UNIT I

CLASSIFICATION OF SIGNALS AND SYSTEMS

1.What are the major classification of signals?

Continuous time and Discrete time signals and they can be classified as

a.Deterministic and Random Signals

b.Even an Odd Signals

c.Energy and power signals

d.Periodic and Aperiodic signals

2.Differentiate Deterministic signal from Random signal?

Deterministic signal can be represented using a mathematic formula where as random signal varies randomly which cannot be expressed

3.What is energy signal?

A signal is said to be energy signal if energy is finite and power is 0.

$0<E<\infty$

4.What is power signal?

A signal x(t) is said to be power signal if power is finite and the energy is infinite

$0<p<\infty$

5.Give the mathematic representation of Unit and Ramp sequence?

U(t)={1,t>0.

R(t)={t,t>0.

6.Define periodic signal with an example?

A signal X(t) is periodic if x(t)=x(t+T) for all values of t .The smallest value of T for which the condition is satisfied is called fundamental period.

Ex:Sinusoidal signal

7.What is even signal?

A signal X(t) is said to be even if x(t)=x(-t)

Ex:x(t)=Acosωt

8.What is odd signal?

A signal x(t) is said to be odd if x(t)=-x(-t).

Ex:X(t)=Asinωt

9.Define symmetric and Antisymmetric signal?

Symmetric Signal

It is a even signal and a signal X(t) is said to be symmetric if x(t)=x(-t)

Ex:x(t)=Acosωt

AntiSymmetric Signal

It is a odd signal and a signal X(t) is said to be antisymmetric if

x(t)=-x(-t)

Ex:$x(t)=A\sin\omega t$

10.Give the formula to determine odd and even part of an arbitrary signals?

$X(t)=x_e(t)+x_o(t)$

$x_e(t)=1/2[x(t)+x(-t)]$

$x_o(t)=1/2[x(t)-x(-t)]$

11.Give the precedence rule for combined time scaling and time shifting operation?

For combined time scaling and time shifting operation

Time shifting is carried out first next time scaling is carried out.

12.How are systems classified?

Static and dynamic system

Causal and non causal system

Linear and non linear system

Time variant and time invariant system

Stable and unstable system

13.Define causal system?

A causal system is non anticipating system.output of the system depend only on past and present inputs and not on future inputs.

14.Differentiate static and dynamic system?

Output of the static system is defined for a particular time so its memoryless where as Dynamic system is defined for values at specific time and other time

15. Define time invariant system.?

A system is said to be time invariant if the input/output characteristic do not change with time.

16.Define a continuous time LTI system?

A system is said to be a continuous time LTI system if it follows the property of linearity and time invariance.

17. Define a non causal system.?

A non causal system is one whose output depends on future input.

18. Define a non linear system.?

A system which does not obeys the principle of superposition that is weighted sum of inputs equal to weighted sum of outputs is said to be a non linear system

19.Determine whether the system described by the following relationship y(t)=x(-t) is causal?

For t=-1,y(-1)=x(1)

So for negative values of time t the output depends on future input .therefore the system is non causal

20. Determine whether the system described by the following relationship y(t)=x(-t) is linear?

$Y_1(t)=ax_1(-t)$

$Y_2(t)=bx_2(-t)$

So on adding both $Y(t)= ax_1(-t)+bx_2(-t)$

So its linear

UNIT 2

ANALYSIS OF CONTINUOUS TIME SIGNALS

1.Define continuous time system?

A continous time system is a system in which continuous time input signals are applied and results in continuous time output signals.

2.Define fourier transform pair?

$X(j\omega) = \int x(t)e^{-j\omega t} dt$

$X(t)=(1/2\Pi) \int x(t)e^{j\omega t} d\omega$

3.Write short notes on dirichlets condition for fourier transform ?

i)x(t) be absolutely integrable

ii)x(t) have finite number of maxima and minima within any finite interval

iii)x(t) have a finite number of discontinuities within any interval

4. Explain how aperiodic signals can be expressed using fouruier transform?

Consider an aperiodic signal x(t) and its fourier transform is defined by

$X(j\omega) = \int x(t)e^{-j\omega t}\,dt$

And inverse is $X(t)=(1/2\Pi) \int x(t)e^{j\omega t}\,d\omega$

5.State convolution property in relation to fourier transform?

$Y(t)=x(t)*h(t)$

$Y(j\omega)=X(j\omega)H(j\omega)$

6.State parsevals relation for continuous time fourier transform?

If x(t) and X(jω) are fourier transform pair then

$\int |x(t)^2|dt=(1/2\Pi j) \int |X(j\omega)|^2\ d\omega$

7.Give the formulas to find out exponential fourier transform?

$X(t)=\sum a_k e^{jk\omega t}\,dt.$

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

8.Give Time shifting property?

If $F.T[x(t)] = a_k$

Then $F.T[x(t-t_0)]=e^{-jk\omega t}{}_0\, a_k$

9.Give the formulas to find angle and phase of fourier coefficient a+bj?

Magnitude = $\sqrt{(a^2+b^2)}$

Phase $=\tan^{-1}(b/a)$

10.What is the use of laplace transform?

Its an mathematical tool used for analyzing signals specially its used to analyse unstable systems.

11.what are the types of laplace transform?

a.Unilateral laplace transform

b.Bilateral laplace transform

12.Define bilateral and unilateral transform?

Bilateral Transform: $X(s)=\int x(t)e^{-st}dt$

Integration is taken from $-\alpha$ to $+\alpha$

Unilateral Transform: $X(s)=\int x(t)e^{-st}dt$

Integration is taken from 0 to $+\alpha$

13.Define inverse laplace transform?

$X(t)=(1/2\Pi j)\int X(s)\, e^{st} ds.$

Integration is taken from $\sigma-j\alpha$ to $\sigma+j\alpha$

14.State linearity property of laplacetransform?

Let L.T(x1(t))=X1(S) and L.T (x2(t))=X2(S)

Then L.T (ax1(t)+bx2(t))=aX1(S)+bX2(S).

15. Give Time shifting property of laplace transform?

If L.T[x(t)] = X(S)

Then $L.T[x(t-t_0)] = e^{-st_0} X(S)$

16.Region of Convergence of laplace transform?

The range of values of s for which the integral $\int x(t)e^{-st}dt$ converges is reffered to as ROC of laplace transform

17.What is Pole Zero Plot?

The representation of X(S) through its poles and zeroes in the s plane is referred to as pole zero plot.

18.Define stable system?

When the system produces Bounded Output for Bounded Input (BIBO) then the system is stable , is stable the magnitude of the system will be finite.

19.Define Causal system?

A Causal system generates output depending on present and past inputs .A causal system is non anticipatory.

20.State initial value theorem and final value theorem?

$X(0)=Lt(s->\alpha)SX(S)$ (I.V.T)

$X(\alpha)=Lt(s->0)SX(S)$ (F.V.T)

UNIT . 3

LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEM

1.Define LTI system?

A system obeys the properties of linearity and time invariance is said to be an LTI system

2.What is overall impulse response of system with impulse response h1(t) and h2(t) in series?

Ans:h(t)=h1(t)*h2(t)

3.Write input output relation of LTI system in time and frequency domain?

$Y(t)=x(t)*h(t) = \int x(\tau)h(t- \tau)$

And $Y(j\omega)=X(j\omega)H(j\omega)$

4.Is the system defined by $y(t)=x(2t)$ is time invariant or not?

Here $y(t,T)=x(2t-2T)$

And $y(t-2T)=x(2t-T)$

So its time variant

5.What is impulse response?

i.Its response to unit impulse signal

ii.its denoted by h(t) and is obtained by taking inverse laplace transform of system function

6.A LTI system is given by $y'(t) + ay(t) = x(t)$ .Find frequency response?

$H(j\omega)=Y(j\omega)/X(j\omega)==1/(j\omega+a)$

7. A LTI system is given by $y'(t) + ay(t) = x(t)$ .Find impulse response of the system?

$H(s)=1/(s+a)$

$L^{-1}(H(s))=e^{-at}u(t)$

8.List the drawbacks in transfer function?

i.It describes zero state response of system

ii.it describes relation between input and output of system

iii.its limited to single input and single output

iv.Its applicable for LTI systems

.Why integrators are preferred over differentiators?

i .Differentiators are sensitive to noise and error.

ii.Its difficult to implement a differentiator

10.Define system transfer function?

$H(s) = \frac{\text{Laplace transform of the output}}{\text{Laplace transform of input}}$

11.Determine the frequency response of system $h(t) = \delta(t) - 2e^{-2t}u(t)$?

Sol: $F[h(t)] = 1 - 2/(j\omega+2)$

12.What is eigen value and eigen function?

$y(t)=e^{j\omega t} H(j\omega)$

$e^{j\omega t}$ -> eigen function

$H(j\omega)$ ->eigen value

13.What is impulse response of $y(t) = x(t-t_0)$?

Sol: taking laplace transform $Y(s)=e^{-st_0} X(s)$

$H(S)=Y(s)/X(s)= e^{-st_0}$

Taking L^{-1} => $h(t)= \delta(t - t_0)$

14.What are properties of convolution?

i.Associative

ii.Commutative

iii.Distributive

15.The impulse response of $h(t)=e^{-3t}u(t)$. find Transfer function ?

Sol: $H(s)=1/(S+3)$

16.If the impulse response is $h(t)= \delta (t-a)$, find output of x(t) ?

Sol: $H(s)= e^{-as} =Y(s)/X(s)$

So $y(t)=x(t-a)$

17.Define realization structure?

The block diagram representation of a differential equation is called realization structure.These diagram indicate the manner in which the computations are performed.

18.What are the different types of structure realization?

i.Direct form 1

ii.Direct form 11

iii.Cascade realisation

iv.Parallel realisation

19.What is Natural response?

This is output provided by system only due to initial conditions.Input is zero for natural response.Hence it is also called Zero input response.

20.What is forced response?

This is output produced by system only due to input.Initial conditions are considered to be zero for forced response.

UNIT 4

ANALYSIS OF DISCRETE TIME SYSTEMS

1.What is meant by step response of Discrete time system?

The output of the system y(n) is obtained for the unit step input u(n) then it is said to be step response of the system.

2.Define transfer function of the discrete time system?

It is the ratio of output to input

$H(z)=Y(z)/X(z)$

3.Define impulse response of DT system?

Impulse response is the output response obtained by the system whwn unit impulse is applied at the input , and is defined by the term h(n).

4.State the significance of Differential equation?

The input and output behavior of the DT system can be characterized with the help of linear constant coefficient differential equations.

5.Write the difference equation of Discrete Time system?

$Y(n)= -\sum a_k y(n-k) + \sum b_k x(n-k)$

6.Define frequency respose of DT system?

The frequency response is obtaine from the transfer function by replacing z by $e^{j\omega}$

$H(z)=Y(z)/X(z)$, where $z = e^{j\omega}$

7.What is the condition for stable system?

A LTI system is stable if

$\sum |h(n)| < \alpha$

Summation is absolutely summable

8.Give the blocks used in block diagram representation?

Scalar multipliers,adders and multipliers.

9.State Significance of Block diagram representation

i.More efficient way of system description

ii.It indicates how individual calculations can be performed.

10.What are the properties of Convolution?

i.Associative

ii.Commutative

iii.Distributive

11.Define causal system?

For an LTI system to be causal $h(n)=0$,$n<0$.

12.What is the impulse response of the system $y(t)=x(t-t_0)$?

Sol: $h(t)= \delta(t-t_0)$

13.What is the Condition for causality if H(z) is given?

i.ROC lies outside the circle outside the outer most pole.

ii.Order of numerator polynomial cant be greater than numerator polynomial.

14.What is the condition for stability if H(z) is given?

A Discrete LTI system with rational system function H(z) is stable if all the poles of H(z) lies in unit circle.(ie) they should have magnitude less than one.

15.check whether H(Z) is causal or not ,$H(z)= (z^3+1)/(z^2+z)$?

Not causal because numerator polynomial order > denominator order polynomial

16.Check whether System is stable ,$H(z)=z/(z-a)$,$|a|<1$?

The system is stable because the poles at z=a lies inside unit circle

17.Give the time shifting property in Z transform?

$Z.T[x(n-1)]=Z^{-1}X(z)$

18.Determine the transfer function of y(n)-y(n-1)=x(n)-x(n-2)?

Sol: $H(z) = (1-z^{-2})/(1-z^{-1})$

19.State Commutative property of convolution?

$x(t)*h(t)=h(t)*x(t)$

20.State Associative property of convolution?

$[x(t)*h1(t)]*h2(t)=x(t)*[h1(t)*h2(t)]$

UNIT . 5

LINEAR TIME INVARIANT DISCRETE TIME SYSTEM

1.How a DT system can be represented?

The DT system can be represented either by block diagram or by difference equation method.

2.What are the classification of system based on unit sample response?

i.Finite impulse response

ii.Infinite impulse response

3.what is FIR system?

If the system have finite duration impulse response then the system is said to be FIR system.

4.What is IIR system?

If the system have infinite duration impulse response then the system is said to be IIR system.

5.What is recursive system?

If the present output is dependent on present and past value of the inputs then the system is said to be recursive system.

6.What is non recursive system?

If the present output is dependent on present and past value of the inputs and the past value of output then the system is said to be non recursive system.

7.Define realization structure?

The block diagram representation of a differential equation is called realization structure.These diagram indicate the manner in which the computations are performed.

8.What are the different types of structure realization?

i.Direct form 1

ii.Direct form 11

iii.Cascade realisation

iv.Parallel realisation

9.What is Natural response?

This is output provided by system only due to initial conditions.Input is zero for natural response.Hence it is also called Zero input response.

10.What is forced response?

This is output produced by system only due to input.Initial conditions are considered to be zero for forced response.

11.What is complete response?

The Complete response is the sum of both natural response and forced response.

12.Give the formula to compute convolution?

$Y(n) = x(n)*h(n) = \sum x(k)h(n-k)$

13.What is canonic system?

A digital system structure is said to be canonic if the number of delays in the block diagram representation is equal to the order of the differential equation . (ie) the order of transfer function.

14.Why CT signals are represented by samples?

i.A CT signal cant be processed in digital processor

ii.To enable digital transmission of signals

15.What is meant by sampling?

Sampling is the process of converting CT signals into sequence of discrete samples where each sample representing amplitude of signal.

16.What is aliasing?

When high frequency interferes with low frequency and appears as low then the phenomenan is called aliasing.

17.what are the effects of aliasing?

Since the high frequency interferes with lower frequency a distortion occurs so the signal cant be recovered.

18.How aliasing can be eliminated?

Sampling rate is choosen such that sampling frequency > 2W ,(ie) using the help of an low pass filter we can overcome aliasing.

19.Give the state space representation of a system?

$H(Z)=C(ZI-A)^{-1}B+D$

20.What is state vector of a Discrete time system?

It is a N*1 column matrix (or vector) whose elements are stste variables of the system,(where N is the order of the system).It is denoted by Q(n).