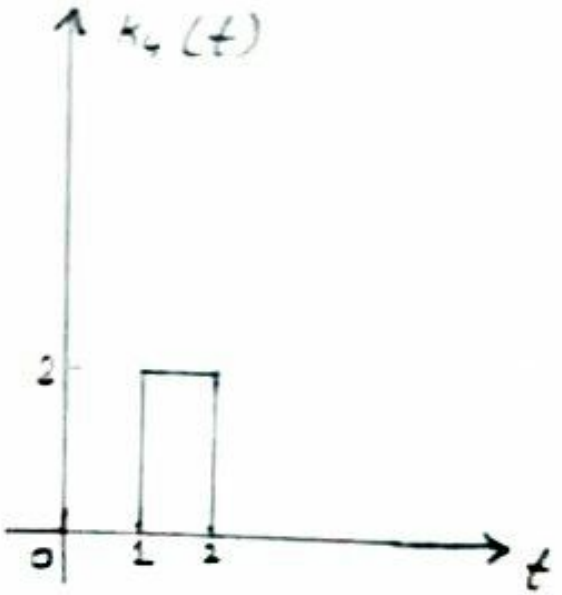
Sol:->

$k_3(t)$ and $k_4(t)$ respectively. All signals are shown below.









In differentiation operations the derivative of signal $g(t)$ with respect to time t is taken, and thus defined as.

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$$y(t) = \frac{d}{dt} g(t) = g'(t)$$

A physical example is an Inductor, as the voltage across the inductor with inductance (L) is equal to L times the derivative of the current following through it.

In Integration operations the Integral of the Signals $g(t)$ with respect to time (t) is taken and thus is defined by.

$$y(t) = \int g(t)\, dt.$$

A physical example is a capacitor, as the voltage across the capacitor with capacitance (C) is equal to $1/C$ times the Integrals of the current (I) flowing through it.

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Q 2: (4)

Explain how Signals can be broadly Classified? Describe in detail any five types of Signals.

Ans 2(a)

Signals are classified into the following.

(1) Continous time and Discreate time Signals
(2) Even and odd Signals.
(3) Periodic and Aperiodic Signals.
(4) Energy and Power Signals.
(5) Deterministic and Non-Deterministic Signals.

(1) Continous Time and Discreate time Signals:

Continous time ~~and~~ Signal is the function of continoustime variable that has uncountable or Infinite set of numbers in its sequence the Continoustime Signal can be represented and defined at any instant of the ~~time~~ ~~termed~~ timed in its sequence the continastime Signal is termed as analog Signal.

Discreate time Signal are "the Signals or quantities that can be defined as

(b)

and represended at certain time instants of the sequence. they are also called digital Signals.

(2) Even and odd Signals:-

Even Signals

A Signal is refered to as an even if it is identical to its time reversed counterparts; $x(t) = x(-t)$

Odd Signals:-

A Signal is odd if $x(t) = -x(t)$

A odd Signal must be 0 at $t=0$, in other words, odd signals passes the origin.

$$= \frac{1}{2}\{x(t) + x(-t)\} + \frac{1}{2}\{x(t) - x(-t)\}$$

where $x_e(t) = \frac{1}{2}\{x(t) + x(-t)\}$, $x_o(t) = \frac{1}{2}$

$x(t) - x(t)$

(3) Periodic and Aperiodic Signal:-

A Signal which repeat itself after specific interval of time is called periodic Signal.

A Signal that does not repeats its pattern over a period is called aperiodic signal or non periodic.

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(4) Energy and Power Signals :-

A Signals having only one square pulse in energy signal. A Signal that decays exponentially has finite energy, so it is also an energy Signals.

Sine wave in finite length is power Signals. dividing finite energy by infinite time (or) length as known as power Signal.

(5) Deterministic and non Deterministic Signals.

In deterministic Signal for a given particular input, the computer will always produce the same output going through the same states but in case of non-deterministic signal, for the same input, the compiler may produce different output in different runs. In fact non Deterministic Signal can't solve the problems in polynomial time and can't determine.

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Q 2: (b)

$$z(t) = t^3 + t^2$$

Sol:-

Ans 2 (b)

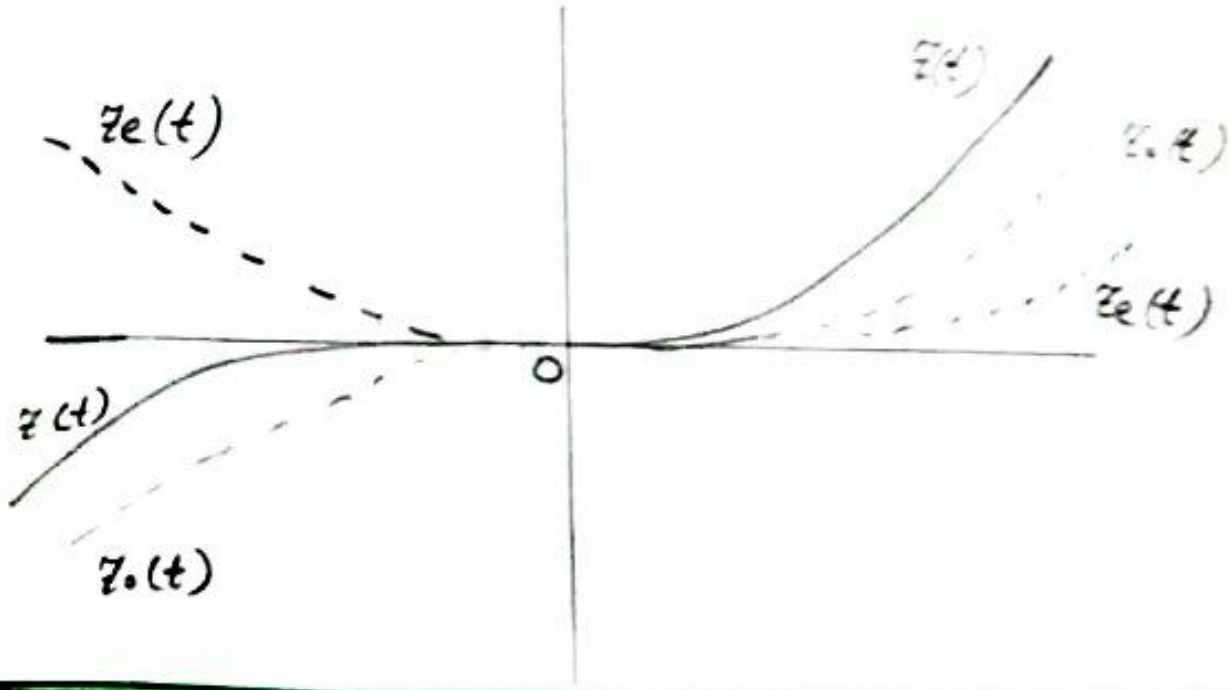
from $z(t)$, we find $z(-t) = -t^3 + t^2$

Since we have $z(t) \neq z(-t)$, $z(t)$ is not an even function, since we have $z(t) \neq -z(t)$ is not an odd function we therefore have to find the odd and even parts of $z(t)$.

$$z_e(t) = \frac{z(t) + z(-t)}{2} = \frac{t^3 + t^2 - t^3 + t^2}{2} = t$$

$$z_o(t) = \frac{z(t) - z(-t)}{2} = \frac{t^3 + t^2 + t^3 - t^2}{2} = t^3$$

this shows $z(t)$, $z_e(t)$ and $z_o(t)$



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Q 3 (a) (10)

Explain main characteristics of Sinusoidal Signals. Describe benefits and applications of Sinusoidal Signals.

Ans 3:-

Sinusoidal Signals :-

All sinusoidal Signal have the same general shape, but they are not identical, three characteristics of sinusoidal Signals are:

1. Amplitude.
2. Frequency.
3. Phase.

1) Amplitude :-

Amplitude specifies the maximum distance blw the horizontal axis and the vertical position of the waveform. A Sine wave with an amplitude of 5V for example, has a maximum value of +5V and a maximum value of -5V

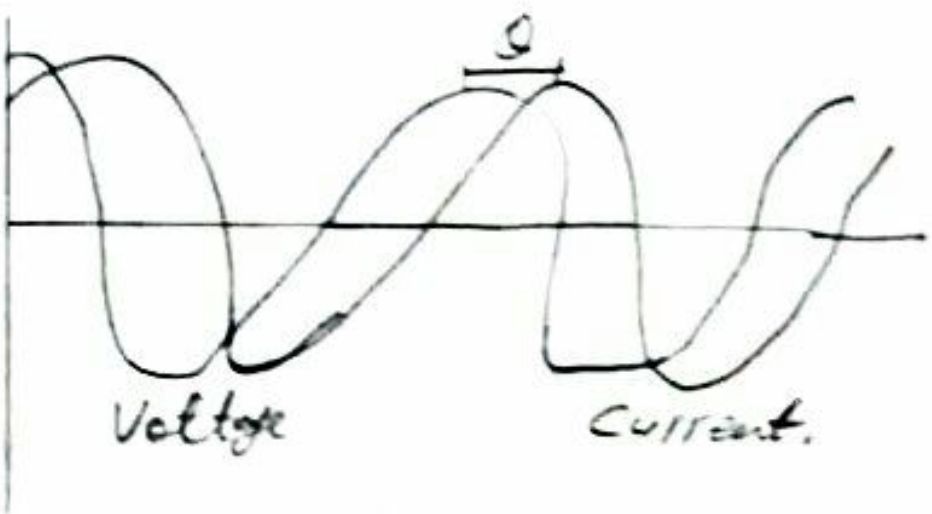
2) Frequency :-

Frequency tells us how quickly the sinusoidal completes full cycles.

this important characteristic influences the maximum rate at which a sinusoidal signal can transmit information and determines how a sinusoidal signal will be effected by circuits that include capacitors and inductors.

(3) Phase :-

Phase refers to the horizontal position of waveform with respect to one cycle. it is easier to understand in the context of phase shift or phase difference, we use these terms when describing to extent to which one signal is shifted to the left or right relative to another signal or to a theoretical references signal.



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Benefits of Sinusoidal wave:-

- Generates less electrical noise in your equipment.
- Microwave ovens cook faster.
- Equipment and appliance lasts longer.
- Equipment and appliance run cooler and more efficiently.

Applications:-

- Sinusoidal are an extremly important category of time-varying funtion (or Signals).
- Here are some exmples of their uses; In electrical power industry ~~sinusoidal~~ sinusoids are the dominants Signal used to transfer power. In communication systems Cellular telephones, radio Signals etc).

the end.