ST. ANNE'S

COLLEGE OF ENGINEERING AND TECHNOLOGY

(Approved by AICTE, New Delhi. Affiliated to Anna University, Chennai)
(An ISO 9001: 2015 Certified Institution)
ANGUCHETTYPALAYAM, PANRUTI – 607 106.

QUESTION BANK

PERIOD : AUG 2020 – DEC 2020 **BATCH**:2019-2023

BRANCH : ECE **YEAR/SEM:**II/III

SUBJECT: EC8352-Signals And Systems

UNIT – I – CLASSIFICATION OF SIGNALS AND SYSTEMS

PART – A

1. **Define Signal**.

A signal is a function of one or more independent variables which contain some information.
Eg: Radio signal, TV signal, Telephone signal etc.

2. Define System.

A system is a set of elements or functional block that are connected together and produces an output in response to an input signal.
Eg: An audio amplifier, attenuator, TV set etc.

3. Define CT signals.

Continuous time signals are defined for all values of time. It is also called as an analog signal and is represented by x(t).
Eg: AC waveform, ECG etc.

4. Define DT signal.

Discrete time signals are defined at discrete instances of time. It is represented by x(n).
Eg: Amount deposited in a bank per month.

5. Give few examples for CT signals.

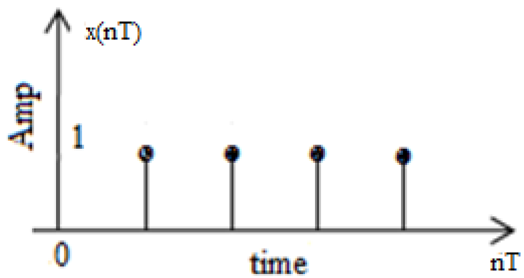
AC waveform, ECG, Temperature recorded over an interval of time etc.

6. Give few examples of DT signals.

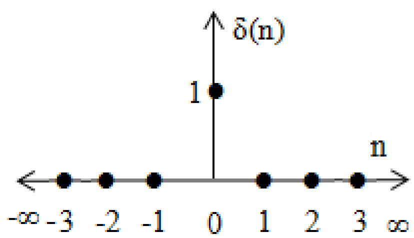
Amount deposited in a bank per month,

7. Define unit step, ramp and delta functions for CT.

Unit step function is defined as
U(t)= 1 for t >= 0
0 otherwise



Unit ramp function is defined as
r(t)= t for t>=0
0 for t<0
Unit delta function is defined as
δ(t)= 1 for t=0
0 otherwise



8. State the relation between step, ramp and delta functions (CT).

The relation ship between unit step and unit delta function is
δ(t)= u(t)
The relationship between delta and unit ramp function is
δ(t).dt = r(t)

9. State the classification of CT signals.

The CT signals are classified as follows
(i) Periodic and non periodic signals
(ii) Even and odd signals
(iii) Energy and power signals
(iv) Deterministic and random signals.

10. Define deterministic and random signals. [MAY/ JUNE 2013]

A deterministic signal is one which can be completely represented by

Mathematical equation at any time.In a deterministic signal there is no uncertainty with respect to its value at any time.

Eg: $x(t)=\cos\omega t$

$x(n)=2\pi fn$

A random signal is one which cannot be represented by any mathematical equation.

Eg: Noise generated in electronic components, transmission channels, cables etc.

11. Define power and energy signals. [APRIL/MAY 2013]

The signal x(t) is said to be power signal, if and only if the normalized average power p is finite and non-zero.

Ie. $0<p<4$

A signal x(t) is said to be energy signal if and only if the total normalized energy is finite and non-zero.

Ie. $0<E< 4$

12. Compare power and energy signals.

S.NO	**POWER SIGNAL**	**ENERGY SIGNAL**
1	The normalized average power is finite and non-zero	Total normalized energy is finite and non- zero.
2	Practical periodic signals are power signals	Non-periodic signals are energy signals

13. Define odd and even signal.

A DT signal x(n) is said to be an even signal if x(-n)=x(n) and an odd signal if x(-n)=-x(n).

A CT signal is x(t) is said to be an even signal if x(t)=x(-t) and an odd signal if x(-t)=-x(t).

14. Define periodic and aperiodic signals.

A signal is said to be periodic signal if it repeats at equal intervals. Aperiodic signals do not repeat at regular intervals.

- A CT signal which satisfies the equation x(t)=x(t+T0) is said to be periodic and a DT signal which satisfies the equation x(n)=x(n+N)is said to be periodic.

15. State the classification or characteristics of CT and DT systems.

The DT and CT systems are according to their characteristics as follows

(i). Linear and Non-Linear systems
(ii). Time invariant and Time varying systems.
(iii). Causal and Non causal systems.
(iv). Stable and unstable systems.
(v). Static and dynamic systems.
(vi). Inverse systems.

16. Define linear and non-linear systems.

A system is said to be linear if superposition theorem applies to that system. If it does not satisfy the superposition theorem, then it is said to be a nonlinear system.

17. Define Causal and non-Causal systems.

A system is said to be a causal if its output at anytime depends upon present and past inputs only.
A system is said to be non-causal system if its output depends upon future inputs also.

18. Define time invariant and time varying systems.

A system is time invariant if the time shift in the input signal results in corresponding time shift in the output.
A system which does not satisfy the above condition is time variant system.

19. Define stable and unstable systems.

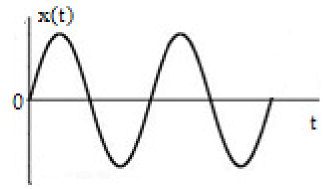
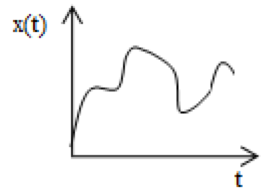
When the system produces bounded output for bounded input, then the system is called bounded input, bounded output stable.
A system which doesnot satisfy the above condition is called a unstable system.

20. Define Static and Dynamic system.

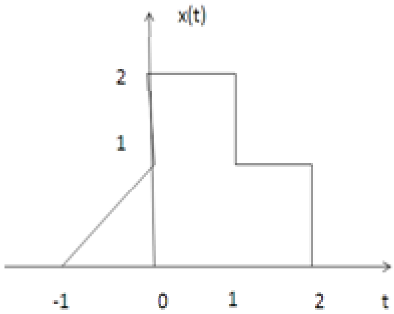
A system is said to be static or memoryless if its output depends upon the present input only.
The system is said to be dynamic with memory if its output depends upon the present and past input values.

21. Difference between Periodic and Aperiodic signals. APRIL/MAY 2010

S.NO	**PERIODIC SIGNAL**	**NON PERIODIC**
1	For CT signal is said to be periodic if, $x(t) = x(t+T)$ for all t.	For CT signal is said to be A periodic If, $x(t) \neq x(t+T)$ for all t.
2	For Discrete, if, $x(n) = x(n+N)$ for all n.	For Discrete, If, $x(n) \neq x(n+N)$ for all n.

3		

22. For the signal shown in Figure, find x(2t + 3) . NOV/DEC 2009 MAY 2014
Solution:



Starting point	Ending point
2t+3 = -1	2t+3 = 2
2t = -4	2t = -1
t= -2	t = -0.5

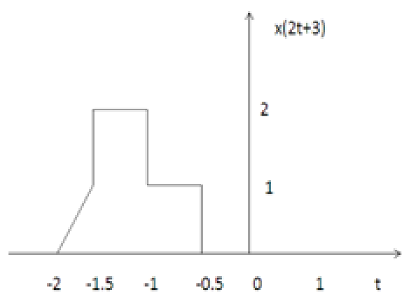


Fig : x(2t+3)

23. Check whether the following system is static or dynamic and also causal and noncausal.

y(n) =x(2n) NOV/DEC 2012, APR/MAY 2010

A System is said to be **static (Memory less)**, if its output depends upon the present input only. A System is said to be **dynamic (System with Memory)**, if its output depends upon post as well as future values of the input.

(i) The given system equation is,

y(n) = x(2n)
Here when, n = 1_ y(1) = x(2)
n = 2_ y(2) = x(4)…
Thus the output y(n) depends upon the future inputs. Hence the system is **non-causal**.

(ii) The given system equation is,
y(n) = x(2n)
Here when, n = 1_ y(1) = x(2)
n = 2_ y(2) = x(4)…
Thus the system needs to store the future input samples. It requires memory. Hence the system is **dynamic.**

24. Determine whether the system y(n) = log(1+|x(n)|) is stable or not. NOV/DEC 2011

Here y(n) = log(1+|x(n)|) is taken.This means 1+ |x(n)| > 0.
Hence y(n) will be bounded for all bounded values of x(n).
The system is **stable**.

25. **Verify whether the system described by the equation is linear and time invariant y(t) = x(t2). APRIL/MAY 2012**
Solution:
Condition for linearity
a1y1(t) + a2y2(t) = f [a1x1(t) + a2x2(t)]
y1(t) = x1(t2)
y2(t) = x2(t2)
a1y1(t) = a1x1(t2)
a2y2(t) = a2x2(t2)
a1y1(t) + a2y2(t) = a1x1(t2) + a2x2(t2)
= [a1x1(t2) + a2x2(t2)] _(1)
R.H.S
f[a1x1(t) + a2x2(t)] = [a1x1(t2) + a2x2(t2)] _(2)
(1) = (2) Therefore the system is **linear.**
Condition for Time Invariant
y(t-T) = F [x(t-T)]
y(t-T) = x(t-T)2_(1)
F[x(t-T)] = x(t2-T) _(2)
(1) ≠ (2)
Therefore the system is **time variant**

26. Sketch the following signals. **MAY/JUNE 2014**
a) x(t) = 2t for all t
b) x(n) = 2n – 3, for all n.
Solution:
a) x(t) = 2t for all t

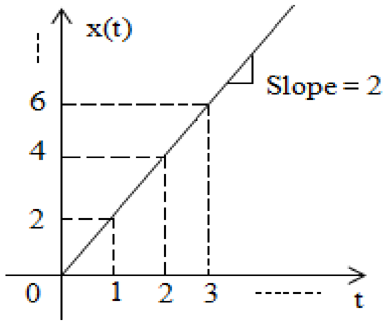


Fig: x(t) = 2t
t = 0, x(t) = 0
t = 1, x(t) = 2
t = 2, x(t) = 4

b) x(n) = 2n – 3, for all n.
n = -2, x(n) = -7
n = -1, x(n) = -5
n = 0, x(n) = -3
n = 1, x(n) = -1
n = 2, x(n) = 1
n = 3, x(n) = 3
n = 4, x(n) = 5
n = 5, x(n) = 7

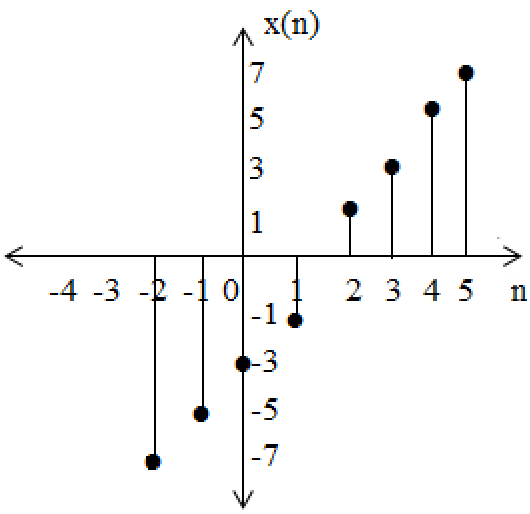


Fig: x(n) = 2n – 3

27. Check whether the discrete time signal sin3n is periodic. MAY/JUNE 2013
Solution:
x(n) = sin3n
$2\pi f=3$

$f=3/2\pi$

The number is the irrational number. Hence the given signal is non-periodic.

28. Define Time Invariant and Variant System (or) what are the condition for a system to be LTI system ?
(or) How do you prove that the system is time invariant? NOV/DEC 2013

• A System is said to be time-invariant, if its input-output characteristics do not change with time.
• A System is said to be linear time Invariant system, if it satisfies the condition.
For CT System, y(t-T) = f [x(t-T)]
For DT System, y(n-K) = f [x(n-K)]
• If it does not satisfies the condition the given system is "Time variant system".
NOTE:
• If all Coefficients are constant, the given system is Linear Time System.
Eg: 2d2y(t)/dt2 + 4dy(t)/dt + 5y(t) = 5x(t)
• If coefficient is a function of time the given system is "Linear Time Varying System".
Eg: 2d2y(t)/dt2 + 4tdy(t)/dt + 5y(t) = x(t).

29.Determine whether the signal x(t) = cos (π/2) t is periodic or not. Also find its period if it is periodic. [D][Apr/May-2017] (Reg 2008)

Solution :

2πf=π/2

F=1/4

The signal is periodic.

30.Check for periodicity of cos (0.01 πn) [Nov/Dec-2010]

Solution:

2πf=π0.01

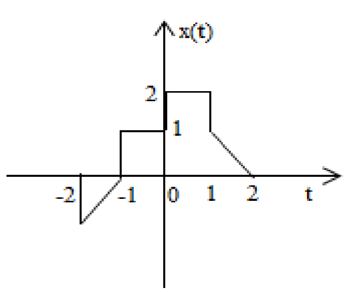
F=0.01/2

F=0.005

Hence the signal is periodic.

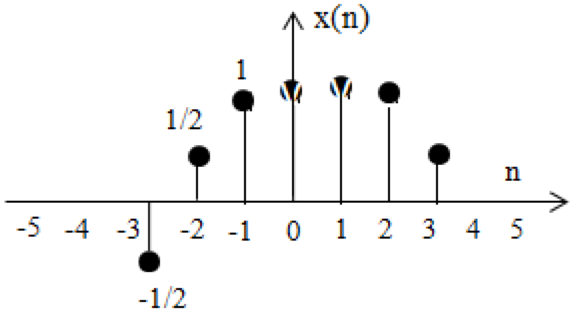
PART – B

1. A continuous time signal x(t) is shown in fig. sketch and label carefully each of the following signal: 1) x(t-1) 2) x(2-t) 3)x(t)[δ(t+3/2) - δ(t-3/2)] 4) x(2t+1) [NOV/DEC 2015]



2. Sketch the following signals: **APRIL/MAY 2011**
1) x(t) = r(t) 2) x(t) = r(-t+2) 3) x(t) = -2r(t)

3. A discrete time signal is shown below: Sketch the following **NOV/DEC 2006**
1) x(n-3) 2) x(3-n) 3) x(2n)



4. CLASSIFICATION OF CT SIGNALS & DT SIGNALS

Check whether the following are periodic **MAY/JUNE 2011**
1) x(n) = sin(6π/7 n+1)

5. Check whether the following signals are periodic/aperiodic signals.
x(n) = 3 + cos(π/2n)+ cos2n**[NOV/ DEC 13, 14]**

6. POWER/ENERGY:
a) Define energy & power signals. Find whether the signals x(n) =(1/2)n u(n)is energy or power signals and calculate their energy and power

7. SYSTEM CLASSIFICATION
1)d/d1 y(t) + ty(t) = x(t)
a) Linear (or) non linear

8. y(n) = x2(n). Calculate the different types of systems**[APRIL/MAY 09, NOV 12]**

9. y(t) =x(n)+nx(n+1). Classify the systems

10.Write about elementary Continuous time Signals in Detail.

Determine the power and RMS value of the following signals.
$(t) = 5\cos\,(50t + \pi/3)$
$(t) = 10 cos 5 t cos 10 t$

11. Determine whether the following system are time invariant or not.
$y(t) = tx(t)$
$(n) = (2n)$

12. Distinguish between the following.

i. Continuous time signal and discrete time signal
ii. Unit step and Unit Ramp functions.
iii. Periodic and Aperiodic Signals.
iv. Deterministic and Random Signals.

13. Check the following for linearity, time invariance, causality and Stability.

$(n) = (n) + (n + 1)$ 8.

14. A Discrete time System is given as y(n) = y2(n-1) = x(n). A bounded input of $(n) = 2(n)$ is applied to the system. Assume that the system is initially relaxed. Check whether the system is stable or unstable.

15. Determine the whether the systems described the i/p o/p equations are linear, time invariant, dynamic and stable.
i. $y1(t) = x(t - 3) + (3 - t)$
ii. dx(t)/dt
iii. $y1[n] = nx[n] + bx2[n]$

16. i. Find whether the following signal
$(t) = 2\cos(10t + 1) - \sin(4t - 1)$ is periodic or not
ii. Explain the properties of unit impulse function.
iii. Find the fundamental period T of the continuous time signal.
$(t) = 20\cos(10\pi t + \pi/6)$

17.Check the signal is periodic or non-periodic
i. X(n)=cos(πn/5)sin(πn/3)
ii. X(t)=cos(2t)+sin(t/5)

18.Find out whether the following signals are periodic or not. If periodic find the period
X (t) = 2 cos (l0t + 1) - sin (4t -1), x (n) =cos (0.1πn). (8) **[Apr/May-2017]**

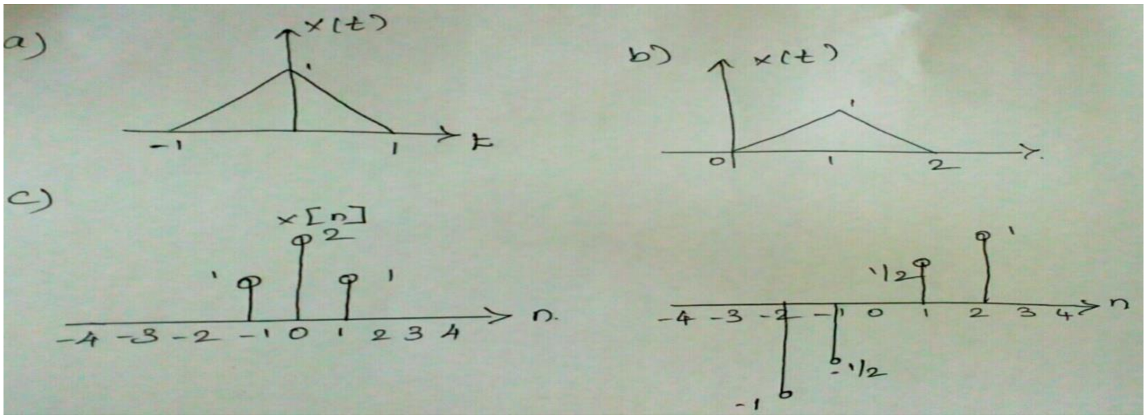
19.Find out whether the following signals are energy or power signal or neither power nor energy as the case may be for the signal. X (t) = u (t) +5 u (t-1) – 2u (t-2) (7)**[Apr/May-2017]**

20Find the whether the signal is an energy signal or power signal.

i) $X(t) = e^{-2t} u(t)$. (5)

ii) Draw the waveform for the signal $x(t) = r(t) - 2r(t-1) + r(t-2)$. (4)

iii) For the given signal determine whether it is even, odd, or neither



21.Sketch i) x (t) ii) x(t+1) iii) x(2t) iv) x(t/2) for following signal: given $x(t) = 1/6(t+2)$, $-2 \leq t \leq 4$

i. 0, otherwise (7) **[D][May/Jun-2014].**

22.Determine whether the discrete time sequence is periodic or not.

$X(n) = \sin[(3\pi/7)n + \pi/4] + \cos(\pi/3)n$ (6) **[D][May/Jun-2014].**

23.Determine whether the signals $x(t) = \sin 20\pi t + \sin 5\pi t$ is periodic and if it is periodic find the fundamental period? **(7)** **[D][Nov/Dec-2013]**

24.Define energy and power signals. Find whether the signal $x(n)=(\frac{1}{2})^n u(n)$ is energy or power signal and calculate their energy and power. **(6) [D][Nov/Dec-2013]**

25.Discuss various forms of real and complex exponential signals with graphical representation.**(6) [D][Nov/Dec-2013]**

26.Define energy and power signals? **(4)** **[D][May/Jun-2013].**

27.Determine whether the following signal are energy and power and calculate their power and energy i) $x(n)=(\frac{1}{2})^n u(n)$ ii) $x(n) = rect(t/T_0)$ iii) $x(n) = \cos^2(\omega_0 n)$. **(7) [ID][May/Jun-2013].**

28.Define unit step, ramp, pulse, impulse and exponential signals. Obtain the relationship between unit step and unit ramp function. **(7) [ID][May/Jun-2013].**

29.How are the signals classified? Explain? **(7) [D][Nov/Dec-2012]**

30.Give the equations and draw the waveforms of discrete time real and complex exponential signals.**(6) [D]**

31.Explain all classification DT signals with example for each category. **(7) [D][Nov/Dec-2011]**

32.If x(n)={0,2,-1,0, 2 , 1,1,0,-1} what is x(n-3) and x(1-n) **(7) [D][Nov/Dec-2010]**
⇧

33.Determine the properties viz linearity, causality, time invariance and dynamicity of the given systems

i) $y(t) = d^2y/dt^2 + 3tdy/dt + y(t) = x(t)$

ii) $y_1(n) = x(n^2) + x(n)$

iii) $y_2(n) = \log_{10} x(n)$ **(13) [D][Apr/May-2017]**

34.Determine whether the following system is Liner and Causal. i) y(n) = x(n). x(n-1) and
y(n) = (1/3) [x(n-1)+ x(n) + x(n+1)] (5)

35.For x() indicate in figure sketch the following:

a) X(1-t)[u(t+1) – u(t-2)] (4)

b) X(1-t)[u(t+1) – u(2-3t)] (4) **[ID][Nov/Dec-2017]**

36. Find whether the following systems are time variant or fixed. Also find whether the systems are linear or nonlinear : i) $d^3y(t)/dt^3 + 4\,d^2y(t)/dt^2 + 5\,dy/dt + y^2t = x(t)$

ii) $y(n) = an^2\,x(n) + bn\,x(n-2)$ (13) **[D] [May/Jun-2016]**

37.Sketch the following signals:

i) u (-t+2)

ii) r(-t+3)

iii) 2δ[n+2] + δ[n]-2δ[n-1]+3 δ[n-3

iv) u[n+2]] u [-n+3]

where u(t), r(t) , g[n], u[n] represent continuous time unit step, continuous time ramp, discrete time impulse and discrete time step functions respectively. (13) **[D][Nov/Dec-2016].**

38.Check the following systems are linear, stable i) $y(t) = e^{x(t)}$ ii) y(n) = x (n-1) (13) **[D][May/Jun-2014].**

Determine whether the discrete time system y(n) = cos (ωn) is i) memory less ii) stable iii) causal iv) linear v) time invariant. **(7) [D][Nov/Dec- 2013].**

39.Define LTI system. List the properties of LTI system. Explain? **(7)[D][Nov/Dec- 2012].**

40.Determine whether the systems described by the following input – output equations are linear, dynamic, causal and time variant: i) $y_1(t) = x(t-3) + (3-t)$ ii) $y_2(t) = dx(t)/dt$ iii) $y_1(n) = n\ x[n] + b\ x_2[n]$ iv) even {x[n-1]}. **(7)[D][May/Jun- 2012].**

41.A discrete time system is given as $y(n) = y^2(n-1) = x(n)$. A bounded input of $x(n) = 2\ \delta(n)$ is applied to the system. Assume that the system is initially relaxed. Check whether system is stable or unstable. **(7)[D][May/Jun- 2012].**

UNIT II

ANALYSIS OF CT SIGNALS

1. Define CT signal

Continuous time signals are defined for all values of time. It is also called as an analog signal and is represented by x(t).
Eg: AC waveform, ECG etc.

2. Compare double sided and single sided spectrums.

The method of representing spectrums of positive as well as negative frequencies are called double sided spectrums.
The method of representing spectrums only in the positive frequencies is known as single sided spectrums.

3. Define Quadrature Fourier Series.

Consider x(t) be a periodic signal. The fourier series can be written for this signal as follows
$x(t)= a0 + \sum an\ cos\omega0nt + \sum bnsin\omega0nt$ .This is known as Quadrature Fourier Series.

4.Define polar Fourier Series.

$x(t)= D0 +\sum Dncos((2\pi nt / T0) +$
The above form of representing a signal is known as Polar Fourier series.

5.Define exponential fourier series.

$x(t)= \sum Cn\ e^{j2\pi nt} / T0$
The method of representing a signal by the above form is known as exponential fourier series.

6. State Dirichlets conditions.

(i).The function x(t) should be single valued within the interval T0
(ii). The function x(t) should have atmost a finite number of discontinuities in the interval T0
(iii). The function x(t) should have finite number of maxima and minima in the interval T0
(iv). The function should have absolutely integrable.

7. State Parsevals power theorem.

Parsevals power theorem states that the total average power of a periodic signal x(t) is equal to the sum of the average powers of its phasor components.

8.Define Fourier Transform.

Let x(t) be the signal which is the function of time t. The fourierr transform of x(t) is given by
$X(\omega)= x(t)e^{-j\omega t}.dt$

9. State the conditions for the existence of fourier series.

(i). The function x(t) should be single valued in any finite time interval T
(ii). The function x(t) should have atmost finite number of discontinuities
in any finite time interval T.
(iii). The function x(t) should have finite number of maxima and minima
in any time interval T.
(iv) The function x(t) should be absolutely integrable.

10. Find the Fourier transform of function x(t)=δ(t)

Ans: 1

11. State Rayleigh's energy theorem.

Rayleigh"s energy theorem states that the energy of the signal may be written in frequency domain as superposition of energies due to individual spectral frequencies of the signal.

12.Define laplace transform.

Laplace transform is the another mathematical tool used for analysis of continuous time signals and systems.It is defined as
F(s) = f(t) e-st dt

13. Obtain the laplace transform of ramp function.

Ans: $1/s^2$

14. What are the methods for evaluating inverse Laplace transform.

The two methods for evaluating inverse laplace transform are
(i). By Partial fraction expansion method.
(ii). By convolution integral.

15. State initial value theorem.

If x(t)-----L---------_X(s), then value of x(t)is geven as,
x(0+) = limt—>0 [sX(s)]
provided thet the first derivative of x(t) should be laplace transformable.

16. State final value theorem.

If x(t) and X(s) are laplace transform pairs, then the final value of x(t) is
given as ,
Lim t->4x(t)= Lim s->0[sX(s)]

17. State the convolution property of fourier transform.

If x1(t) and x1(f) are fourier transform pairs and x2(t) and x2(f) are fourier transform pairs, then ∫x1(t)x2(f-t)dt is fourier transform pair with X1(f)X2(f)

18.What is the relationship between Fourier transform and Laplace transform.

X(s)=X(jw) when s=jw
This states that laplace transform is same as fourier transform when s=jw.

19.Find the fourier transform of sgn function.

Ans: 2/jW
20. Find out the laplace transform of f(t)=eat

Ans: 1/(s-a)

21. What is relation between Fourier Transform and Laplace Transform? (or) Define Laplace Transform? In What way it is different from Fourier Transform NOV/DEC 2010

- x(t) and X(s) is called Laplace Transform pair.

NOV/DEC 2015
x(t) =X(s)

- Variable 's' is the complex frequency

$S = \sigma + j\omega$
σ- attenuation constant (or) damping factor
ω -angular frequency
$X(s) = X(j\omega) = \int x(t)e^{-(\sigma+j\omega)t}\,dt$

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

If the given sign is absolutely integral $\sigma = 0$
$\sigma = 0$, $s = j\omega$, $X(j\omega) = X(s)/s = j\omega$
This is the relation between Fourier Transform and Laplace Transform

22. Define Fourier Series and Fourier Transform? APRIL/MAY 2009
Fourier Series:

Any periodic signal can be represented as an infinite sum of sine and cosine function with angular frequencies o, ωo,......t.ωo. Thus Series of sine and cosine terms is known as "Trigonometric Fourier Series".

It can be written as,

$$X(t)=a(0)+\sum_{k=1}^{\infty}a(k)\cos k\omega_0 t+\sum_{k=1}^{\infty}b(k)\sin k\omega_0 t$$

a0 = dc component, an & bn = constant.

Fourier Transform:

let x(t) be a signal such that and x(t) is absolutely integrable then the Fourier transform of x(t) is defined as,

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

23. Determine the Laplace transform of the signal (t-5) and u(t-5).
APR/MAY 2012

$L[\ (t-5)] = e^{-5s}$ using($L[\ (t-a)] = e^{-as}$)

$L[u(t-5)] = e^{-5s}/s$, ROC: $Re(s) > 0$ using($L[u(t-a)]=e^{-as}/s$)

24. State the time scaling property of Laplace transforms. MAY/JUNE 2013

If $L[x(t)] = X(s)$

Then $L[x(at)] = 1/aX(s/a)$

25. What is the Fourier transform of a DC signal of amplitude 1? MAY/JUNE 2013

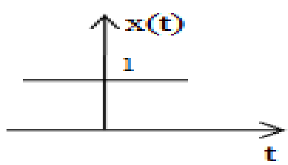


Fig: DC signal

Given: $x(t) = 1$

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

$= \int_{-\infty}^{\infty} 1e^{-j\omega t}\, dt$

$=[\ e^{-j\omega t} /\omega t]_{--\infty}^{\infty}$

Ans: $X(j\omega) = 2p\delta(\omega)$

26. Define Bilateral and Unilateral Laplace transform?
Bilateral Laplace Transform:

It is defined as,

$X(s) = \int_{-\infty}^{\infty} x(t)e^{-st}\, dt$

Here the integration is taken from -∞ to ∞. Hence it is called bilateral Laplace transform.

Unilateral Laplace Transform:

It is defined as,
$X(s) = \int_0^{\infty} x(t)e^{-st}\, dt$

Here the integration is taken from 0 to ∞. Hence it is called unilateral Laplace transform.

28.Find the Laplace transform of x (t) = e^{-at} u (t). **[D] [Nov/Dec -2016].**

29.What is the inverse Fourier transform of i) $e^{-j2\pi f t o}$ ii)δ (f-fo) [D] [**May/June 2016]**

30.Give the Laplace Transform of x(t) = $3e^{-2t}$ u(t) - $2e^{-t}$ u(t) with ROC. [D] [**May/June 2016]**

PART B

1. i). Distinguish between Fourier series Analysis and Fourier Transforms
ii. properties of fourier transform

2. i). Determine the Fourier Transform for double exponential pulse whose function is

given by
$(t) = e{-}2|t|$. Also draw its magnitude and phase spectra
. ii). Obtain inverse Laplace Transform of the function
, $x(s)=1/(s^2 +3s+2)$ ROC: -2< Re{s} <-1

3. i). Find the Laplace Transform and ROC of the signal $(t) = e{-}(t) + e{-}btu(t)$ ii). State and Prove Convolution property and parseval's relation of Fourier series

4. i). Find the trigonometric Fourier series for the periodic signal (t) shown in the fig. ii. State and prove Parseval's Relation of Fourier Transform.

5. i). Find the Laplace Transform of the following. a) $(t) = (t - 2)$
b) $(t) = t^2\, e{-}2(t)$

ii) Find the Fourier Transform of Rectangular pulse. Sketch the signal and Fourier transform.
6. i. Find out the inverse Laplace Transform of

$X(S)=(s-2)/s(s+1)^3$

ii) What are the two types of Fourier representations? Give the relevant mathematical representations.
iii)Solve the differential equation:
$d^2\, y(t)/dt+4d(y)/dt+5y(t)=5x(t)$

and x(t) = u(t)

8. State and Prove the properties of Laplace Transforms.

9. i. Find the laplace transform of the following signal x(t)=sinπt, 0< t <1

0 , otherwise
ii. Find the Fourier Transform of the Triangular Function.

10. i. Find the inverse Laplace transform of ;X(S)=(2s^2+5s+5)/(s+1)^2(s+2) Re{s}>-1

iii. Determine the initial value and final value of signal x(t) whose Laplace Transform is, X(S)=2s+5/s(s+3)

11. State and prove the properties of Fourier Transform

12.Find the Fourier Transform of x(t) = t cos at. (8) [D][Apr/May-2017] (2008 Reg)

[Second Half]

[Laplace Transforms and properties]

13.Determine the inverse Laplace transform of the following) x(s) = 1-2s^2-14s/s(s+3) (s+4) ii) x(s) = 2s^2+ 10s +7 / (s+1)(s^2+3s+2). (6) **[D][Apr/May-2017]**

14.i) Find the Laplace transform of half wave rectifier with amplitude A overtime period 0 to π.
ii) Find the inverse Laplace transform of F(s) = S-2/S(S+1)^3. (10) **[D][Apr/May-2017] (2008 Reg)**

15.Obtain the inverse Laplace transform of the function

X(s) = 1/ (s2 + 3s+2), ROC: -2<Re{s}<-1 (6) [D][**Nov/Dec -2017]**

16.Find the inverse Laplace transform of X(S) = 8s + 10/(s+1)(s-2)^3 . (10) **[D][Apr/May-2015]**

17.Find the inverse Laplace transform of X(S) = 1/s2 +3s +2, ROC: -2<Re (s)< -1 . (8) [D][**Nov/Dec -2012]**

UNIT III

LINEAR TIME INVARIANT - CONTINUOUS TIME SYSTEMS

PART A

1. Write Convolution integral of x(t).

The convolution integral is given as,

$$Y(t) = \int_{-\infty}^{\infty} X(\tau).H(T-\tau).D\tau$$

2. What are the properties of convolution?

i. Commutative property: x(t)*h(t)= h(t)*x(t)

ii. Associative Property : [x(t)*h1(t)]*h2(t) = x(t)*{h1(t)+h2(t)}

iii. Distributive property : x(t)*h1(t)+h2(t)= x(t)*{h1(t)+h2(t)}

3. Define impulse response of continuous system

The impulse response is the output produced by the system when unit impulse is applied at the input. The impulse response is denoted by h(t).

4. Find the unit step response of the system given by h (t)=1.($e^{-t/RC}$)/RC .u(t)

The step response can be obtained from impulse response as,

∞ *T*

1

$$Y(t) = \int H(\tau)D\tau = \int (1/rc).\, e^{-t/RC}\, u(t)dt$$

$$= \int (1/RC).\, e^{-t/RC}\, .d\tau$$

$$=1^{-e-t/RC} \text{ for } t \geq 0$$

This is the step response.

5. What is the impulse response of the system y(t)= x(t-to)

Take laplace transform of given equation ,

$Y(s)= e^{-sto} X(s)$

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

Taking inverse laplace transform

$h(t)=\delta(t-to)$

6. Define eigenvalue and eigenfunction of LTI-CT system.

Let the input to LTI-CT systembe a complex exponential e^{st}

. Then using the convolution theorem we get the output as, $y(t) = H(s)\, e^{st}$

Thus output is equal to input multiplied by H(s). Hence e^{st} is called eigen function and H(s) is called eigen value.

7. The impulse response of the LTI-CT system is given as h(t) = e^{-t} u(t). Determine transfer function and check whether the system is causal and stable.

$h(t) = e^{-t} u(t)$
Taking Laplace Transform ,
H(s) = 1/(s+1)
Here pole at s=-1 , i.e., located in left half of s-plane. Hence this system is causal and stable.

8. Give four steps to compute convolution integral.
Or
What are the basic steps involved in convolution integrals?
i. Folding
ii. Shifting
iii. Multiplication
iv. Integration

9. What is the overall impulse response h (t) when two systems with impulse response h1 (t) and h2(t) are in parallel and in series?
Or
State the properties needed for interconnecting LTI systems.
For parallel connection, h(t)= h1(t) + h2(t)
For series connection, h(t) = h1(t) * h2(t)

1 0. Define linear time invariant system.
The output response of linear time invariant system is linear and time invariant

11. Define impulse response of a linear time invariant system.
Impulse response of LTI system is denoted by h(t). It is the response of the system to unit impulse input.

12. Write down the input-output relation of LTI system in time and frequency domain.
Y(t)= h(t)*x(t) : Time domain
Y(f) = H(f) X(f) : Frequency Domain
Or Y(s) = H(S) X(s) : Frequency Domain

13. Define transfer function in CT systems.
Transfer function relates the transforms of input and output i.e.,
H(f) = Y(f)/X(f), using Fourier transform Or H(s) = Y(s)/X(s)

14. What is the relationship between input and output of an LTI system?
Input and Output of an LTI system are related by,

$$\mathbf{Y(t)=} \int_{-\infty}^{\infty} X(\tau).H(T-\tau).D\tau \text{ i.e convolution}$$

15. What is the transfer function of a system whose poles are at -0.3±j 0.4 and a zero at -0.2?
P1= -0.3 + j 0.4, p2 + -0.3 – j0.4

Z=-0.2
H(s) = (s-z)/(s-p1)(s-p2)
= (s+0.2)/(s+0.3-j0.4)(s+0.3+j0.4)
= $(s+0.2)/((s+0.3)^2+0.4^{2)}$
= $(s+0.2)/(s^2+0.6s+0.25\ )$

16. Find the impulse response of the system given by H(S) = 1/(s+9)
e-at u(t) ↔ 1/(s+a) hence
e-at u(t) ↔ 1/(s+9)
Thus impulse response $h(t)=e^{-9t}u(t)$

17. Find the Fourier Transform of impulse response.
Impulse response h(t)= x(t)*h(t)
FT[h(t)] = FT[x(t)*h(t)]
H(f) = X(f).H(f)

18. What is the impulse response of an identity system?
For identity system,
y(t) = x(t) i.e., output is same as input Then y(t) = h(t) * x(t)
= x(t) only if h(t) = δ(t)
Thus identity system has impulse response of h(t)= δ(t)

19.Define zeros.
The zeros of the system H(z) are the values of z for which H(z) = 0.

20. Define poles.
The poles of the system H(z) are the values of z for which H(z) = α.

21. What are the three elementary operations in block diagram representation of continuous time system? MAY/JUNE 2013 NOV/DEC 2012

i). Scalar Multiplication:
The input X(s) is multiplied by a constant "a". Hence the output is Y(s) = aX(s)

Fig: Scalar Multiplication

ii). Adder:
The two signals X1(s) & X2(s) are added to give the output Y(s)

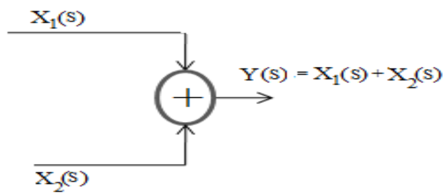


Fig: Adder

iii). Integrators:

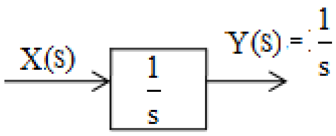


Fig: Integrators

22. Determine the response of the sysytem with impulse response NOV/DEC 2011 h(t) = tu(t) for the input x(t) = u(t).

Solution

The response is given as

y(t) =∫h(t)dt

=∫tu(t)u(t-τ)dτ

Hence = 1 for 0 to t. The above equation becomes

y(t) =∫(τ)dτ = 0.5t^2

23. State the sufficient condition for an LTI continuous time system to be causal. MAY/JUNE 2014

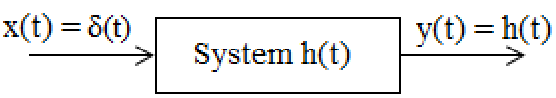
• An LTI system is causal **h(t) = 0 for t < 0**, if its impulse response is zero for negative values of "t".

• The system is said to be causal, if its output depends on present and past input.

• The system is said to be non-causal, if its output depends on future input.

24. What is meant by impulse response of any system? APR/MAY2011

When the unit impulse function is applied as input to the system, the output is nothing but impulse response h(t). The impulse response is used to study various properties of the system such as causality, stability, dynamicity etc.



• Impulse response h(t) is the output y(t) produced by CT system when unit impulse\ is applied at the input.

• Impulse response h(t) is obtained by taking inverse Laplace transform from the transfer function.

25. Define realization structure?
1. Block diagram representation of the differential equation is called realization structure.
2. Block diagram is a pictorial representation of the system.
3. It is implemented with the help of scalar, multipliers, adder and integrators

.**26. What are the different types of structure realization?**

1. Direct form I realization.
2. Direct form II realization.
3. Cascade form realization.
4. Parallel form realization.

27. **Mention the advantages of direct form II structure over direct form I structure.**

No.of integrators are reduced to half

28.. **Define Eigen function and Eigen value.**
In the equation given below,
$y(t)=H(s)e^{st}$
H(s) is called Eigen value and est is called Eigen function.

29. **Define Causality and stability using poles**.
For a system to be stable and causal, all the poles must be located in the
left half of the s plane

30. **Find the impulse response of the system y(t)=x(t-t0) using laplace transform**.
Ans:
h(s)= d(t-t0)

31.**The impulse response of the LTI CT system is given as h(t)=e-t u(t). Determine transfer function and check whether the system is causal and stable.**
Ans:
H(s)=1/(s+1)
The system is causal,stable.

32.Consider an LTI system with transfer function H(s) is given by H(s) =1/ (s +1)(s + 3) Re(s)>3; determine h(t). [D][**Nov/Dec -2017]**

33.Find whether the following system whose impulse response is given is causal and stable
$h(t) = e^{-2t} u(t-1)$. [D][**Nov/Dec -2017] (reg 2008)**

34.Find whether the following system whose impulse response is given is causal and stable h(t) = e-2t u(t - 1). **[D][May/June- 2016]**

35.Realize the block diagram representing the system H(s) = s/(s+1) **[D][May/June- 2016]**

36.Convolve the following signals u(t -1) and δ(t -1). **[D][Nov/ Dec- 2016] (reg 2008)**

37.Given H(S) =S / (S^2+2S+1). Find the differential equation representation of the system. **[D][Nov/ Dec- 2016] (reg 2008)**

PART –B

[First Half]

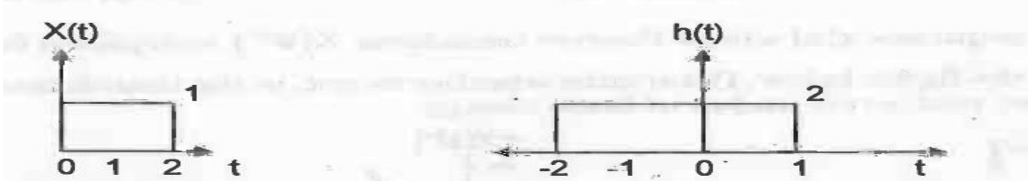
[Impulse response - Differential Equation]

1. A causal LTI system having a frequency response H (jΩ) = 1/ (jΩ+3) producing an output
   y(t) = e^{-3t}u(t) –e^{-4t}u(t) for a particular input x(t). Determine x (t). (13) [D] [**Apr/May -2017]**
2. Realize the given system in parallel form H(s) = s(s+2)/ (s^3+8s^2+9s+12) (13) [D] [**Apr/May -2017]**
3. Using Laplace transform of x(t). Give the pole -zero plot and find ROC of the signal x(t). x(t) = $e^{-b|t|}$ for both b>0 and b<0. (6) [D][**Nov/Dec -2017]**
4. Find the condition for which Fourier transform exists for x(t). Find the Laplace transform of x(t) and its ROC. x(t) = e^{-at} u(-t). (7) [D][**Nov/Dec -2017]**
5. realize the following in indirect form II d^3y(t)/dt^3+4d^2y(t)/dt^2+7dy(t)/dt + 8y(t) = 5 d^2x(t)/dt^2+ 4dx(t)dt+ 7 x(t) (6) **[D][May/June- 2016]**
6. An LTI system is defined by the differential equation d^2y(t)/dt^2 – 4dy(t)/dt + 5y(t) = 5 x(t) Find the response of the system y(t) for an input x(t) = u (t), if the initial conditions are y(0) = 1; $(dy(t) / dt)\big|_{t=0}$ = 2. (7) **[D][May/June- 2016]**
7. Determine frequency response and impulse response for the system described by the following differential equation. Assume zero initial conditions dy(t)/dt + 3y(t) = x(t) (6) **[D][May/June- 2016]**
8. A system is described by the differential equation d^2y(t)/dt^2+6dy(t)/dt + 8y(t) = dx(t)dt + x(t) . find the transfer function and output signal y(t) for x(t) = δ(t). (13) **[D][Nov/ Dec- 2016]**
9. The signal x(t)=u(t-3)-u(t-6) is fed through an LTI system with an impulse response h(t)=e^{-3t}u(t).Determine the output response. (8) **[D][**
10. The input and output of a causal LTI system described by the following differential equation d^2 y(t)/dt2 + 7 dy(t)/dt + 12 y(t) = 2 x(t).If the input x(t) to the LTI system is given by x(t)=2e^{-2t}u(t), determine the response y(t). (7) **[D][**
11. Realize the d2 y(t)/dt2 + 7 dy(t)/dt + 12 y(t) = 2 x(t).system using Direct Form I and Direct Form II. (6) **[D][**

12. Find the block diagram representation of the system given by $d^3y(t)/dt^3+3d^2y(t)/dt^2+5dy(t)/dt+6y(t) = d^2x(t)/dt^2+6dx(t)/dt+5x(t)$. (7) **[D][**
13. Draw the block diagram representation for $H(s) = (4s+28) / s^2 +6s+5$. (6) **[D][**
14. Realize the given system in parallel form $H(s) = s(s+2)/ s^3+8s^2+19s+12$. (13) **[D][**
15. A causal LTI system having a frequency response $H(j\Omega) = 1/j\Omega+3$ is producing an output $y(t) = e^{-3t}u(t) – e^{-4t} u(t)$ for a particular input x(t). Determine x(t). **[D][** (13)
16. Realize the following direct form I, indirect form II $d^3y(t)/dt^3 +4 d^2y(t)/dt^2+ 7dy(t)/dt+8 y(t) = 5 d^2x(t)/dt^2+ 4dx(t)/dt+7x(t)$. **[D][** (10)
17. Verify whether the following systems are BIBO stable, causal or not. $h(t) = 1/RC\ e^{-t}/RC$ for $t \geq 0$ and 0 for $t<0$. **[D] (13)**
18. A system is described by the differential equation $d^2y(t)/dt^2 +6\, d/dt\, y(t) +8y(t) = d/dt\, x(t) + x(t)$. Find the transfer function and the output signal y (t) for $x(t) = \delta(t)$ (13) **[D][**
19. Find the output of an LTI system with impulse response $h(t) =\delta(t-3)$ for the input $x(t) =\cos 4t + \cos 7t$. (13) **[D][**
20. Draw the direct form I & II structures for a CT-LTI system described by the differential equation $7\, dy(t)/dt + 12\, y(t) = dx(t)/dt + x(t)$. (6) **[D][**

Convolution integrals

21. Using graphical method, find the output sequence y[n] of the LTI system whose response h [n] is given and input x[n] is given as follows.
    x[n] = {0.5, 2} ; h[n] = {1, 1, 1}. (6) [D][**Nov/Dec -2017]**
22. Convolve the following signals x(t) = e-3t u(t)
    h(t) = u(t+3) (6)
23. Derive an expression for convolution integral. (6)
24. Convolve the following signals x(t) $e^{-3t}u(t)$
    h(t)= u(t + 3) (13) **[D][Nov/ Dec- 2016]**
25. Find the response y(t) of an LTI system whose x(t) and h(t) are shown in fig. (Using convolution integral).



(7)

[D][**Nov/Dec -2017]**

26. Using graphical convolution, find the response of the system whose impulse response is $h(t) = e^{-2t}u(t)$ for an input $x(t) = A,\ 0 \leq t \leq 2$,
    0 for otherwise (7) **[D][May/June- 2016]**

[Second Half]

[Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel]

27. Solve the differential equation $(D^2 + 3D + 2)\, y(t) = D\, x(t)$ using the input $x(t) = 10e^{-3t}$ and with initial condition $y(0^+) = 2$ and $y(0^+) = 3$. (7) **[D][**
28. Using convolution, find the response of the system whose impulse response is h(t) = e-2t u(t) for an input x(t)= {A, for $0 \leq t \leq 2$, 0 , otherwise (6) **[D][**
29. For a LTI system with H(s) = (s+5) / (s 2 +4s+3) find the differential equation. Find the system output y (t) to the output x (t) = e -2t u (t). (7) **[D][**
30. Determine the response of the system with impulse response h(t) = u(t) for the input x(t) = e^{-2t} u(t). (7) **[D][**
31. The LTI system is described by d/dt y(t)+2y(t) = x(t). Obtain an output for the input of x (t)=e^{-t}u(t) using Fourier Transform. (6) **[D][**
32. Solve the following differential equation, d2y(t)/dt +4 dy(t)/dt + 5y (t) = 5x(t) with y (0^-) = 1 and dy(t)/dt │0- = 2. And x(t) = u(t) (8) **[D][**
33. Find the response y(t) of a continuous time system using Laplace transform with transfer function H(S) = 1/ (S+1)(S+2)for an input x(t)= e^{-t} u(t). **(15)[D][Nov/ Dec- 2016]**

UNIT- IV

ANALYSIS OF DISCRETE TIME SIGNALS

PART A

1. Define system function of the discrete time system.
The system function of the the discrete time system is
$H(z) = Y(z)/X(z)$ = z-transform of the output/z-transform of the in input Or $H(z) = Z\{h(n)\}$ i.e, z-transform of unit sample response.

2. A system specified by a recursive difference equation is called infinite impulse response system (True/False).
This statement is true. An IIR system can be represented by recursive difference equation.

3. If u(n) is the impulse response of the system, what is its step response?
Here $h(n) = u(n)$ and the input is $x(n) = u(n)$
Hence output $y(n) = h(n) * x(n) = u(n) * u(n)$

4.Determine the system function of the discrete time system described by the difference equation.
$Y(n)-1/2y(n-1) + 1/4y(n-2) = x(n) – x(n-1)$
Taking z-transform of both sides,
$Y(z) -1/2 z^{-1}Y(z) +1/4z^{-2}Y(z) = X(z) – z^{-1} X(z)$
$Y(z) / X(z) = 1-z^{-1} / 1-1/2z^{-1} + ¼ z^{-2}$
$H(z) = 1-z^{-1}/1-1/2z^{-1}+1/4z^{-2}$

5. Determine the transfer function of the system described by y(n) = ay(n-1) + x(n) (Nov./Dec.-2005)
$Y(z) = a z^{-1} Y(z) + X(z)$
$Y(z) [1-az^{-1}] = X(z)$
$H(z) = Y(z)/X(z) = 1/1-az^{-1}$

6.What are all the blocks are used to represent the CT signals by its samples?
* Sampler * Quantizer

7. Define sampling process.
Sampling is a process of converting CT signal into DT signal.

8.Mention the types of sampling.
* Up sampling
* Down sampling

9.What is meant by quantizer?
It is a process of converting discrete time continuous amplitude into discrete time

discrete amplitude.

10. List out the types of quantization process.
* Truncation * Rounding

11. Define truncation.
Truncating the sequence by multiplying with window function to get the finite value.

12. What is rounding?
In this we consider the nearest value.

13. State sampling theorem.[Nov/Dec 2017]
The sampling frequency must be atleast twice the maximum frequency present in the signal.
That is $F_s \geq 2f_m$
Where, Fs = sampling frequency Fm =maximum frequency

14. Define nyquist rate.[nov/dec 2016]
It is the minimum rate at which a signal can be sampled and still reconstructed from its samples. Nyquist rate is always equal to 2fm.

15. Define aliasing or folding.
The superimposition of high frequency behaviour on to the low frequency behaviour is referred as aliasing. This effect is also referred as folding.

16. What is the condition for avoid the aliasing effect?
To avoid the aliasing effect the sampling frequency must be twice the maximum frequency present in the signal.

17. Define z transform?
The Z transform of a discrete time signal x(n) is defined as,
$X(Z)=\sum x(n)Z^{-n}$

18. What is meant by ROC?
The region of convergence (ROC) is defined as the set of all values of z for which X(z) converges.

19. Explain about the roc of causal and anti-causal infinite sequences?
For causal system the roc is exterior to the circle of radius r. For anti causal system it is interior to the circle of radius r.

20. Explain about the roc of causal and anti causal finite sequences
For causal system the roc is entire z plane except z=0. For anti causal system it is entire z plane except z=α.

21`. What are the properties of ROC?

a. The roc is a ring or disk in the z plane centered at the origin.
b. The roc cannot contain any pole.
c. The roc must be a connected region
d. The roc of an LTI stable system contains the unit circle.

22. Explain the linearity property of the z transform
If z{x1(n)}=X1(z) and z{X2(n)}=x2(z) then,
z{ax1(n)+bx2(n)}=aX1(z)+bX2(z) a&b are constants.

23. State the time shifting property of the z transform.
If z{x(n)}=X(z) then z{x(n-k)}=z-kX(z)

24. State the scaling property of the z transform
If z{x(n)}=X(z) then z{an x(n)}=X(a-1 z)

25. State the time reversal property of the z transform
If z{x(n)}=X(z) then z{x(-n)}=X(z-1)

26. Explain convolution property of the z transform
If z{x(n)}=X(z) & z{h(n)}=H(z) then, z{x(n)*h(n)}=X(z)H(z)

27. What are the different methods of evaluating inverse z-transform?
It can be evaluated using several methods.
i. Long division method
ii. Partial fraction expansion method
iii. Residue method
iv. Convolution method

28. Define DTFT and IDTFT of a sequence?[may/jun 2015]
The DTFT (Discrete Time Fourier Transform) of a sequence x(n) is defined
As,
The IDTFT is defined as,
$\mathbf{X[n]=1/2\pi\int X(\omega)e^{j\omega n}}\, d\omega$

29. What is the drawback in DTFT?
The drawback in discrete time fourier transform is that it is continuous function of ω and cannot be processed by digital systems.

30. Represent the DTFT pair.

$\mathbf{X(n)\leftrightarrow X(\omega)}$

31. What is the need for DTFT?
DTFT is used for the analysis of non-periodic signals.

32. What is the need for Z-transform?

Z-transform is used for analysis the both periodic and aperiodic signals..

33.Find x (∞) f the signal for with the z -transform is given by X(Z) = (Z+1) / 3(Z-1)(Z+0.9) [D] [**Apr/May -2017]**

34.Find the Z transform of a sequence x[n] = cos (ωnT) u[n]. [D][**Nov/Dec -2017]**

35.Find the final value of the given signal x(z) = 1 / ($1+2^{z-1}+3^{z-2}$) [D] [**May/ Jun -2016]**

36.Find the Nyquist rate of the signal x(t) = sin 200πt - cos100πt [D][**Nov/Dec -2016]**

37.Find the Z -transform of the signal and its associated ROC x(n) = {2, -1, 3,0,2} [D][**Nov/Dec -2016]**

38.Find inverse z -transform for 1/ (z+0.1). [D][**Nov/Dec -2017] (2008 reg)**

PART B
[First Half]

[Baseband signal Sampling]

1. State and prove Sampling theorem. (13) [D] [**Apr/May -2017]** [D][**Nov/Dec -2017, 2014] (2008 reg)(10) [May/Jun 2016]**
2. What is aliasing? Explain the steps to be taken to avoid aliasing. **(6) [D][May/Jun 2016]**
3. State and prove sampling theorem for a band limited signal. . [ID][**Nov/Dec -2013] (2008 reg)**
4. Discuss the effects of undersampling a signal using necessary diagrams. (5) [ID][**Nov/Dec -2016]**
5. Consider an analog signal x(t) = 5 cos 200 π t. i) Determine the minimum sampling rate to avoid aliasing. ii) If sampling rate Fs = 400 Hz. What is the DT signal after sampling? (6) [D][**Nov/Dec -2017]**

[Fourier Transform of discrete time signals (DTFT) – Properties of DTFT]

6. State and prove the following properties of DTFT
   (i) Differentiation in frequency
   (ii) Convolution in frequency domain. (13) [D] [**Apr/May -2017]**
7. Determine unit step response of the LTI system defined by
   $d^2y/dt^2 + 5dy/dt + 6y(t) = dx/dt + x(t)$. (6) [D][**Nov/Dec -2017]**
8. State and prove the following theorems :
   i) Convolution theorem of DTFT (6)
   (ii) Initial value theorem of z-transform (7) **[D][May/Jun 2016]**

9. Find the discrete -time Fourier transform of the following i) x(n) = {1,-1,2,2}
   ii) $X(n) = 2^n u(n)$
   iii) $X(n) = 0.5^n u(n) + 2^{-n} u(-n-1)$ (13) [D][**Nov/Dec -2017] (2008 reg)**
10. Compute DTFT of a sequence x(n) = (n-1) x(n) Use DTFT properties. (6) [D][**Nov/Dec -2015] (2008 reg)**
11. Find the discrete time Fourier transform of $x[n]=[(1/2)^{n-1} u(n-1)]$ (7) [D][**Nov/Dec -2015] (2008 reg)**
12. Determine the discrete time Fourier transform of $x(n) = a^{|n|}$, IaI <1 (7) [D][**Nov/Dec -2013] (2008 reg)**

[Second Half]

[Z Transform & its properties]

13. Find the Z transform and sketch the ROC of the following sequence $x[n] = 2^n u[n] + 3^n u(-n-1)$. (13) **[D][**
14. Find the Inverse z -transform using partial fraction method. $X(z) = (3- (5/6)z^{-1})/(1-(1/4)^{z-1})(1-(1/3)^{z-1})$; $|z| > 1/3$ (7) [D][**Nov/Dec -2017]**
15. Find the Z -transform of x[n]. $a^n u[n]- b^n u[-n-1]$ and specify its ROC. (8) [D][**Nov/Dec -2016]**
16. Give the relation between Discrete Time Fourier Transform (DTFT) and Z -transform. (5) [D][**Nov/Dec -2016]**
17. State and prove the time shifting property and time reversal property of Z -transform. (8) [D][**Nov/Dec -2016]**
18. b) State and prove any four properties of z -transform. (13) [D][**Nov/Dec -2017] (2008 reg)**
19. Write the properties of z -transform. Explain in detail about complex convolution theorem and final value theorem. (13) [D][**Nov/Dec -2017] (2008 reg)**
20. State and prove the properties of z -- transform. (13) [D][**Nov/Dec -2015] (2008 reg)**
21. Find the X(Z) if $x(n) = n^2 u(n)$. (4) [D][**Nov/Dec -2014] (2008 reg)**
22. Find the z transform and ROC of the sequence $x(n) = r^n \cos(\theta n) u(n)$. (6) [D][**Nov/Dec -2013] (2008 reg)**
23. Find the inverse z-transform of the function $x(z) = (1+z^{-1})/(1-(2/3z^{-1)})^2$ ROC IzI > 2/3 (6) [D][**Nov/Dec -2013] (2008 reg)**

UNIT – V

LINEAR TIMES INVARIANT- DISCRETE TIME SYSTEMS

PART-A

1. Define convolution sum?
If x(n) and h(n) are discrete variable functions, then its convolution sum
y(n) is given by,
y(n)=_ x(k) h(n-k)

2. List the steps involved in finding convolution sum?
o folding
o Shifting
o Multiplication
o Summation

3.List the properties of convolution?
o Commutative property of convolution
x(n) * h(n) = h(n) * x(n) = y(n)
o Associative property of convolution

[x(n) * h1(n)] * h2(n) = x(n) * [h1(n) * h2(n)]
o Distributive property of convolution
x(n) * [h1(n) + h2(n)] = x(n) * h1(n) + x(n) * h2(n)

4. Define LTI causal system?
A LTI system is causal if and only if ,h(n) = 0 for n<0.This is the sufficient
and necessary condition for causality of the system.

5. Define LTI stable system?
The bounded input x(n) produces bounded output y(n) in the LTI system only
if, _ | h(k)| <_. When this condition is satisfied ,the system will be stable.

6. Define FIR system?
The systems for which unit step response h(n) has finite number of terms, they
are called Finite Impulse Response (FIR) systems.

7. Define IIR system?
The systems for which unit step response h(n) has infinite number of terms,
they are called Infinite Impulse Response (IIR) sysrems.

8. Define non recursive and recursive systems?
When the output y(n) of the system depends upon present and past inputs
then it is called non-recursive system.
When the output y(n) of the system depends upon present and past inputs as

9. State the relation between fourier transform and z transform?
The fourier transform is basically the z-transform of the sequence evaluated on unit circle.
i.e., X(z)|z=e
jw = X(w) at |z|=1 i.e., unit circle.

10. Define system function?
H(z)= Y(z) is called system function.It is the z transform of the unit sample
X(Z)
response h(n) of the system.

11. What is the advantage of direct form 2 over direct form 1 structure?
The direct form 2 structure has reduced memory requirement compared to direct form 1 structure.

12. Define butterfly computation?
In the figure the two values „a‟ and „b‟ are available as input. From these two values
„A‟ and „B‟ are computed at the output. This operation is called Butterfly computation.

13.What is an advantage of FFT over DFT?
FFT algorithm reduces number of computations.

14. List the applications of FFT?
o Filtering
o Spectrum analysis

o Calculation of energy spectral density

15. How unit sample response of discrete time system is defined?
The unit step response of the discrete time system is output of the system to unit
sample sequence. i.e., T[ð(n)]=h(n). Also h(n)=z {H(z)}.

16.A causal DT system is BIBO stable only if its transfer function has _________.
Ans:A causal DT system is stable if poles of its transfer function lie within the
unit circle.

17. If u(n) is the impulse response response of the system, What is its step response?
Here h(n) = u(n) and the input is x(n) = u(n).
Hence the output y(n) = h(n) * x(n)
= u(n) * u(n)

18.Convolve the two sequences x(n)={1,2,3} and h(n)={5,4,6,2}

Ans: y(n)={5,14,29,26,22,6}

19.State the maximum memory requirement of N point DFT including twiddle factors?
Ans: [2N+N/2]

20.Determine the range of values of the parameter „a" for which the linear time invariant system with impulse response h(n)=an u(n) is stable?
Ans: H(z)= z , There is one pole at z=a. The system is stable, if all its
poles.
z-a
i.e., within the unit circle. Hence |a| < 1 for stability.

21.Realize the difference equation y[n] = x[n] - 3x[n -1] in direct form I. [D][**Nov/Dec -2017]**

22.From discrete convolution sum, find the step response in terms of h(n). **[D][May/Jun 2016]**

23.Convolve the following sequences x[n] = {1, 2,3} & h[n] = 11, 1, 2} . [D][**Nov/Dec -2016]**

24.Given the system function $H(z) = 2+ 3z^{-1} + 4z^{-3} - 5z^{-4}$ Determine the impulse response h[n] [D][**Nov/Dec -2016]**

25.Convolve the following signals x(n) = {1, 2, 3} and h(n) = {1, 1, 2}.[D][**Nov/Dec -2017] (Reg 2008)**
⇧ ⇧

26.Determine the z -transform of the following signal $x(n) = a^n u[n]$, lal > 1 and also specify whether Fourier transform of the signal exists.[D][**Nov/Dec -2017] (Reg 2008).**

29.Give the impulse response of a linear time invariant time as h(n) = sin πn, check whether the system is stable or not. [D][**Nov/Dec -2014]**

30.In terms of ROC, state the condition for an LTI discrete time system to be causal and stable. [D][**Nov/Dec -2014]**

31.Write the nth order difference equation. [D][**Nov/Dec -2014] (Reg 2008)**

32.Define convolution sum with its equation. [D][**Nov/Dec -2013] (Reg 2008)**

33.Convolve the following two sequences :

X (n) = {1, 1, 1, 1}
h (n) = {3, 2}2

34.Give the Nth order linear constant coefficient difference equation of discrete system. [ID] [**Apr/May -2017] (Reg 2008)**

35.Find the stability of the system whose impulse response is h (n) = 2"u (n). [D] [**Apr/May -2017] (Reg 2008)**

36.A causal LTI system has impulse response h(n), for which the z-transform is

$H(z) = (1 + z^{-I}) / (1 - 0.5 z^{-I}) (1 + 0.25 z^{-I})$. Is the system stable? Explain. **[D][May/Jun 2016] (Reg 2008)**

PART B

[First Half]

[Impulse response – Difference equations]

1. For a causal LTI system the input x(n) and output y(n) are related through a difference equation y(n) -1/6 y(n-1)- 1/6 y(n-2) = x(n). Determine the frequency response $H(e^{j\omega})$ and the impulse response h(n) of the system. (13) [D] [**Apr/May -2017]**
   Obtain the parallel realization of the system given by y(n) - 3y(n - 1) + 2 y(n - 2) = x(n). (7) [D][**Nov/Dec -2017]**
2. Determine the direct form II structure for the system given by difference equation
   y(n) = (1/2)y(n -1)- (1/4)y(n - 2) + x(n)+x(n -1). (7) [D][**Nov/Dec -2017]**
3. Using the properties of inverse Z -transform solve : i) $x(z) = \log(1+az^{-1})$; $|z|>|a|$ and
   $X(z) = az^{-1}/(1-z^{-1})^2 |z|>|a|$
   ii) Check whether the system function is causal or not.
   $H(z) = 1/(1-(1/2)z^{-1}) + 1/1-2z^{-1}$ |;z|>|2|
   iii) Consider a system with impulse response $H(s) = e^s/s+1$; Re{s} > -1. Check
   Whether the given systems function is causal or not. (13) [D][**Nov/Dec -2017]**
4. Realize the following system in cascade form: $H(z) = (1+(1/5)z^{-1}) / [(1-1/2^{z-1}+1/3z^{-2})(1+1/4z^{-1})]$ (7)**[D][May/Jun 2016]**
5. A system is governed by a linear constant coefficient difference equation y(n) = 0.7 y (n - 1) - 0.1 y(n 2) + 2x (n) -x (n - 2). Find the output response of the system y(n) for an input x(n) = u(n). (13)**[D][May/Jun 2016]**
6. Determine whether the given system is stable by finding H(z) and plotting the pole -zero diagram y[n] = 2y[n -1] - 0.8y[n - 2] + x[n] + 0.8x[n -1]. (13) [D][**Nov/Dec -2016]**
7. Find the output response of the system y(n) for an input x(n) = u(n)
8. Determine the impulse response and step response o y(n)+y(n-1)-2y(n-2)= x(n-1)+2x(n-2) (10) [**Apr May 2015]**
9. Obtain the cascade realization of y(n)-1/4 y(n-1)-1/8y(n-2)=x(n)+3x(n-1)+2x(n-2). **(13)** [**Apr May 2015]**
10. Draw direct form I and direct form II implementations of the system described by difference equation.
    Y(n) + ¼ y(n-1) + 1/8 y(n-2) = x(n) + x(n-1) **(7)**

11. Obtain the impulse response of the system given by the difference equation Y(n) – 5/6 y(n-1) + 1/6 y(n-2) = x(n) **(7) [D][May/ Jun 2013]**
12. Determine the range of values of the parameter "a" for which LTI system with impulse $h(n) = a^n u(n)$ is stable. **(6) [D][May/ Jun 2013]**
13. Compute the response of the system y(n) = 0.7 y(n-1) – 0.12y(n-2) + x(n-1) + x(n-2) to the input x(n) = nu(n). is the system stable? **(6) [D][May/ Jun 2013]**
14. Derive the necessary and sufficient condition for BIBO stability of an LSI system. (4)[D] **[Nov/Dec-2012]**
15. Draw the direct form, cascade form and parallel form block diagrams of the following system function:
    H(Z) = 1/ (1-1/2Z-1)(1-1/4Z-1) **(13)** [D] **[Nov/Dec-2012]**
16. Find the impulse response of the difference equation y(n) – 2y(n-2) +y(n-1)+3y(n-3) = x(n)+2x(n-1) (13) **[D]**
17. Find the input x (n) which produces the output y(n) = {3,8,1,4,8,3} when passed through the system having h(n) = {1,2,3}. (7) **[ID]**
18. Obtain the Direct form II structure for y(n) – ¾ y(n-1) + 1/8y(n-2) = x(n) + 1/2x(n-1). (7) **[ID][**

[Convolution sum]

19. Convolve the following signals x[n] = u[n]- u[n -3] & $h[n] = (0.5)^n u[n]$ .. (13) [D][**Nov/Dec -2016]**
20. Perform convolution to find the response of the systems h_1 (n) and h_2 (n) for the input sequences x_1 (n) and x_2 (n) respectively. (i) x_1 (n) = (1, 1, 2, 3) h_1 (n) = (1, 2, 3, 1)
    (ii) x_2(n) = (1, 2, 3, 2) h_2(n) = (1,2,2). (13) [D] [**Apr/May -2017]**
21. Compute y(n) = x(n)*h(n) where $x(n)= (1/2)^{-n} u(n-2)$, h(n) = u(n-2) (13) **AU DEC 2014**
22. Find the convolution sum between x(n)={1,4,3,2} and h(n)= {1,3,2,1}(6) **AU MAY 2015**
23. Convolve x(n) = {1, 1, 0, 1, 1}, h(n) = {1, -2, -3, 4} (6)**[D][May/Jun 2016]**
    ⇧ ⇧
24. Convolve the following signals $x(n) = (1/2)^{n-2} u(n-2)$, h (n) = u (n+2). **(13) AU DEC 2015**
25. Find the convolution sum of x[n] = r[n] and h[n] = u[n]. (16) AU JUN-2014 **(7 Marks)**
26. Compute the linear convolution of x(n)= {1,1,0,1,1} and h()= {1,-2,-3,4**}. (6) AU DEC 2002/05**
    ⇧ ⇧
27. Compute the convolution sum of the following sequences x(n) = {1, 0 ≤ n ≤ 4; 0, otherwise
    H (n) = {α^n, 0 ≤ n ≤ 6; 0, otherwise. (7) [**D] [Nov/Dec-2013]**

[Second Half]

[Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel]

28. Analyze on recursive and non -recursive systems with an example. (15) [D][**Nov/Dec - 2017]**

29. Find the output sequence y(n) of the system described by the equation y(n)=0.7 y(n-1)-0.1 y(n-2)+2x(n)-x(n-2. For the input sequence x(n)=u(n). (13) AU MAY/DEC 2009
30. LTI discrete time system y(n)= 3/2y(n-1)-1/2y(n-2)+x(n) + x(n-1)is given an input x(n)= u(n).i) find the transfer function of the system ii) find the impulse response of the system. (13) **AU DEC 2014**
31. A causal LTI system has x(n) = δ(n) + ¼ δ(n-1)-1/8 δ(n-2) and y(n) = δ(n) – ¾ δ(n-1. Find the impulse response and output if x(n)= $(1/2)^n$ u(n). **(10)AU DEC 2015**
32. Compare recursive and non recursive systems. (4) **AU DEC 2016**
33. Consider an LTI system with impulse response h(n) = α^nu(n) and the input to this system is x(n) = β^n u(n) with |α|&|β|<1. Determine the response y(n). i) when α≠ β ii) when α = β using DTFT. (13) **AU DEC 2015**
34. A causal LTI system is described by the difference equation, y(n)=y(n-1)+y(n-2)+x(n-1) i) find the system function of the system ii) find the unit impulse function of the system. (13) **AU MAY 2008**
35. The system function of the LTI system given a H(Z) = $(3\text{-}4Z^{-1})/\ (1\text{-}3.5Z^{-1}+1.5Z^{-2})$ Specify the ROC of H (Z) and determine h(n) for the following condition. I) stable system ii) causal system (13) **[D]**
36. A discrete time causal system has a transfer function H(Z) = $(1\text{-}Z^{-1})/\ 1\text{-}0.2Z^{-1}\text{-}0.15Z^{-2}$
    i) Determine the difference equation of the system.
    ii) Show pole zero diagram
    iii) Find impulse response of the system(13) **[D]**
37. Given the difference equation representation of the system y[n] – 3/4y [n -1]+ 1/8 y (n-2) = x(n) – 1/2x(n). Find the response y[n] for the input x[n] = $(1/2)^n$ u (n) using DTFT. (13) **[D]**

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