Subject code: EC203

Subject: Signals and Systems

UNIT I

2 Mark Questions and Answers

1.Define Signal.

Signal is a physical quantity that varies with respect to time , space or any other independent variable.

Or

It is a mathematical representation of the system

Eg $y(t) = t$. and $x(t)= \sin t$.

2. Define system .

A set of components that are connected together to perform the particular task.

3.What are the major classifications of the signal?

(i) Discrete time signal
(ii) Continuous time signal

4.Define discrete time signals and classify them.

Discrete time signals are defined only at discrete times, and for these signals, the independent variable takes on only a discrete set of values.

<u>Classification of discrete time signal:</u>

1.Periodic and Aperiodic signal
2.Even and Odd signal

5.Define continuous time signals and classify them.

Continuous time signals are defined for a continuous of values of the independent variable. In the case of continuous time signals the independent variable is continuous.

For example:

(i) A speech signal as a function of time
(ii) Atmospheric pressure as a function of altitude

<u>Classification of continuous time signal:</u>

(i) Periodic and Aperiodic signal
(ii) Even and Odd signal

6.Define discrete time unit step &unit impulse.

Discrete time Unit impulse is defined as

$$\delta [n]= \begin{cases} 0, & n\neq 0 \\ 1, & n=0 \end{cases}$$

Unit impulse is also known as unit sample.

Discrete time unit step signal is defined by

$U[n]=\{0, n=0$

$\{1, n>= 0$

7. Define continuous time unit step and unit impulse.

Continuous time unit impulse is defined as

$\delta (t)=\{1, t=0$

$\{0, t \neq 0$

Continuous time Unit step signal is defined as

$U(t)=\{0, t<0$

$\{1, t\geq0$

8. Define unit ramp signal.

Continuous time unit ramp function is defined by

$r(t)=\{0, t<0$

$\{t, t\geq0$

A ramp signal starts at t=0 and increases linearly with time 't'.

9. Define periodic signal. and nonperiodic signal.

A signal is said to be periodic ,if it exhibits periodicity.i.e.,

$X(t +T)=x(t)$, for all values of t.

Periodic signal has the property that it is unchanged by a time shift of T.

A signal that does not satisfy the above periodicity property is called an aperiodic signal.

10. Define even and odd signal ?

A discrete time signal is said to be even when,

$x[-n]=x[n]$.

The continuous time signal is said to be even when,

$x(-t)= x(t)$

For example,Cosωn is an even signal.

The discrete time signal is said to be odd when

$x[-n]= -x[n]$

The continuous time signal is said to be odd when

$x(-t)= -x(t)$

Odd signals are also known as nonsymmetrical signal.

Sine wave signal is an odd signal.

11. Define Energy and power signal.

A signal is said to be energy signal if it have finite energy and zero power.

A signal is said to be power signal if it have infinite energy and finite power.

If the above two conditions are not satisfied then the signal is said to be neigther energy nor power signal

12.Define unit pulse function.

Unit pulse function ∏(t) is obtained from unit step signals

∏(t)=u(t+1/2)- u(t-1/2)

The signals u(t+1/2) and u(t-1/2) are the unit step signals shifted by 1/2units in the time axis towards the left and right ,respectively.

13.Define continuous time complex exponential signal.

The continuous time complex exponential signal is of the form

$x(t)=Ce^{at}$

where c and a are complex numbers.

14.What is continuous time real exponential signal.

Continuous time real exponential signal is defined by

$x(t)=Ce^{at}$

where c and a are complex numbers. If c and a are real ,then it is called as real exponential.

15.What is continuous time growing exponential signal?

Continuous time growing exponential signal is defined as

$x(t)=Ce^{at}$

where c and a are complex numbers.

If a is positive,as t increases , then x(t) is a growing exponential.

16.What is continuous time decaying exponential?

Continuous time growing exponential signal is defined as

$x(t)=Ce^{at}$

where c and a are complex numbers.

If a is negative, as t increases, then x(t) is a decaying exponential.

17.What are the types of Fourier series?

1. Exponential Fourier series
2. Trigonometric Fourier series

18.Write down the exponential form of the fourier series representation of a periodic signal?

$x(t)=\sum a_k e^{jk\omega ot}$

Here the summation is taken from -∞ to ∞.

$a_k=1/T \int x(t) e^{-jk\omega ot}$

Here the integration is taken from 0 to T.

The set of coefficients { a_k} are often called the fourier series coefficients or spectral coefficients.

The coefficient a_o is the dc or constant component of x(t).

19.Write down the trigonometric form of the fourier series representation of a periodic signal?

$x(t)= a_o+\sum [a_n \cos n\omega ot + b_n \sin n\omega ot]$

where

$a_o=1/T \int x(t)\, dt$

$a_n =1/T \int x(t)\cos n\omega ot\, dt$

$b_n=1/T \int x(t)\cos n\omega ot\, dt$

20.Write short notes on dirichlets conditions for fourier series.

a. x(t) must be absolutely integrable
b. The function x(t) should be single valued within the interval T.
c. The function x(t) should have finite number of discontinuities in any finite interval of time T.
d. The function x(t) should have finite number of maxima &minima in the interval T.

21.State Time Shifting property in relation to fourier series.

$x(t-to) \xrightarrow{FS} a_k e^{-jk\omega ot}$

Time shifting property states that; when a periodic signal is shifted in time, the magnitudes of its fourier series coefficients, remain unaltered.

22.State parseval's theorem for continuous time periodic signals.

Parseval's relation for continuous time periodic signals is

$1/T \int |x(t)^2| \ dt =\sum| a_k^2|$

Parseval's relation states that the total average power in a periodic signal equals the sum of the average power in all of its harmonic components.

Part B(6 Marks)

1 Explain in detail elementary DT signal.

Discrete time Unit impulse is defined as

$\delta [n]= \{0, \ n\neq 0$

{1, n=0

Unit impulse is also known as unit sample.

Discrete time unit step signal is defined by

U[n]={0,n=0

{1,n>= 0

Continuous time unit impulse is defined as

δ (t)={1, t=0

{0, t ≠ 0

Continuous time Unit step signal is defined as

U(t)={0, t<0

{1, t≥0

Continuous time unit ramp function is defined by

r(t)={0,t<0

{t, t≥0

A ramp signal starts at t=0 and increases linearly with time ‘t’.

2. Find the energy of the signal $x(n) = (½)^n u(n)$.

Given: $x(n) = (½)^n u(n)$

$$E = \underset{N\to\alpha}{Lt} \sum_{n=-N}^{N} |x(n)|^2$$

$$= \underset{N\to\alpha}{Lt} \sum_{n=-N}^{N} |(½)^n u(n)|^2$$

$$= \underset{N\to\alpha}{Lt} \sum_{n=0}^{N} (½)^{2n}$$

$$= \underset{N\to\alpha}{Lt} \sum_{n=0}^{N} (1/4)^n \quad \alpha$$

$$E = \frac{1}{1-0.25}$$

$$E = \frac{4}{3}$$

2. Explain in detail complex exponential CT signal.

The continuous time complex exponential signal is of the form

$x(t)=Ce^{at}$

where c and a are complex numbers.

Continuous time real exponential signal is defined by

$x(t)=Ce^{at}$

where c and a are complex numbers. If c and a are real ,then it is called as real exponential.

Continuous time growing exponential signal is defined as

$x(t)=Ce^{at}$

where c and a are complex numbers.

If a is positive,as t increases , then x(t) is a growing exponential.

Continuous time growing exponential signal is defined as

$x(t)=Ce^{at}$

where c and a are complex numbers.

If a is negative, as t increases, then x(t) is a decaying exponential.

4.Find the odd and even components of the signal cost + sint + cost sint.

Given:

$X(t) = \cos t + \sin t + \cos t \sin t$

$X(-t)= \cos(-t) + \sin(-t) + \cos(-t) \sin(-t)$

$= \cos t - \sin t - \cos t \sin t$

$$Xe(t)= \frac{1}{2}\left[x(t)+x(-t)\right]$$

$$= \frac{1}{2}\left[\cos t+\sin t+\cos t\sin t+\cos t-\sin t-\cos t\sin t\right]$$

$$= \frac{1}{2}\left[2\cos t+2\cos t\sin t\right]$$

$Xe(t)= \cos t + \cos t \sin t.$

$$Xo(t)= \frac{1}{2}\left[x(t)-x(-t)\right]$$

$$=\frac{1}{2}\left[\cos t+\sin t+\cos t\sin t-\cos t+\sin t-\cos t\sin t\right]$$

$$=\frac{1}{2}\left[2\sin t\right]$$

$Xo(t)= \sin t$

$X_e(t)=$ cost + cost sint

$X_o(t)=$ sint

5. Find the odd and even components of the x(n)={1,2,2,3,4}.

Given: x(n)={1,2,2,3,4}.

Solution:

$$x(n) = \{1,2,2,3,4\}.$$

$$X(-n) = \{4,3,2,2,1\}.$$

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

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

$$= \frac{1}{2}\{1+4,\ 2+3,\ 2+2,\ 3+2,\ 4+1\}$$

$$=\frac{1}{2}\{5,\ 5,\ 4,\ 5,\ 5\}$$

$$= \{2.5,\ 2.5,\ 2,\ 2.5,\ 2.5\}$$

$$X_o(n) = \frac{1}{2}\{x(n)-x(-n)\}$$

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

$$= \frac{1}{2}\{1-4,\ 2-3,\ 2-2,\ 3-2,\ 4-1\}$$

$$=\frac{1}{2}\{-3,\ -1,\ 0,\ 1,\ 3\}$$

$$= \{-1.5,\ -0.5,\ 0,\ 0.5,\ 1.5\}$$

$$x(n) = \{1,\quad 2,\quad 2,\quad 3,\quad 4\}.$$

$$X_e(n) = \{2.5,\quad 2.5,\quad 2,\quad 2.5,\quad 2.5\}$$

$$X_o(n) = \{-1.5,\quad -0.5,\quad 0,\quad 0.5,\quad 1.5\}$$

6.Find the energy of the signal e^{-2t} u(t).

Given: $x(t) = e^{-2t}\, u(t)$

$$E = \underset{T\to\alpha}{Lt} \int_{-T/2}^{T/2} |x(t)|^2\, dt$$

$$= \underset{T\to\alpha}{Lt} \int_{0}^{T/2} \left|e^{-2t}\right|^2 dt$$

$$= \underset{T\to\alpha}{Lt} \int_{0}^{T/2} \left|e^{-2t}\right|^2 dt$$

$$= \underset{T\to\alpha}{Lt} \int_{0}^{T/2} e^{-4t}\, dt \ \alpha$$

$$\underset{T\to\alpha}{Lt} \left[\frac{e^{-4t}}{-4}\right]_0^{T/2}$$

$$= \underset{T\to\alpha}{Lt} \frac{-1}{4}\left[e^{-2T} - 1\right]$$

$$E = \frac{-1}{4}\left[0 - 1\right]$$

$$\text{Energy, } E = \frac{1}{4}$$

7.Determine the power of the signal e^{-2t} u(t).

Solution:

$$P = \underset{T\to\alpha}{Lt} \frac{1}{T} \int_{-T/2}^{T/2} |x(t)|^2\, dt$$

$$= \underset{T\to\alpha}{Lt} \frac{1}{T} \int_{0}^{T/2} \left|e^{-2t}\right|^2 dt$$

$$= \underset{T\to\alpha}{Lt} \frac{1}{T} \int_{0}^{T/2} \left|e^{-2t}\right|^2 dt$$

$$= \underset{T\to\alpha}{Lt} \frac{1}{T} \int_0^{T/2} e^{-4t} dt \ \alpha$$

$$\underset{T\to\alpha}{Lt} \frac{1}{T} \left[\frac{e^{-4t}}{-4} \right]_0^{T/2}$$

$$= \underset{T\to\alpha}{Lt} \frac{1}{T} \frac{-1}{4} \left[e^{-2T} - 1 \right]$$

$$P = \underset{T\to\alpha}{Lt} \frac{1}{4T} \left[e^{-2T} - e^{0} \right]$$

P= 0

Power , P = 0

.

8. Test Whether the signal y(t) = ax(t) + b is linear or non linear.

Solution:

y(t) = ax(t) + b

$y_1(t)$ is the output of input signal $x_1(t)$

$$y_1(t) = a\, x_1(t) + b$$

similarly, $y_2(t)$ is the output of input signal $x_2(t)$

$$y_2(t) = a\, x_2(t) + b$$

Now $x_1(t)$ and $x_2(t)$ related with $x_3(t)$

ie , $x_3(t) = a\, x_1(t) + b\, x_2(t)$

The output $y_3(t)$ defined as $y_3(t) = a\, x_3(t) + b$

$$= a\, [a\, x_1(t) + b\, x_2(t)] + b$$

$$= a \,.\, a\, x_1(t) + a.\, b\, x_2(t) + b$$

$$\neq a\ y_1(t) + b\, y_2(t)$$

Hence the system is non linear.

9. Find the power and rms value of signal x(t)=20cos2πt.

Given: x(t)=20cos2πt.

$$P = \underset{T\to\alpha}{Lt}\frac{1}{2T}\int_{-T}^{T}\left|x(t)\right|^{2} dt$$

$$= \underset{T\to\alpha}{Lt}\frac{1}{2T}\int_{-T}^{T}\left|20\cos 2\pi t.\right|^{2} dt$$

$$= \underset{T\to\alpha}{Lt}\frac{1}{2T}\int_{-T}^{T}400\cos^{2} 2\pi t.\ dt$$

$$= \underset{T\to\alpha}{Lt}\frac{400}{4T}\int_{-T}^{T}(1+\cos 4\pi t)(dt\ \alpha$$

$$\underset{T\to\alpha}{Lt}\frac{400}{4T}\int_{-T}^{T}1dt + 0$$

$$= \underset{T\to\alpha}{Lt}\frac{400}{4T}\left[T-(-T)\right]$$

$$P = \underset{T\to\alpha}{Lt}\frac{400}{4T}\left[2T\right]$$

Power P= 200.

The r.m.s value = $\sqrt{200}$ = 14.14.

***10.* Explain the following signals.**

***(i) P*eriodic and aperiodic**

(ii) Even and odd

*(i) P*eriodic and aperiodic

A signal is said to be periodic ,if it exhibits periodicity.i.e.,

X(t +T)=x(t), for all values of t.

Periodic signal has the property that it is unchanged by a time shift of T.

A signal that does not satisfy the above periodicity property is called an aperiodic signal.

(ii) Even and odd

A discrete time signal is said to be even when,

x[-n]=x[n].

The continuous time signal is said to be even when,

$x(-t)= x(t)$

For example,Cosωn is an even signal.

The discrete time signal is said to be odd when

$x[-n]= -x[n]$

The continuous time signal is said to be odd when

$x(-t)= -x(t)$

Odd signals are also known as nonsymmetrical signal.

Sine wave signal is an odd signal.

Part C (10 marks)

***1 .Find the trigonometric fourier series for half wave rectified sine wave*.**

Solution

$$x(t)= a_o+\sum_{n=1}^{\alpha} a_n \cos n\omega_0 t + \sum_{n=1}^{\alpha} b_n \sin n\omega_0 t$$

where

$a_o=1/T \int x(t)\, dt$

$a_n =1/T \int x(t)\cos n\omega ot\, dt$

$b_n=1/T \int x(t)\cos n\omega ot\, dt$

$x(t)=\{\sin t, \quad \pi > t >= 0$

$\quad 0, \quad 2\pi > t > \pi$

The fundamental period ,T= 2π

The fundamental frequency $\omega_0 = \frac{2\pi}{T} = 1$,

$$a_0 = \frac{1}{T}\int_{t_0}^{t_0+T} x(t)dt$$

$$= \frac{1}{2\pi}\int_{0_0}^{\pi} \sin t dt$$

$$= \frac{1}{2\pi}\left[-\cos t\right] \Big|_0^{\pi}$$

$$= \frac{1}{\pi}$$

$$a_n = \frac{2}{T}\int_{t_0}^{t_0+T} x(t)\cos n\omega_0 t dt$$

$$= \frac{2}{2\pi}\int_{t_0}^{t_0+T} \sin t \cos ntdt$$

$$= \frac{1}{\pi}\int_0^{\pi} \frac{1}{2}\left[\sin(n+1)t + \sin(1-n)t\right]dt$$

$$= \frac{1}{2\pi}\int_0^{\pi} \sin(n+1)tdt + \frac{1}{2\pi}\int_0^{\pi} \sin(1-n)t \,\mathrm{dt}$$

$$= \frac{1}{\pi}\left[\frac{1+(-1)^n}{1-n^2}\right]$$

To find b_n

$$b_n =_n = \frac{2}{T}\int_{t_0}^{t_0+T} x(t)\sin n\omega_0 t dt$$

$$= \frac{2}{2\pi}\int_{t_0}^{t_0+T} \sin t \sin ntdt$$

$$= \frac{1}{\pi}\int_0^{\pi} \frac{1}{2}\left[\cos(n-1)t - \cos(n+1)t\right]dt$$

$$= \frac{1}{2\pi}\int_0^{\pi} \sin(n+1)tdt + \frac{1}{2\pi}\int_0^{\pi} \sin(1-n)t \,\mathrm{dt}$$

$$= \frac{1}{2\pi}\left[\frac{\sin(n-1)\pi - \sin 0}{(n-1)} - \frac{\sin(n+1)\pi - \sin 0}{(n+1)}\right]$$

$$= 0$$

$$X(t) = \frac{1}{\pi} + \frac{1}{\pi}\sum\left[\frac{1+(-1)^n}{1-n^2}\cos n\omega_0 t\right] + \frac{1}{2}\sin \omega_0 t$$

2.Find the trigonometric fourier series representation of a periodic square wave
x(t) = 1, for the interval (0 , π).
= 0,for the interval (π , 2π)

$$x(t)= a_o+\sum_{n=1}^{\alpha} a_n \cos n\omega_0 t + \sum_{n=1}^{\alpha} b_n \sin n\omega_0 t$$

where

a_o=1/T ∫ x(t) dt

a_n =1/T ∫ x(t)cos nωot dt

b_n=1/T ∫ x(t)cos nωot dt

x(t)={1, $\pi > t >= 0$
-1 , $2\pi > t > \pi$

The fundamental period ,T= 2π

The fundamental frequency $\omega_0 = \frac{2\pi}{T} = 1$,

$$a_0 = \frac{1}{T}\int_{t_0}^{t_0+T} x(t)dt$$

$$= \frac{1}{2\pi}\int_{0_0}^{\pi} 1dt + \frac{1}{2\pi}\int_{\pi}^{2\pi}(-1)dt$$

$$= 0$$

$$a_n = \frac{2}{T}\int_{t_0}^{t_0+T} x(t)\cos n\omega_0 tdt$$

$$= \frac{2}{2\pi}\int_{0_0}^{\pi} 1\cos ntdt + \frac{2}{2\pi}\int_{\pi}^{2\pi}(-1)\cos ntdt$$

$$= \frac{1}{n\pi}\left[(\sin n\pi - \sin 0) - (\sin 2n\pi - \sin n\pi)\right]$$

$$= 0$$

To find b_n

$$b_n = {}_n = \frac{2}{T}\int_{t_0}^{t_0+T} x(t)\sin n\omega_0 tdt$$

$$= \frac{2}{2\pi} \int_{t_0}^{t_0+T} \sin t \sin nt dt$$

$$= \frac{1}{\pi} \int_0^{\pi} 1.\sin nt dt + \frac{1}{\pi} \int_{\pi}^{2\pi} (-1).\sin nt dt$$

$$= \frac{1}{n\pi} [-(\cos n\pi - \cos 0) + (\cos n2\pi - \cos n\pi)]$$

$$= \frac{1}{n\pi} \{-[(-1)^n - 1] + [1 - (-1)^n]\}$$

$$= \frac{2}{n\pi} [1 - (-1)^n]$$

$$X(t) = \sum_{n=1}^{\alpha} \frac{2}{n\pi} [1 - (-1)^n] \sin nt$$

3. Test Whether the signal x(n) = (½)^n u(n) energy or power signal.

Given: $x(n) = (½)^n u(n)$

$$E = \underset{N \to \alpha}{Lt} \sum_{n=-N}^{N} | x(n) |^2$$

$$= \underset{N \to \alpha}{Lt} \sum_{n=-N}^{N} | (½)^n u(n) |^2$$

$$= \underset{N \to \alpha}{Lt} \sum_{n=0}^{N} (½)^{2n}$$

$$= \underset{N \to \alpha}{Lt} \sum_{n=0}^{N} (1/4)^n \quad \alpha$$

$$= \frac{1}{1-0.25} = \frac{4}{3} < \alpha$$

$$P = \underset{N\to\alpha}{Lt} \frac{1}{2N+1} \sum_{n=-N}^{N} |x(n)|^2$$

$$= \underset{N\to\alpha}{Lt} \frac{1}{2N+1} \sum_{n=-N}^{N} |(1/2)^n u(n)|^2$$

$$= \underset{N\to\alpha}{Lt} \frac{1}{2N+1} \sum_{n=-N}^{N} (1/2)^{2n}$$

$$= \underset{N\to\alpha}{Lt} \frac{1}{2N+1} \sum_{n=-N}^{N} (1/4)^{n}$$

$$= \frac{1}{\alpha} = 0$$

E=finite and P=0

Hence the signal is Energy signal

Energy, E= $\frac{1}{4}$

4. Test Whether the signal x(t) = e^{-2t} u(t).) energy or power signal.

Given: x(t) = e^{-at} u(t)

$$E = \underset{T\to\alpha}{Lt} \int_{-T/2}^{T/2} |x(t)|^2 dt$$

$$= \underset{T\to\alpha}{Lt} \int_{0}^{T/2} |e^{-2t}|^2 dt$$

$$= \underset{T\to\alpha}{Lt} \int_{0}^{T/2} |e^{-2t}|^2 dt$$

$$= \underset{T\to\alpha}{Lt} \int_{0}^{T/2} e^{-4t} dt \ \alpha$$

$$\underset{T\to\alpha}{Lt} \left[\frac{e^{-4t}}{-4} \right]_0^{T/2}$$

$$=\underset{T\to\alpha}{Lt}\ \frac{-1}{4}\left[e^{-2T}-1\right]$$

$$E=\ \frac{-1}{4}\left[0-1\right]$$

Energy, $E=\ \frac{1}{4}$

$$P=\ \underset{T\to\alpha}{Lt}\frac{1}{T}\int_{-T/2}^{T/2}\left|x(t)\right|^{2}dt$$

$$=\ \underset{T\to\alpha}{Lt}\frac{1}{T}\int_{0}^{T/2}\left|e^{-2t}\right|^{2}dt$$

$$=\ \underset{T\to\alpha}{Lt}\frac{1}{T}\int_{0}^{T/2}\left|e^{-2t}\right|^{2}dt$$

$$=\underset{T\to\alpha}{Lt}\frac{1}{T}\int_{0}^{T/2}e^{-4t}dt\ \alpha$$

$$\underset{T\to\alpha}{Lt}\frac{1}{T}\left[\frac{e^{-4t}}{-4}\right]_{0}^{T/2}$$

$$=\underset{T\to\alpha}{Lt}\ \frac{1}{T}\ \frac{-1}{4}\left[e^{-2T}-1\right]$$

$$P=\ \underset{T\to\alpha}{Lt}\ \frac{1}{4T}\left[e^{-2T}-e^{0}\right]$$

P= 0

Hence the signal is Energy signal

5. Explain in detail different classification of signals.

signal

Signal is a physical quantity that varies with respect to time , space or any other independent variable.

Or

It is a mathematical representation of the system

Eg y(t) = t. and x(t)= sin t.

Signal is mainly classified as

(i).Continuous time signal
(ii).Discrete time signal

continuous time signals

Continuous time signals are defined for a continuous of values of the independent variable. In the case of continuous time signals the independent variable is continuous. For example:

(iii) A speech signal as a function of time
(iv) Atmospheric pressure as a function of altitude

<u>Classification of continuous time signal:</u>

(iii) Periodic and Aperiodic signal
(iv) Even and Odd signal

Discrete time signals

Discrete time signals are defined only at discrete times, and for these signals, the independent variable takes on only a discrete set of values.

<u>Classification of discrete time signal:</u>

1.Periodic and Aperiodic signal
2.Even and Odd signal

Elementary signal

Discrete time Unit impulse is defined as

$$\delta [n]= \begin{cases} 0, & n \neq 0 \\ 1, & n=0 \end{cases}$$

Unit impulse is also known as unit sample.

Discrete time unit step signal is defined by

$$U[n]= \begin{cases} 0, & n=0 \\ 1, & n>= 0 \end{cases}$$

Continuous time unit impulse is defined as

$$\delta (t)= \begin{cases} 1, & t=0 \\ 0, & t \neq 0 \end{cases}$$

Continuous time Unit step signal is defined as

$$U(t)= \begin{cases} 0, & t<0 \\ 1, & t\geq 0 \end{cases}$$

Continuous time unit ramp function is defined by

$$r(t)= \begin{cases} 0, & t<0 \\ t, & t\geq 0 \end{cases}$$

A ramp signal starts at t=0 and increases linearly with time ‘t’

Complex exponential CT signal.

The continuous time complex exponential signal is of the form

$x(t)=Ce^{at}$

where c and a are complex numbers.

Continuous time real exponential signal is defined by

$x(t)=Ce^{at}$

where c and a are complex numbers. If c and a are real ,then it is called as real exponential.

Continuous time growing exponential signal is defined as

$x(t)=Ce^{at}$

where c and a are complex numbers.

If a is positive,as t increases , then x(t) is a growing exponential.

Continuous time growing exponential signal is defined as

$x(t)=Ce^{at}$

where c and a are complex numbers.

If a is negative, as t increases, then x(t) is a decaying exponential.

NOORUL ISLAM UNIVERSITY, KUMARACOIL.

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING.

QUESTIONS &ANSWERS BANK

SUBJECT CODE: EC 203

SUBJECT NAME: SIGNALS AND SYSTEMS

Prepared by,

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Electronics &Communication Engineering

Subject code: EC203

Subject: Signals and Systems

(For IV semester ECE)

Questions Bank

UNIT I

2 Mark Questions and Answers

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Or

It is a mathematical representation of the system

Eg $y(t) = t$. and $x(t)= \sin t$.

2. Define system .

A set of components that are connected together to perform the particular task.

3.What are the major classifications of the signal?

(iii) Discrete time signal
(iv) Continuous time signal

4.Define discrete time signals and classify them.

Discrete time signals are defined only at discrete times, and for these signals, the independent variable takes on only a discrete set of values.

Classification of discrete time signal:

1.Periodic and Aperiodic signal
2.Even and Odd signal

5.Define continuous time signals and classify them.

Continuous time signals are defined for a continuous of values of the independent variable. In the case of continuous time signals the independent variable is continuous.

For example:

(v) A speech signal as a function of time
(vi) Atmospheric pressure as a function of altitude

Classification of continuous time signal:

(v) Periodic and Aperiodic signal
(vi) Even and Odd signal

6.Define discrete time unit step &unit impulse.

Discrete time Unit impulse is defined as

$$\delta [n]= \{0, \ n\neq 0$$
$$\{1, \ n=0$$

Unit impulse is also known as unit sample.

Discrete time unit step signal is defined by

$$U[n]=\{0,n=0$$
$$\{1,n>= 0$$

12. Define continuous time unit step and unit impulse.

Continuous time unit impulse is defined as

$$\delta (t)=\{1, t=0$$

{0, $t \neq 0$

Continuous time Unit step signal is defined as

U(t)={0, t<0

{1, t≥0

13. Define unit ramp signal.

Continuous time unit ramp function is defined by

r(t)={0,t<0

{t, t≥0

A ramp signal starts at t=0 and increases linearly with time 't'.

14. Define periodic signal. and nonperiodic signal.

A signal is said to be periodic ,if it exhibits periodicity.i.e.,

X(t +T)=x(t), for all values of t.

Periodic signal has the property that it is unchanged by a time shift of T.

A signal that does not satisfy the above periodicity property is called an aperiodic signal.

15. Define even and odd signal ?

A discrete time signal is said to be even when,

x[-n]=x[n].

The continuous time signal is said to be even when,

x(-t)= x(t)

For example,Cosωn is an even signal.

The discrete time signal is said to be odd when

x[-n]= -x[n]

The continuous time signal is said to be odd when

x(-t)= -x(t)

Odd signals are also known as nonsymmetrical signal.

Sine wave signal is an odd signal.

16. Define Energy and power signal.

A signal is said to be energy signal if it have finite energy and zero power.

A signal is said to be power signal if it have infinite energy and finite power.

If the above two conditions are not satisfied then the signal is said to be neigther energy nor power signal

12.Define unit pulse function.

Unit pulse function ∏(t) is obtained from unit step signals

∏(t)=u(t+1/2)- u(t-1/2)

The signals u(t+1/2) and u(t-1/2) are the unit step signals shifted by 1/2units in the time axis towards the left and right ,respectively.

13.Define continuous time complex exponential signal.

The continuous time complex exponential signal is of the form

$x(t)=Ce^{at}$

where c and a are complex numbers.

14.What is continuous time real exponential signal.

Continuous time real exponential signal is defined by

$x(t)=Ce^{at}$

where c and a are complex numbers. If c and a are real ,then it is called as real exponential.

15.What is continuous time growing exponential signal?

Continuous time growing exponential signal is defined as

$x(t)=Ce^{at}$

where c and a are complex numbers.

If a is positive,as t increases , then x(t) is a growing exponential.

16.What is continuous time decaying exponential?

Continuous time growing exponential signal is defined as

$x(t)=Ce^{at}$

where c and a are complex numbers.

If a is negative, as t increases, then x(t) is a decaying exponential.

17.What are the types of Fourier series?

1. Exponential Fourier series
2. Trigonometric Fourier series

18.Write down the exponential form of the fourier series representation of a periodic signal?

$x(t)=\sum a_k e^{jk\omega ot}$

Here the summation is taken from $-\infty$ to ∞.

$a_k=1/T \int x(t) e^{-jk\omega ot}$

Here the integration is taken from 0 to T.

The set of coefficients $\{ a_k\}$ are often called the fourier series coefficients or spectral coefficients.

The coefficient a_o is the dc or constant component of x(t).

19.Write down the trigonometric form of the fourier series representation of a periodic signal?

$x(t)= a_o+\sum [a_n \cos n\omega ot + b_n \sin n\omega ot]$

where

a_o=1/T ∫ x(t) dt

a_n =1/T ∫ x(t)cos nωot dt

b_n=1/T ∫ x(t)cos nωot dt

20.Write short notes on dirichlets conditions for fourier series.

a. x(t) must be absolutely integrable
b. The function x(t) should be single valued within the interval T.
c. The function x(t) should have finite number of discontinuities in any finite interval of time T.
d. The function x(t) should have finite number of maxima &minima in the interval T.

21.State Time Shifting property in relation to fourier series.

$x(t-to) \xrightarrow{FS} a_k e^{-jk\omega ot}$

Time shifting property states that; when a periodic signal is shifted in time, the magnitudes of its fourier series coefficients, remain unaltered.

22.State parseval's theorem for continuous time periodic signals.

Parseval's relation for continuous time periodic signals is

$1/T \int |x(t)^2| \ dt = \sum | a_k^2 |$

Parseval's relation states that the total average power in a periodic signal equals the sum of the average power in all of its harmonic components.

Part B(6 Marks)

1 Explain in detail elementary DT signal.

Discrete time Unit impulse is defined as

$\delta [n]=$ {0, $n\neq 0$
{1, n=0

Unit impulse is also known as unit sample.

Discrete time unit step signal is defined by

U[n]={0,n=0
{1,n>= 0

Continuous time unit impulse is defined as

$\delta(t)=\{1, t=0$

$\{0, t \neq 0$

Continuous time Unit step signal is defined as

$U(t)=\{0, t<0$

$\{1, t\geq 0$

Continuous time unit ramp function is defined by

$r(t)=\{0, t<0$

$\{t, t\geq 0$

A ramp signal starts at t=0 and increases linearly with time ‘t’.

2. Find the energy of the signal $x(n) = (½)^n u(n)$.

Given: $x(n) = (½)^n u(n)$

$$E = \underset{N\to\alpha}{Lt} \sum_{n=-N}^{N} |x(n)|^2$$

$$= \underset{N\to\alpha}{Lt} \sum_{n=-N}^{N} |(½)^n u(n)|^2$$

$$= \underset{N\to\alpha}{Lt} \sum_{n=0}^{N} (½)^{2n}$$

$$= \underset{N\to\alpha}{Lt} \sum_{n=0}^{N} (1/4)^n \quad \alpha$$

$$E = \frac{1}{1-0.25}$$

$$E = \frac{4}{3}$$

3. Explain in detail complex exponential CT signal.

The continuous time complex exponential signal is of the form

$x(t)=Ce^{at}$

where c and a are complex numbers.

Continuous time real exponential signal is defined by

$$x(t)=Ce^{at}$$

where c and a are complex numbers. If c and a are real ,then it is called as real exponential.

Continuous time growing exponential signal is defined as

$$x(t)=Ce^{at}$$

where c and a are complex numbers.

If a is positive,as t increases , then x(t) is a growing exponential.

Continuous time growing exponential signal is defined as

$$x(t)=Ce^{at}$$

where c and a are complex numbers.

If a is negative, as t increases, then x(t) is a decaying exponential.

4.Find the odd and even components of the signal cost + sint + cost sint.

Given:

$$X(t) = \cos t + \sin t + \cos t \sin t$$

$$X(-t)= \cos(-t) + \sin(-t) + \cos(-t) \sin(-t)$$

$$= \cos t - \sin t - \cos t \sin t$$

$$Xe(t)= \frac{1}{2}\left[x(t)+x(-t)\right]$$

$$= \frac{1}{2}\left[\cos t + \sin t + \cos t \sin t + \cos t - \sin t - \cos t \sin t\right]$$

$$= \frac{1}{2}\left[2\cos t + 2\cos t \sin t\right]$$

$$Xe(t)= \cos t + \cos t \sin t.$$

$$Xo(t)= \frac{1}{2}\left[x(t)-x(-t)\right]$$

$$=\frac{1}{2}\left[\cos t + \sin t + \cos t \sin t - \cos t + \sin t - \cos t \sin t\right]$$

$$=\frac{1}{2}\left[2\sin t\right]$$

$$Xo(t)= \sin t$$

$$Xe(t)= \cos t + \cos t \sin t$$

$$Xo(t)= \sin t$$

5. Find the odd and even components of the x(n)={1,2,2,3,4}.

Given: x(n)={1,2,2,3,4}.

Solution:

$$x(n) = \{1,2,2,3,4\}.$$

$$X(-n) = \{4,3,2,2,1\}.$$

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

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

$$= \frac{1}{2}\{1+4, \quad 2+3, \; 2+2, \; 3+2, \; 4+1\}$$

$$=\frac{1}{2}\{5 \;, 5 \;, 4, 5, 5\}$$

$$= \{2.5, 2.5, 2, 2.5, 2.5\}$$

$$X_o(n) = \frac{1}{2}\{x(n)-x(-n)\}$$

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

$$= \frac{1}{2}\{1-4, \quad 2-3, \; 2-2, \; 3-2, \; 4-1\}$$

$$=\frac{1}{2}\{-3 \;, -1 \;, 0, 1, 3\}$$

$$= \{-1.5, -0.5, 0, 0.5, 1.5\}$$

$$x(n) = \{1, \quad 2, \quad 2, \quad 3, \quad 4\}.$$

$$X_e(n) = \{2.5, \; 2.5, \; 2, \quad 2.5, \quad 2.5\}$$

$$X_o(n) = \{-1.5, \quad -0.5, \quad 0, \quad 0.5, \; 1.5\}$$

6.Find the energy of the signal e^{-2t} u(t).

Given: $x(t) = e^{-2t}\,u(t)$

$$E = \underset{T\to\alpha}{Lt} \int_{-T/2}^{T/2} |x(t)|^2 \, dt$$

$$= \underset{T\to\alpha}{Lt} \int_{0}^{T/2} |e^{-2t}|^2 \, dt$$

$$= \underset{T\to\alpha}{Lt} \int_{0}^{T/2} |e^{-2t}|^2 \, dt$$

$$= \underset{T\to\alpha}{Lt} \int_{0}^{T/2} e^{-4t} dt \ \alpha$$

$$\underset{T\to\alpha}{Lt} \left[\frac{e^{-4t}}{-4} \right]_0^{T/2}$$

$$= \underset{T\to\alpha}{Lt} \frac{-1}{4} \left[e^{-2T} - 1 \right]$$

$$E = \frac{-1}{4} [0 - 1]$$

$$\text{Energy, } E = \frac{1}{4}$$

7.Determine the power of the signal e^{-2t} u(t).

Solution:

$$P = \underset{T\to\alpha}{Lt} \frac{1}{T} \int_{-T/2}^{T/2} |x(t)|^2 \, dt$$

$$= \underset{T\to\alpha}{Lt} \frac{1}{T} \int_{0}^{T/2} |e^{-2t}|^2 \, dt$$

$$= \underset{T\to\alpha}{Lt} \frac{1}{T} \int_{0}^{T/2} |e^{-2t}|^2 \, dt$$

$$= \underset{T\to\alpha}{Lt} \frac{1}{T} \int_{0}^{T/2} e^{-4t} dt \ \alpha$$

$$\underset{T\to\alpha}{Lt}\frac{1}{T}\left[\frac{e^{-4t}}{-4}\right]_0^{T/2}$$

$$=\underset{T\to\alpha}{Lt}\ \frac{1}{T}\ \frac{-1}{4}\left[e^{-2T}-1\right]$$

$$P=\ \underset{T\to\alpha}{Lt}\ \frac{1}{4T}\left[e^{-2T}-e^{0}\right]$$

P= 0

Power , P = 0

.

8. Test Whether the signal y(t) = ax(t) + b is linear or non linear.

Solution:

y(t) = ax(t) + b

$y_1(t)$ is the output of input signal $x_1(t)$

$y_1(t) = a\,x_1(t) + b$

similarly, $y_2(t)$ is the output of input signal $x_2(t)$

$y_2(t) = a\,x_2(t) + b$

Now $x_1(t)$ and $x_2(t)$ related with $x_3(t)$

ie , $x_3(t) = a\,x_1(t) + b\,x_2(t)$

The output $y_3(t)$ defined as $y_3(t) = a\,x_3(t) + b$

$= a\,[a\,x_1(t) + b\,x_2(t)] + b$

$= a\,.\,a\,x_1(t) + a.\,b\,x_2(t) + b$

$\neq a\ y_1(t) + b\,y_2(t)$

Hence the system is non linear.

9. Find the power and rms value of signal x(t)=20cos2πt.

Given: x(t)=20cos2πt.

$$P=\underset{T\to\alpha}{Lt}\frac{1}{2T}\int_{-T}^{T}\left|x(t)\right|^{2}dt$$

$$= \quad \underset{T\to\alpha}{Lt}\frac{1}{2T}\int_{-T}^{T}\left|20\cos 2\pi t.\right|^{2} dt$$

$$= \quad \underset{T\to\alpha}{Lt}\frac{1}{2T}\int_{-T}^{T}400\cos^{2}2\pi t.\ dt$$

$$= \underset{T\to\alpha}{Lt}\frac{400}{4T}\int_{-T}^{T}(1+\cos 4\pi t)(dt\ \ \alpha$$

$$\underset{T\to\alpha}{Lt}\frac{400}{4T}\int_{-T}^{T}1dt + 0$$

$$=\underset{T\to\alpha}{Lt}\frac{400}{4T}\left[T-(-T)\right]$$

$$P = \underset{T\to\alpha}{Lt}\frac{400}{4T}\left[2T\right]$$

Power P= 200.

The r.m.s value = $\sqrt{200}$ = 14.14.

***10.* Explain the following signals.**

***(i) P*eriodic and aperiodic**

(ii) Even and odd

*(i) P*eriodic and aperiodic

A signal is said to be periodic ,if it exhibits periodicity.i.e.,

X(t +T)=x(t), for all values of t.

Periodic signal has the property that it is unchanged by a time shift of T.

A signal that does not satisfy the above periodicity property is called an aperiodic signal.

(ii) Even and odd

A discrete time signal is said to be even when,

x[-n]=x[n].

The continuous time signal is said to be even when,

x(-t)= x(t)

For example,Cosωn is an even signal.

The discrete time signal is said to be odd when

$x[-n]= -x[n]$

The continuous time signal is said to be odd when

$x(-t)= -x(t)$

Odd signals are also known as nonsymmetrical signal.
Sine wave signal is an odd signal.

Part C (10 marks)

1 .Find the trigonometric fourier series for half wave rectified sine wave.

Solution

$$x(t)= a_o+\sum_{n=1}^{\alpha} a_n \cos n\omega_0 t + \sum_{n=1}^{\alpha} b_n \sin n\omega_0 t$$

where

$a_o=1/T \int x(t)\, dt$

$a_n =1/T \int x(t)\cos n\omega o t\, dt$

$b_n=1/T \int x(t)\cos n\omega o t\, dt$

$x(t)=\{\sin t, \quad \pi > t >= 0$

$\quad 0, \quad 2\pi > t > \pi$

The fundamental period ,$T= 2\pi$

The fundamental frequency $\omega_0 = \dfrac{2\pi}{T} = 1$,

$$a_0 = \frac{1}{T}\int_{t_0}^{t_0+T} x(t)dt$$

$$= \frac{1}{2\pi}\int_{0_0}^{\pi} \sin t dt$$

$$= \frac{1}{2\pi}\left[-\cos t\right] \Big|_0^{\pi}$$

$$= \frac{1}{\pi}$$

$$a_n = \frac{2}{T}\int_{t_0}^{t_0+T} x(t)\cos n\omega_0 t dt$$

$$= \frac{2}{2\pi}\int_{t_0}^{t_0+T} \sin t \cos ntdt$$

$$= \frac{1}{\pi}\int_0^{\pi} \frac{1}{2}\left[\sin(n+1)t + \sin(1-n)t\right]dt$$

$$= \frac{1}{2\pi}\int_0^{\pi} \sin(n+1)tdt + \frac{1}{2\pi}\int_0^{\pi} \sin(1-n)t \, \mathrm{dt}$$

$$= \frac{1}{\pi}\left[\frac{1+(-1)^n}{1-n^2}\right]$$

To find b_n

$$b_n =_n = \frac{2}{T}\int_{t_0}^{t_0+T} x(t)\sin n\omega_0 t dt$$

$$= \frac{2}{2\pi}\int_{t_0}^{t_0+T} \sin t \sin ntdt$$

$$= \frac{1}{\pi}\int_0^{\pi} \frac{1}{2}\left[\cos(n-1)t - \cos(n+1)t\right]dt$$

$$= \frac{1}{2\pi}\int_0^{\pi} \sin(n+1)tdt + \frac{1}{2\pi}\int_0^{\pi} \sin(1-n)t \, \mathrm{dt}$$

$$= \frac{1}{2\pi}\left[\frac{\sin(n-1)\pi - \sin 0}{(n-1)} - \frac{\sin(n+1)\pi - \sin 0}{(n+1)}\right]$$

$$= 0$$

$$X(t) = \frac{1}{\pi} + \frac{1}{\pi}\sum\left[\frac{1+(-1)^n}{1-n^2}\cos n\omega_0 t\right] + \frac{1}{2}\sin \omega_0 t$$

2.Find the trigonometric fourier series representation of a periodic square wave
x(t) = 1, for the interval (0 , π).
= 0,for the interval (π , 2π)

$$x(t) = a_o + \sum_{n=1}^{\alpha} a_n \cos n\omega_0 t + \sum_{n=1}^{\alpha} b_n \sin n\omega_0 t$$

where

$a_o = 1/T \int x(t)\, dt$

$a_n = 1/T \int x(t) \cos n\omega o t\, dt$

$b_n = 1/T \int x(t) \cos n\omega o t\, dt$

$x(t) = \{1, \quad \pi > t >= 0$

$\quad -1 \quad , \quad 2\pi > t > \pi$

The fundamental period ,T= 2π

The fundamental frequency $\omega_0 = \dfrac{2\pi}{T} = 1$,

$$a_0 = \frac{1}{T} \int_{t_0}^{t_0+T} x(t)dt$$

$$= \frac{1}{2\pi} \int_{0_0}^{\pi} 1dt + \frac{1}{2\pi} \int_{\pi}^{2\pi} (-1)dt$$

$= 0$

$$a_n = \frac{2}{T} \int_{t_0}^{t_0+T} x(t) \cos n\omega_0 t dt$$

$$= \frac{2}{2\pi} \int_{0_0}^{\pi} 1 \cos ntdt + \frac{2}{2\pi} \int_{\pi}^{2\pi} (-1) \cos ntdt$$

$$= \frac{1}{n\pi} \left[(\sin n\pi - \sin 0) - (\sin 2n\pi - \sin n\pi) \right]$$

$= 0$

To find b_n

$$b_n =_n = \frac{2}{T} \int_{t_0}^{t_0+T} x(t) \sin n\omega_0 t dt$$

$$= \frac{2}{2\pi} \int_{t_0}^{t_0+T} \sin t \sin ntdt$$

$$=\frac{1}{\pi}\int_{0}^{\pi}1.\sin ntdt+\frac{1}{\pi}\int_{\pi}^{2\pi}(-1).\sin ntdt$$

$$=\frac{1}{n\pi}\left[-(\cos n\pi-\cos 0)+(\cos n2\pi-\cos n\pi)\right]$$

$$=\frac{1}{n\pi}\left\{-\left[(-1)^{n}-1\right]+\left[1-(-1)^{n}\right]\right\}$$

$$=\frac{2}{n\pi}\left[1-(-1)^{n}\right]$$

$$X(t)=\sum_{n=1}^{\alpha}\frac{2}{n\pi}\left[1-(-1)^{n}\right]\sin nt$$

3. Test Whether the signal x(n) = (½) ^{n} ***u(n) energy or power signal.***

Given: x(n) = (½) ^{n} u(n)

$$E=\underset{N\to\alpha}{Lt}\sum_{n=-N}^{N}|x(n)|^{2}$$

$$=\underset{N\to\alpha}{Lt}\sum_{n=-N}^{N}|(½)^{n}\ u(n)|^{2}$$

$$=\underset{N\to\alpha}{Lt}\sum_{n=0}^{N}(½)^{2n}$$

$$=\underset{N\to\alpha}{Lt}\sum_{n=0}^{N}(1/4)^{n}\quad \alpha$$

$$=\frac{1}{1-0.25}=\frac{4}{3}<\alpha$$

$$P = \underset{N\to\alpha}{Lt} \frac{1}{2N+1} \sum_{n=-N}^{N} | x(n) |^2$$

$$= \underset{N\to\alpha}{Lt} \frac{1}{2N+1} \sum_{n=-N}^{N} | (1/2)^n u(n) |^2$$

$$= \underset{N\to\alpha}{Lt} \frac{1}{2N+1} \sum_{n=-N}^{N} (1/2)^{2n}$$

$$= \underset{N\to\alpha}{Lt} \frac{1}{2N+1} \sum_{n=-N}^{N} (1/4)^n$$

$$= \frac{1}{\alpha} = 0$$

E=finite and P=0

Hence the signal is Energy signal

Energy, E= $\frac{1}{4}$

4. Test Whether the signal $x(t) = e^{-2t}$ u(t).) energy or power signal.

Given: $x(t) = e^{-at}$ u(t)

$$E = \underset{T\to\alpha}{Lt} \int_{-T/2}^{T/2} |x(t)|^2 \, dt$$

$$= \underset{T\to\alpha}{Lt} \int_{0}^{T/2} |e^{-2t}|^2 \, dt$$

$$= \underset{T\to\alpha}{Lt} \int_{0}^{T/2} |e^{-2t}|^2 \, dt$$

$$= \underset{T\to\alpha}{Lt} \int_{0}^{T/2} e^{-4t} dt \ \alpha$$

$$\underset{T\to\alpha}{Lt} \left[\frac{e^{-4t}}{-4} \right]_0^{T/2}$$

$$= \underset{T\to\alpha}{Lt} \frac{-1}{4} \left[e^{-2T} - 1 \right]$$

$$E= \frac{-1}{4}[0-1]$$

$$\text{Energy, } E= \frac{1}{4}$$

$$P= \underset{T\to\alpha}{Lt}\frac{1}{T}\int_{-T/2}^{T/2}|x(t)|^2\, dt$$

$$= \underset{T\to\alpha}{Lt}\frac{1}{T}\int_{0}^{T/2}|e^{-2t}|^2\, dt$$

$$= \underset{T\to\alpha}{Lt}\frac{1}{T}\int_{0}^{T/2}|e^{-2t}|^2\, dt$$

$$= \underset{T\to\alpha}{Lt}\frac{1}{T}\int_{0}^{T/2}e^{-4t}dt\ \alpha$$

$$\underset{T\to\alpha}{Lt}\frac{1}{T}\left[\frac{e^{-4t}}{-4}\right]_0^{T/2}$$

$$=\underset{T\to\alpha}{Lt}\ \frac{1}{T}\ \frac{-1}{4}\left[e^{-2T}-1\right]$$

$$P= \underset{T\to\alpha}{Lt}\ \frac{1}{4T}\left[e^{-2T}-e^{0}\right]$$

$$P= 0$$

Hence the signal is Energy signal

5. Explain in detail different classification of signals.

signal

Signal is a physical quantity that varies with respect to time , space or any other independent variable.

Or

It is a mathematical representation of the system

Eg y(t) = t. and x(t)= sin t.

Signal is mainly classified as

(i).Continuous time signal

(ii).Discrete time signal

continuous time signals

Continuous time signals are defined for a continuous of values of the independent variable. In the case of continuous time signals the independent variable is continuous. For example:

(vii) A speech signal as a function of time

(viii) Atmospheric pressure as a function of altitude

Classification of continuous time signal:

(vii) Periodic and Aperiodic signal

(viii) Even and Odd signal

Discrete time signals

Discrete time signals are defined only at discrete times, and for these signals, the independent variable takes on only a discrete set of values.

Classification of discrete time signal:

1.Periodic and Aperiodic signal

2.Even and Odd signal

Elementary signal

Discrete time Unit impulse is defined as

$$\delta[n] = \begin{cases} 0, & n \neq 0 \\ 1, & n=0 \end{cases}$$

Unit impulse is also known as unit sample.

Discrete time unit step signal is defined by

$$U[n] = \begin{cases} 0, n=0 \\ 1, n>= 0 \end{cases}$$

Continuous time unit impulse is defined as

$$\delta(t) = \begin{cases} 1, t=0 \\ 0, t \neq 0 \end{cases}$$

Continuous time Unit step signal is defined as

$$U(t) = \begin{cases} 0, t<0 \\ 1, t \geq 0 \end{cases}$$

Continuous time unit ramp function is defined by

$$r(t) = \begin{cases} 0, t<0 \\ t, t \geq 0 \end{cases}$$

A ramp signal starts at t=0 and increases linearly with time ‘t’

Complex exponential CT signal.

The continuous time complex exponential signal is of the form

$x(t)=Ce^{at}$

where c and a are complex numbers.

Continuous time real exponential signal is defined by

$x(t)=Ce^{at}$

where c and a are complex numbers. If c and a are real ,then it is called as real exponential.

Continuous time growing exponential signal is defined as

$x(t)=Ce^{at}$

where c and a are complex numbers.

If a is positive,as t increases , then x(t) is a growing exponential.

Continuous time growing exponential signal is defined as

$x(t)=Ce^{at}$

where c and a are complex numbers.

If a is negative, as t increases, then x(t) is a decaying exponential.