SIGNALS AND SYSTEMS QUESTION BANK

UNIT – I

2 Marks

1. For the signal Shown in the fig, Find x(2t+3).
2. What is the Classification of Systems?
3. Prove that $\delta(n) = u(n) - u(n-1)$
4. Check for periodicity of $\cos(0.01\pi n)$.
5. Define Unit impulse and Unit Step Signals.
6. When is a System said to be memory less? Give Example.
7. Define Step and impulse function in Discrete Signals.
8. Distinguish between Deterministic and random Signals.
9. Determine whether the given signal is Energy Signal or power Signal. And calculate its energy or power.
$$(t) = e^{-2t}(t)$$
10. Check whether the following system is static or dynamic and also causal or non-causal system.
$$(n) = (2n)$$
11. Verify whether the given system described by the equation is linear and time invariant.
$$(t) = (t^2)$$
12. Find the Fundamental Period of the Given Signal. $x[n] = \sin\left(\left(\frac{6\pi n}{7} + 1\right)\right)$
13. Check whether the discrete time signal sin3n is periodic?
14. Define Random Signal.
15. Give the mathematical and graphical representation of continuous time and Discrete time impulse function.
16. What are the Conditions for a System to be LTI System?
17. What are the Classification of signals?
18. What is continuous time and discrete time signals?
19. Define energy and power signals?
20. Define odd and even signals?

16 Marks

1. Write about elementary Continuous time Signals in Detail.
2. Determine the power and RMS value of the following signals.
$$(t) = 5\cos(50t + \pi/3)$$
$$(t) = 10cos5tcos10t$$
3. Determine whether the following system are linear or not.

$$\frac{dy}{dt} + 3ty(t) = t^2x(t)$$

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

4. Determine whether the following system are time invariant or not.

$$y(t) = tx(t)$$

$$(n) = (2n)$$

5. 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.

6. i. Find whether the following signal

$(t) = 2\cos(10t + 1) - \sin(4t - 1)$ is periodic or not. ii. Find the summation $\sum_{n=-\infty}^{\infty} e^{2n}\,\delta(n-2)$ iii. Explain the properties of unit impulse function. iv. Find the fundamental period T of the continuous time signal.

$$(t) = 20\cos(10\pi t + \pi/6)$$

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

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

Check whether the following are periodic.

$$x[n] = \sin\left(\left(\frac{6\pi n}{7} + 1\right)\right)$$

$$x(n) = e^{j3\pi/5(n+\frac{1}{5})}$$

9. Sketch the following signals.

i. x(t) = r(t) ii. x(t) = r(-t+2) iii. x(t) = -2r(t) where r(t) is the ramp signal.

10. Explain all classification of signals with Examples for Each Category.
11. A Discrete time System is given as $y(n) = y^2(n-1) = x(n)$. 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.
12. Determine the whether the systems described the i/p o/p equations are linear, time invariant, dynamic and stable.

i. $y_1(t) = x(t-3) + (3-t)$ ii. $y_2(t) = \frac{dx(t)}{dt}$ iii. $y_1[n] = nx[n] + bx^2[n]$

iv. $Eve\{x[n-1]\}$

UNIT - II PART- A

1. Obtain Fourier Series Coefficients for $x(n) = sinw_0n$
2. Give Synthesis and Analysis Equation of Continuous time Fourier Transform.
3. Define ROC of the Laplace Transform.
4. State Initial and Final value Theorem of Laplace Transforms.
5. Find the Laplace Transform of the signal$(t) = e^{-at}u(t)$.
6. State Convolution property of Fourier Transform.
7. Give the Relationship between Laplace Transform and Fourier Transform.
8. What are the Transfer functions of the following?
   a) An ideal integrator
   b) An ideal delay of T seconds.
9. Write the N^{th} order differential equation.
10. What are the Dirichlet's conditions of Fourier series?
11. What is the condition for Laplace transform to exist.
12. Write the equations for trigonometric & exponential Fourier series .
13. What are the Laplace transform of δ(t) and u(t)?
14. Find the Fourier transform of $x(t)=e^{j2\pi ft}$?
15. Difference between unilateral and bilateral transform
16. The output response (t) of a continuous time LTI system is $2e^{-3t}(t)$ when the input x(t) is u(t) find the Transfer function.
17. Find the transfer function of an ideal differentiator.
18. What is meant by Total response.
19. Write the differentiation and integration property of Laplace transform.
20. State Parseval's theorem of Fourier series

PART - B

1. i). Distinguish between Fourier series Analysis and Fourier Transforms

ii. Obtain Fourier series of half wave Rectified Sine wave.

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

$$X(s) = \frac{1}{s^2+3s+2}\text{ , ROC: -2< Re\{s\} <-1}$$

3. i). Find the Laplace Transform and ROC of the signal $(t) = e^{-at}u(t) + e^{-bt}u(t)$

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) $x(t) = u(t - 2)$

b) $(t) = t^2e^{-2t}u(t)$

ii) Find the Fourier Transform of Rectangular pulse. Sketch the signal and Fourier transform.

6. i. Find out the inverse Laplace Transform of

$$X(s) = \frac{s-2}{s(s+1)^3}$$

ii) What are the two types of Fourier representations? Give the relevant mathematical representations. iii) iii. Solve the differential equation:

$$\frac{d^2y(t)}{dt} + 4\frac{dy(t)}{dt} + 5y(t) = 5x(t)$$ 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 $(s) = \frac{2s^2+5s+5}{(s+1)^2(s+2)}$; Re{s}>-1

ii. Determine the initial value and final value of signal x(t) whose Laplace Transform is,

$$X(s) = \frac{2s+5}{s(s+3)}$$

11. State and prove the properties of Fourier Transform

12. Obtain Trigonometric Fourier series for the full wave rectified sine wave

<u>UNIT-III</u> <u>PART-A</u>

1. What is the Laplace transform of the function X(t)=u(t)-u(t-2)
2. What are the transfer functions of the following
   a) An ideal integrator
   b) An ideal delay of T seconds

3. State the convolution Integral for CT LTI systems?
4. What is the impulse response of two LTI systems connected in parallel?
5. Write the N^{th} order differential equation
6. Write down the convolution integral to find the output of the CT systems
7. Give the system impulse response h(t). State the conditions for stability and causality.
8. Write the equation for the complete response of a CT system in terms of state transition matrix.
9. What is meant by impulse response of any system?
10. Determine the Laplace transform of the signal f(t-5) &u(t-5)
11. Determine the convolution of the signals X(n)={2,-1,3,2} & h(n)={1,-1,1,1}
12. List and draw the basic elements for the bloc diagram representation of the CT systems.
13. Check the causality of the system with response $h(t)=e^{-t}u(t)$.
14. What are the three elementary operations in block diagram representation of CT system
15. Check whether the causal system with transfer function $h(s)=\frac{1}{s-2}$ is stable
16. What is the condition of LTI system to be stable?
17. Define LTI CT systems
18. List and state the properties of convolution Integral.
19. What are the tools used for analysis of LTI CT systems?
20. Define Natural, Forced and complete response?

PART-B

1. i) Determine the impulse response h(t) of the system given by the differential equation $\frac{d^2y(t)}{dt^2}+3\frac{dy(t)}{dt}+2y(t) = x(t)$ with all initial conditions to be zero.

   ii) Obtain DF-I realization of,

$$\frac{d^2y(t)}{dt^2}+5\frac{dy(t)}{dt}+4y(t)=\frac{dx(t)}{dt}$$

2. The system produces the output $y(t) = e^{-t}u(t)$ for an input $x(t) = e^{-2t}u(t)$. Determine i) frequency response ii)
   magnitude & phase of the response iii)
   the impulse response
3. i) define convolution Integral and describe its equation.
   ii) A stable LTI system is characterized by the differential equation

$$\frac{d^2y(t)}{dt^2}+4\frac{dy(t)}{dt}+3y(t)=\frac{dx(t)}{dt}+2x(t)$$

   Find the frequency response & Impulse response using Fourier transform.

4. i) Draw DF-I cascade form & parallel form of a system with system function,

$$H(s)=\frac{1}{(s+1)(s+2)}$$

5. Compute & plot the convolution y(t) of the given signals.
   i) X(t)=u(t-3) – u(t-5) ,h(t)=e^{-3t}u(t) ii) X(t)=u(t)
   ,h(t)= e^{-t}u(t)
6. The LTI system is characterized by impulse response for given by H(s)=$\frac{1}{(s+10)}$ Roc : R_e>.10.

   i)Determine the output of a system when it is excited by the input

   $$x(t)=-2e^{-2t}u(-t)-3e^{-3t}u(t)$$
7. i) What is Impulse Response? Show that the Response of an LTI system is convolution Integral of its impulse Response with input signal?
   ii) Obtain the convolution of the following two signals?
   $$X(t)=e^{2t}u(-t)$$
   h(t) = u(t-3)
8. The input x(t) & y(t) for a system satisfy the differential equation

   $$\frac{d^2y(t)}{dt^2}+3\frac{dy(t)}{dt}+2y(t)=x(t)$$
   i) Compute the transfer function & impulse response ii) Draw DF, cascade form & parallel form Representations
9. i) Explain the steps to Compute convolution of two integrals.
   ii) Find the Convolution of the following signals.
   $$x(t) = e^{-2t}u(t)$$
   $$h(t) = u(t+2)$$
10. i). Explain the properties of convolution integral.

    ii). Using laplace transform, find the impulse response of an LTI system described by the differential equation.
    $$\frac{d^2y(t)}{dt^2}-\frac{dy(t)}{dt}-2y(t)=x(t)$$
11. i). Realize the following in direct form II
    $$\frac{d^3y(t)}{dt^3}+4\frac{d^2y(t)}{dt^2}+7\frac{dy(t)}{dt}+8y(t)=5\frac{d^2x(t)}{dt^2}+4\frac{dx(t)}{dt}+7x(t)$$
    ii). obtain convolution of the signals $x_1(t)=e^{-at}u(t)$ and $x_2(t)=e^{-bt}u(t)$ 12.

12.i) Find the laplace transform of the signal.
$$x(t)=e^{-at}u(t)+e^{-bt}u(-t)$$
ii). Find the Fourier transform of
$$x(t)=e^{-|t|}\ for -1\le t\le 1$$
$$= 0 \qquad \text{otherwise}$$

UNIT IV PART A

1. Define Sampling theorem?
2. Define convolution integral of continuous time system?
3. What is main condition to avoid aliasing?
4. What is ROC in Z transforms?
5. What is z transform of sequence $X(n)=a^n u(n)$
6. What is the relation between DTFT and Z transform?
7. Find DTFT of u(n).
8. Define unilateral and bilateral Z transform
9. Define convolution sum with its equation
10. Check whether the system with system function H(z)=1/(1-1/2z-1)
11. Prove that x(n) * =x(n)
12. Find the convolution of two sequence x(n)={1,1,1,1} h(n)={2,2}
13. Define system function.
14. Define shifting property of the discrete time unit impulse function.
15. State the sufficient condition for the existence of DTFT for an aperiodic sequence?
16. State Parseval's relation for discrete time aperiodic signals.
17. What is an antialiasing filter?
18. Define one sided Z transform and two sided Z transform.
19. What is convolution property of DTFT
20. Find the system function for the given difference equation Y(n) = 0.5 y(n-1)+ x(n)

PART B

1. i) Prove the sampling theorem and explain how the original signal can be reconstructed from the sampled version.

   ii) Find the DTFT for the signal $x(n) = u(n-2)$

2. State & explain the following Properties of DTFT

   1) Convolution
   2) Time Shifting
   3) Time Reversal
   4) Frequency Shifting

3. Determine the Z Transform of the Signal

   x(n)={1,2,3,2}

   x(n)={1,2,-1,2,3}   x(n)= u(n)-u(n-

4. (i) State and prove the Convolution Property of Z Transform

ii) Obtain the relationship between DTFT and Z transform

5. State and prove the following properties of Z transform

   i) Linearity

   ii) Time shifting

   iii) Differentiation

   iv) Correlation

6. Find the inverse Z Transform of $X(z) = 1/(1-0.5z^{-1} + 0.5z^{-2})$

   for ROC $|Z| >1$

7. Determine the transfer function and impulse response for the causal LTI system described by the equation using Z transform

   $Y(n) – 1/4y(n-1)-3/8y(n-2) = -x(n) + 2x(n-1)$

8. Find the Z transform and ROC of the sequence $x(n) = r^{n} \cos(n\theta)u(n)$

9. Determine the Z transform of $x(n) = a^{n} \cos(w_o n)u(n)$

10. Determine the DTFT of $(1/2)^{n} u(n)$.Plot its spectrum.

11. Compute the response of the system

   $Y(n) = 0.7 y(2n-1) – 0.12y(n-2) + x(n-1) + x(n-2)$

12. State and prove sampling theorem for low pass band limited signal and explain the process of reconstruction of the signal from its samples.

UNIT-V PART A

1. Define one sided Z- transform and two sided Z-transform?
2. Define the shifting property of discrete time unit impulse function?
3. What is the Z-transform of sequence $x(n)=a^nu(n)$?
4. Define system function?
5. Determine the range of ‘a’ for which the LTI system with impulse response $h(n)=a^nu(n)$ Is stable

6. PT x(n)*del(n)= x(n)
7. Write the difference equation for non recursive system?
8. Find the convolution of two sequences x(n)={1,1,1,1} and h(n)={2,2}?
9. What is the overall impulse response h(n) when two system impulse response h1(n) and h2(n) are connected in parallel and in series?
10. State any two properties of DFT?
11. Find the DFT of x(n)={1,1,1,1,1,1,0,0} 12. Define natural response and forced response?
13. Find the convolution of x1(t) and x2(t) ,x1(t)=tu(t),x2=u(t) 14. What is mean by ROC?
15. Define the impulse response and step response of a system?
16. What are the properties of convolution?
17. Find linear convolution of x(n)={1,2,3,4,5,6} wih y(n)={2,-4,6,-8}
18. What is the overall impulse response h(n)when two system with impulse response h1(n)and h2(n) are connected in parallel in series?
19. What is the necessary and sufficient condition on impulse response for stability?
20. What are the basic operations on block diagram representation?

PART B

1. Find the impulse response of the discrete time system described by the difference equation

   y(n-2)-3y(n-1)+2y(n)=x(n-1)
2. Discuss the block diagram representation for LTI discrete time systems
3. Describe the state variable model for discrete time systems.
4. Find the state variable matrices A,B,C,D for the equation

   y(n)-3y(n-1)-2y(n-2)=x(n)+5x(n-1)+6x(n-2)
5. Find the impulse and step response of the following system

   y(n)-3/4y(n-1)+1/8y(n-2)=x(n)
6. Obtain the cascade and parallel form realization of the following system

   y(n)-1/4y(n-1)-1/8y(n-2)= x(n)+3x(n-1)+2x(n-2)
7. (a) The system function of the LTI system is given as

   $H(Z)= (3-4(Z^{-1})) / (1-3.5Z+1.5Z^{2})$

   Specify the ROC of H(Z) and determine h(n) for the following condition

   (1) stable system

   (2) causal system

   (b) Obtain the discrete form II structure for

   y(n)-3/4y(n-1)+1/8y(n-2)=x(n)+1/2x(n-1)

8. A discrete time causal system has a transfer function

   $H(Z)= (1-Z^{-1}) / (1-0.2Z^{-1}-0.15Z^{-2})$

(i) Determine the difference equation of the system

(ii) Show pole zero diagram

(iii) Find the impulse response

9. (a) Obtain the cascade realization of

   Y(n)-1/4y(n-1)-1/8y(n-2)=x(n)+3x(n-1)+2x(n-2)

   (b) Obtain the relationship between DIFT and Z transforms.

10. The state variable description of the system is given as

$$A=\begin{bmatrix} 0 & 1 \\ -1 & 1 \end{bmatrix},\ B=\begin{bmatrix} 0 \\ 2 \end{bmatrix}, C=[3\ \ 0],\ D=[0]$$

   Determine the transfer function of the system

11. Determine the system function and impulse response of the causal LTI system

   Defined by the difference equation

   Y(n)-1/2y(n-1)+1/4y(n-2)=x(n)

   Using Z transform, determine y(n) if x(n)=u(n).

12. Determine the state model of the system governed by the equation

   Y(n)=-2y(n-1)+3y(n-2)+0.5y(n-3)+2x(n)+1.5x(n-1)+2.5x(n-2)+4x(n-3)