SRM VALLIAMMAI ENGINEERING OLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

III SEMESTER

EC3363 SIGNALS AND SYSTEMS

Regulation – 2023

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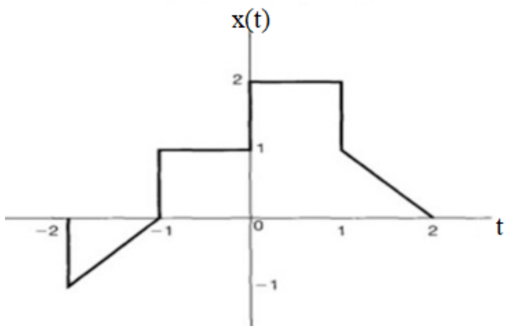
SUBJECT : EC3363 SIGNALS AND SYSTEMS

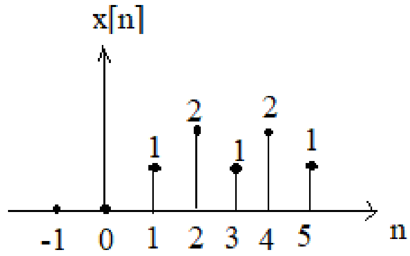
SEM / YEAR: III/ II-year B.E.

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS				
Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_ Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.				
PART – A				
Q. No	Questions	CO	BT Level	Competence
1.	Distinguish between continuous and discrete time signal.	CO1	BTL 2	Understanding
2.	List the elementary continuous time signals.	CO1	BTL 1	Remembering
3.	Define symmetric and anti-symmetric signals.	CO1	BTL 1	Remembering
4.	Express the signal for given function $x[n] = u[n] - u[n-5]$.	CO1	BTL 2	Understanding
5.	Label the signal$u(t-2) - u(t-5)$.	CO1	BTL 2	Understanding
6.	Find the periodicity of $\cos(0.1\pi n)$.	CO1	BTL 2	Understanding
7.	Write the conditions for a system to be an LTI System.	CO1	BTL 2	Understanding
8.	When the system is said to be memoryless? Give example.	CO1	BTL 2	Understanding
9.	Identify whether the following system is Time Invariant/Time variant and also causal/non causal: $y(t) = x(\frac{t}{3})$.	CO1	BTL 1	Remembering
10.	The system is described by$y[n] = x[2n]$. Classify it as static or dynamic and also causal or non-causal system.	CO1	BTL 2	Understanding
11.	Outline the periodicity of the discrete time signal$\sin[3n]$.	CO1	BTL 2	Understanding
12.	Express the relationship among the impulse signal and step signal.	CO1	BTL 2	Understanding
13.	Compare energy and power signals.	CO1	BTL 2	Understanding
14.	Show whether the signal $x(n) = \sin(\frac{6\pi n}{7} + 1)$ is periodic. If periodic what is its fundamental period ‘T’?	CO1	BTL 1	Remembering
15.	Find the even and odd components of the signal $x(t) = e^{jt}$	CO1	BTL 1	Remembering
16.	Distinguish between odd and even signals.	CO1	BTL 2	Understanding
17.	What is the energy and power of a unit step signal?	CO1	BTL 1	Remembering
18.	Find whether the signal is causal or not. $y(n) = u(n+3) - u(n-2)$.	CO1	BTL 1	Remembering
19.	Predict the conditions for the system to be BIBO Stability.	CO1	BTL 1	Remembering
20.	Infer whether the given system described by the equation is linear	CO1	BTL 2	Understanding

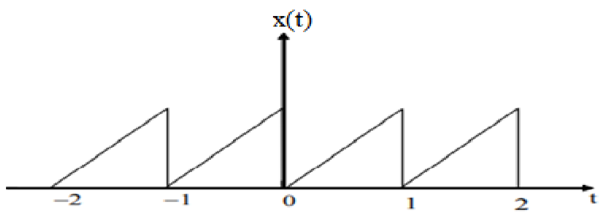
	or not. $y(n) = nx(n)$.				
21	Examine the mathematical and graphical representation of discrete type ramp sequence.		CO1	BTL 1	Remembering
22	Mention two types of time scaling with example.		CO1	BTL 1	Remembering
23	State the input-output relationship of a discrete time systems y(n)= cos[x(n)]. Check whether the system is stable.		CO1	BTL 1	Remembering
24	List the properties of linear system.		CO1	BTL 1	Remembering
	PART- B				
1.	(i) Write about elementary Continuous time Signals in detail. (ii) Find whether the following signal is periodic. If periodic, Determine the fundamental period. (a) $x(t) = e^{j\frac{2\pi}{3}t} + e^{j\frac{3\pi}{4}t}$ (b) $x(t) = 3\cos(4t) + 2\sin(\pi t)$	(8) (8)	CO1	BTL 3	Applying
2.	(i) Identify whether the following systems are linear or not. (a) $y(t) = x^2(t)$ (b) $y[n] = 3x[n] + \frac{1}{x[n-1]}$ (ii) Derive the odd and even components of the following signal. $x(t) = \sin(t) + 2\sin(t) + 2\sin^2(t)\cos(t)$	(8) (8)	CO1	BTL 4	Analyzing
3.	(i) Examine whether the following systems are time invariant or not. (a) $y(t) = e^{x(t)}$ (b) $y[n] = x(n) + nx(n-1)$ (ii) What is the power and RMS value of the signal? (a) $x(t) = Acos(\Omega_0 t + \theta)$ (b) $x(t) = \cos(t)$	(8) (8)	CO1	BTL 4	Analyzing
4.	(i) Identify whether the following systems are linear or not. (a) $\frac{dy}{dt} + 3ty(t) = t^2x(t)$ (b) $\frac{dy}{dt} + 2y(t) = x(t)\frac{dx(t)}{dt}$ (ii) Examine whether the following system are time invariant or not (a)$y(t) = x(-t)$ (b)$y(n) = x(n^2)$	(5) (5) (3) (3)	CO1	BTL 3	Applying
5.	(i) Check whether the following signals are periodic or not. (a) $x(t) = 2\cos(10t + 1) - \sin(4t - 1)$ (b) $x(t) = u(t) - u(t - 10)$ (ii) Estimate the fundamental period T for the following	(8) (8)	CO1	BTL 4	Analyzing

	continuous time signals. (a) $y(t) = 20\cos(10\pi t + {}^{\pi}/_{6})$ (a) $x(t) = 3\cos(17\pi t + {}^{\pi}/_{3})$ $+2\sin(19\pi t - {}^{\pi}/_{3})$				
6.	(i) A Continuous time signal x(t) is shown in figure below, Sketch and label each of the following signals (a)x(t-1) (b) x(2-t) (c) x(t)[$\delta(t+\frac{3}{2})$ - $\delta(t-\frac{3}{2})$] (d) x(2t+1)  { (ii) Estimate the energy and power of the given signal x[n]= $cos\ [\frac{\pi}{4}n]$	(9) (7)	CO1	BTL 4	Analyzing
7.	Examine whether the following signals are energy signals or power signals (a) $y(n) = \left(\frac{1}{3}\right)^{n} u[n]$ (b) $x(t) = tu(t)$ (c) $x(t) = (1 + e^{-5t})$	(5) (5) (6)	CO1	BTL 3	Applying
8.	(i) Sketch the following signals (a) $-2u(t-1)$ (b) $3r(t-1)$ (c) $-2r(t)$ (d) $r(-t+2)$ Where u(t) and r(t) are unit step and unit ramp signal respectively. (ii) Determine the power and R.M.S value of the following signal $y(t) = 10\sin(50\pi t + {}^{\pi}/_{4})$+ $16\sin(100t + {}^{\pi}/_{3})$	(8) (8)	CO1	BTL 3	Applying
9.	(i) Find whether the following systems are dynamic or not		CO1	BTL 3	Applying

	(a) $y(t) = x(t-2)$ (b) $y(n) = x(n+2)$ (c) $y(t) = x^2(t)$ (ii) Check whether the following systems are casual or not (a) $y(n) = x(n) + \frac{1}{x(n-1)}$ (b) $y(n) = x(-n)$ (c) $y(n) = x(n^2)$	(3) (3) (3) (3) (2) (2)			
10.	(i) Analyze whether the following systems are linear or not. (a) $y(t) = e^{x(t)}$ (b) $y(t) = t^2 x(t)$ (ii) Examine whether the following systems are time invariant or not. (a) $y(n) = x(-n)$ (b) $y(n) = x(n+1) + x(n) + x(n-1)$	(5) (5) (3) (3)	CO1	BTL 4	Analyzing
11.	The input-output relation of a full wave rectifier is given by $y(t) = \|x(t)\|$. Analyze whether the full wave rectifier is (a) Linear (b) Time-invariant (c) Stable (d) Memoryless (e) Causal.	(3) (4) (3) (3) (3)	CO1	BTL 3	Applying
12.	Identify whether the following systems are static or dynamic, linear or nonlinear, and time invariant or time variant. (i) y(n) = x(n) - x(n-1) (ii) y(t)=$\frac{d}{dt}x(t)$	(8) (8)	CO1	BTL 4	Analyzing
13.	(i)Examine the fundamental period T of the continuous time signal $x(t) = 3\cos(60\pi t)+2\sin(50\pi t)$. (ii)Sketch the waveforms represented by the following functions. $f_1(t) = 2u(t-1)$ $f_2(t) = -2u(t-2)$ $f(t) = f_1(t) + f_2(t)$ $f(t) = f_1(t) - f_2(t)$	(8) (8)	CO1	BTL 3	Applying
14.	A discrete time signal x[n] is shown below.		CO1	BTL 4	Analyzing

	 Sketch and label carefully each of the following signals. (i) $x[n-2]$ (ii) $x[n+1]$ (iii) $x[-n]$ (iv) $x[-n+1]$ (i) $x[2n]$	(3) (3) (3) (4) (3)			
15.	Derive the relation between the following signals (i) unit ramp and unit step signals (ii) unit step and unit impulse signals	 (8) (8)	CO1	BTL 3	Applying
16.	Check periodicity of the following signal and also determine the fundamental period, if they are periodic. (i) $x(n) = cos(\pi n/5) sin(\pi n/3)$. (ii) $cos100\pi t + sin50\pi t$ (iii) $x(n) = sin(\frac{6\pi n}{7} + 1)$	(6) (5) (5)	CO1	BTL 3	Applying
17.	Classify the following signals as energy, power signals or neither and find the corresponding value. (i) $x(t) = e^{-2t} u(t)$ (ii) $x(n) = -(0.5)^n u(n)$ (iii) $x(t) = e^{j(3t + \pi/4)}$	(5) (5) (6)	CO1	BTL 4	Analyzing

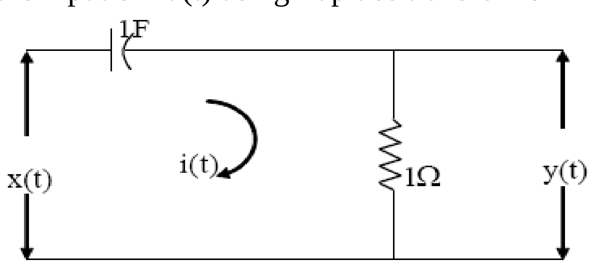
UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS				
Fourier series for periodic signals - Fourier Transform – Inverse Fourier Transform - properties- Laplace Transforms - Inverse Laplace Transform and properties				
PART – A				
Q. No	Questions	CO	BT Level	Competence
1.	Define Parseval's relation for CT periodic signals.	CO2	BTL 1	Remembering
2.	List the equations for trigonometric & exponential Fourier series.	CO2	BTL 1	Remembering
3.	State the Dirichlet's conditions of Fourier series.	CO2	BTL 1	Remembering
4.	Solve for the complex Fourier series representation of $x(t) = \sin \omega_0$ t.	CO2	BTL 2	Understanding
5.	Express the Fourier series representation of the signal $$x(t) = cos(\frac{2\pi}{3}t)$$	CO2	BTL 2	Understanding
6.	Distinguish between Fourier series and Fourier transform.	CO2	BTL 2	Understanding
7.	What is the Fourier transform of the signal, $x(t)=e^{-at}u(t)$?	CO2	BTL 1	Remembering
8.	Mention the Fourier Series coefficients of the signal, x(t)=4(cos t) (sin 4t)	CO2	BTL 1	Remembering
9.	Infer the Fourier transform of $x(t)= 6\sin^2 2t$.	CO2	BTL 2	Understanding
10.	Outline the significance of Fourier series representation.	CO2	BTL 2	Understanding
11.	Using Fourier transform property, determine the Fourier transform of x(t) = x(4t – 8).	CO2	BTL 2	Understanding
12.	Find the Fourier transform of the signal x(t) = δ(t) also sketch the magnitude and phase spectrum.	CO2	BTL 2	Understanding
13.	The function x(t) is defined as, x(t) =u(t)-u(t-2). Calculate X(s).	CO2	BTL 2	Understanding
14.	Interpret the Laplace transform of $x(t) = 2e^{-2t}u(t)+4e^{-4t}u(t)$ and analyze its ROC.	CO2	BTL 2	Understanding
15.	Define the Laplace transform of δ(t) and u(t).	CO2	BTL 1	Remembering
16.	Compare the Relationship between Laplace Transform and Fourier Transform.	CO2	BTL 2	Understanding
17.	Interpret the significance of ROC of the Laplace Transform.	CO2	BTL 1	Remembering
18.	What is x(t)? from given X(s), if $X(s)= \frac{1}{s(s+2)}$.	CO2	BTL 1	Remembering
19.	Find the Laplace Transform of the signal $x(t) =-te^{-2t}$ u(t).	CO2	BTL 1	Remembering
20.	Write the differentiation and integration property of Laplace transform.	CO2	BTL 1	Remembering
21	Differentiate between Fourier series and Fourier transform.	CO2	BTL 2	Understanding
22	Outline the analysis and synthesis equations of Fourier transform.	CO2	BTL 2	Understanding
23	Mention the initial and final value of the function $x(s) = \frac{1}{s^2+5s-2}$.	CO2	BTL 1	Remembering
24	List the various mathematical tools to be used for continuous time signals.	CO2	BTL 1	Remembering
PART- B				
1.	Realize the Fourier transform of each of the following signals and sketch the magnitude and phase as a function of frequency, including both positive and negative frequencies	CO2	BTL 4	Analyzing

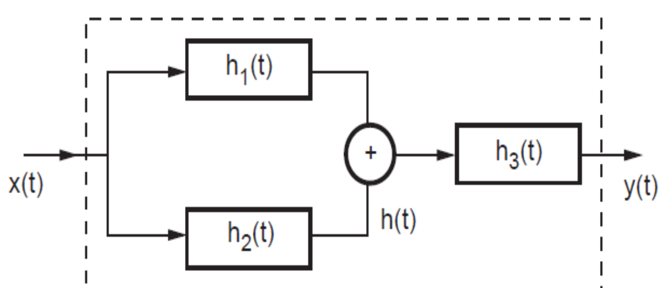
	(i) $\delta(t+1) + \delta(t-1)$ (ii) $e^{-at}u(t)$, α-real and positive	(8) (8)			
2.	(i) Solve the Fourier transform of $x(t)=e^{-at}u(-t)$ (ii) Determine the Fourier series representation of the signal $x(t) = 2+\cos(4t) + \sin(6t)$.	(8) (8)	CO2	BTL 3	Applying
3.	Examine the trigonometric Fourier series over the interval (-1, 1) for the signal $x(t) = t^2$.	(16)	CO2	BTL 4	Analyzing
4.	Obtain the exponential Fourier series for the periodic signal $x(t) = t;\ 0 < t < 1$ and it repeats for every one second. 	(16)	CO2	BTL 4	Analyzing
5.	Determine the Fourier transform of $x(t) = e^{-2\|t\|}u(t)$ and plot the Fourier spectrum.	(16)	CO2	BTL 3	Applying
6.	(i) Illustrate the properties of CT Fourier Transform. (ii) Describe about the Trigonometric Fourier series for the full wave rectified sine wave.	(8) (8)	CO2	BTL 3	Applying
7.	(i) Estimate the Fourier Transform of $x(t) = 1-e^{-\|t\|}\cos\omega_0 t$. (ii) Derive the Fourier Transform of Rectangular pulse and sketch the signal.	(8) (8)	CO2	BTL 4	Analyzing
8.	Using Partial fraction expansion find inverse Fourier transform for the following, (i) $X(j\Omega) = \frac{5j\Omega+12}{(j\Omega)^2+5(j\Omega)+6}$ (ii) $X(j\Omega) = \frac{1+2j\Omega}{(j\Omega+2)^2}$	 (8) (8)	CO2	BTL 3	Applying
9.	(i) Derive the Laplace Transform and ROC of the signal $x(t)=e^{-3t}u(t)+e^{-2t}u(t)$ (ii) State and prove the convolution property of Laplace transform.	(8) (8)	CO2	BTL 4	Analyzing
10.	(i) Solve the inverse Laplace transform of $x(s) = \frac{(s+3)}{(s+1)(s+2)^2}$. (ii) Calculate the initial value and final value of signal x(t) whose Laplace Transform is $x(s) = \frac{s+5}{s^2+3s+2}$.	(8) (8)	CO2	BTL 3	Applying
11.	(i) Find the inverse Laplace Transform of, $x(s) = \frac{3}{s^2(s+1)}$. (ii) Solve for the Laplace Transform of, $x(t) = t^2e^{-2t}u(t)$.	(8) (8)	CO2	BTL 3	Applying

12.	Analyze the inverse Laplace transform of x(s) = $\frac{4}{(s+2)(s+4)}$ with reference to the following ROCs. (i)Re(s) < -4 (ii) Re(s) > -2 (iii) -2 > Re(s) > -4.	(16)	CO2	BTL 4	Analyzing
13.	Evaluate the Laplace transform, ROC, Pole location for the following signals. (i) x(t) =$e^{-b\|t\|}$ (ii) x(t)=e^{-at}u(t)+ e^{-bt}u(-t)	 (8) (8)	CO2	BTL 4	Analyzing
14.	For the Laplace transform of, $x(t) = \{e^t sin2t, \quad t \leq 0, 0 \qquad t > 0$ Find the location of its poles and plot it. Also identify its Region of Convergence.	(16)	CO2	BTL 4	Analyzing
15.	Compute the Fourier transform for the following signals x(t) = $e^{-at}\ u(t)$ and plot the Fourier spectrum.	(16)	CO2	BTL 4	Analyzing
16.	Obtain the Laplace transform of the following (i) $e^{-at}\ sin\omega t$ (ii) $e^{-at}\ cos\omega t$	 (8) (8)	CO2	BTL 3	Applying
17.	State and prove the following properties of Laplace transform. (i) Linearity (ii) Time shifting (iii) Time scaling (iv) Differentiation in time domain	 (4) (4) (4) (4)	CO2	BTL 3	Applying

UNIT III LINEAR TIME INVARIANT- CONTINUOUS TIME SYSTEMS				
Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.				
PART - A				
Q.No	Questions	CO	BT Level	Competence
1.	Write the condition for LTI system to be stable and causal.	CO3	BTL 1	Remembering
2.	Given the differential equation representation of the system $\frac{d^2y(t)}{dt^2} + 2\frac{dy(t)}{dt} - 3y(t) = 2\,x(t)$. Examine the frequency response.	CO3	BTL 2	Understanding
3.	Identify the differential equation relating the input and output a CT system represented by $H(j\Omega) = \frac{1}{(j\Omega)^2+8(j\Omega)+1}$	CO3	BTL 1	Remembering
4.	Given the input x(t) =u(t) and h(t) = δ(t-1). Find the response y(t).	CO3	BTL 1	Remembering
5.	List the properties for convolution integral.	CO3	BTL 1	Remembering
6.	The input - output relationship of the system is described as,	CO3	BTL 1	Remembering

	$\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 2y = \frac{dx}{dt}$. Find the system function H(s) of the system.				
7.	What is the impulse response of an LTI system?		CO3	BTL 1	Remembering
8.	Given H(s) = $\frac{1}{s^2+2s+1}$. Express the differential equation representation of the system.		CO3	BTL 2	Understanding
9.	Estimate whether the causal system with transfer function $H(s) = \frac{1}{s-2}$ is stable.		CO3	BTL 2	Understanding
10.	What is the the unit step response of a CT LTI system ? if $h(t) = e^{-2t}u(t)$.		CO3	BTL 1	Remembering
11.	If the system function $H(s) = 4 - \frac{3}{s+2}$; Re(s)>-2, analyze the impulse response h(t)		CO3	BTL 2	Understanding
12.	Find the unit step response of the system given by $$h(t) = (\frac{1}{RC})\, e^{-\frac{t}{RC}}\, u(t).$$		CO3	BTL 2	Understanding
13.	Solve the impulse response of the system given by $H(s) = 1/(s+9)$.		CO3	BTL 1	Remembering
14.	Explain the expression of convolution integral.		CO3	BTL 2	Understanding
15.	What is the impulse responses of two systems $h_1(t)$ and $h_2(t)$ when connected in cascade?		CO3	BTL 2	Understanding
16.	Two systems with impulse response $h_1(t) = e^{-at}\, u(t)$ and $h_2(t) = u(t-1)$ are connected in parallel. What is the overall impulse response h(t) of the system?		CO3	BTL 2	Understanding
17.	Examine the causality of the system with response h(t)= e^{-t} u(t).		CO3	BTL 2	Understanding
18.	Find the transfer function of the system with the impulse response, h(t) = δ(t) + e^{-3t} u(t) + $2e^{-t}$ u(t).		CO3	BTL 2	Understanding
19.	Write the N^{th} order differential equation for an LTI continuous time system.		CO3	BTL 2	Understanding
20.	Combine the following signals using Convolution. u(t-1) and δ(t-1).		CO3	BTL 1	Remembering
21	What are the drawbacks of representing a system using its transfer function?		CO3	BTL 1	Remembering
22	Check whether given system is causal and stable. h(t)=e^{-4t} u(t+10).		CO3	BTL 2	Understanding
23	Given $H(s) = \frac{s^2}{s^2+2s+1}$, Determine the differential equation of the system.		CO3	BTL 1	Remembering
24	Mention the three elementary operations in block diagram representation of CT Systems.		CO3	BTL 1	Remembering
	PART- B				
1.	Evaluate the Convolution of following signals. x(t) = u(t) and h(t)= e^{-at} u(t), |a| > 0	(16)	CO3	BTL 4	Analyzing
2.	(i) Analyze convolution Integral and describe its equation. (ii) A stable LTI system is characterized by the differential	(8) (8)	CO3	BTL 4	Analyzing

	equation $d^2y(t)/dt^2 + 4dy(t)/dt + 3y(t) = dx(t)/dt + 2x(t)$. Derive its frequency response & impulse response using Fourier transform.				
3.	(i) Examine the impulse response h(t) of the system given by the differential equation $d^2y(t)/dt^2 + 3dy(t)/dt + 2y(t) = x(t)$ with all initial conditions to be zero. (ii) Calculate the unit step response of the first order system governed by the equation $\frac{dy(t)}{dt} + 0.5y(t) = x(t)$ with zero initial conditions.	(8) (8)	CO3	BTL 4	Analyzing
4.	Solve the output expression of the system described by the differential equation $d^2y(t)/dt^2 + 6dy(t)/dt + 8y(t) = dx(t)/dt + x(t)$, when the input signal is x(t) =u(t) and the initial conditions are $y(0^+)=1, dy(0^+)/dt=1$.	(16)	CO3	BTL 3	Applying
5.	The system produces the output y(t) = e^{-t}u(t) for an input x(t) =e^{-2t}u(t). Estimate its frequency response and impulse response.	(16)	CO3	BTL 3	Applying
6.	(i) The impulse response of the system is e^{-4t}u(t) and the output response is $[1-e^{-4t}]$ u(t). Estimate the input x(t). (ii) Using Laplace transform, obtain the impulse response of an LTI system described by the differential equation. $d^2y(t)/dt^2 - dy(t)/dt - 2y(t) = x(t)$.	(8) (8)	CO3	BTL 3	Applying
7.	(i) Solve the transfer function of the system for the impulse response h(t)= $\delta(t) + e^{-3t}u(t) + 2e^{-t}u(t)$ (ii) Calculate the output of the system shown in figure for the input e^{-2t} u(t) using Laplace transform. 	(8) (8)	CO3	BTL 3	Applying
8.	Examine the convolution y(t) of the given signals. (i) x(t)=cost u(t), h(t)=u(t) (ii) x(t)=u(t), h(t)= $\frac{R}{L}e^{-tR/L}$u(t)	(8) (8)	CO3	BTL 3	Applying
9.	(i) Using graphical method, determine the output y[t] for the LTI system with impulse response h[t] = u(t-3) and input x[t]= (t+1). (ii) Solve the step response of the system h(t) = e^{-4t} u(t).	(8) (8)	CO3	BTL 3	Applying
10.	The input-output of a causal LTI system is related by the differential equation $d^2y(t)/dt^2 + 6dy(t)/dt + 8y(t) = 2x(t)$.		CO3	BTL 4	Analyzing

	(i) Determine the impulse response of h(t). (ii) Analyze the response y(t) of the system if x(t)=u(t) using Fourier Transform.	(8) (8)			
11.	Estimate the output response (y(t)) of the following systems (h(t)) for the given input (x(t)). (i) $x(t) = u(t)$, $h(t) = 2e^{-3t}u(t)$ (ii) $x(t) = e^{-t}u(t)$, $h(t) = e^{-2t}u(t)$	 (8) (8)	CO3	BTL 3	Applying
12.	Examine the impulse response and step response of the system $H(s) = \frac{s+4}{s^2+5s+6}$.	(16)	CO3	BTL 4	Analyzing
13.	A system is described by the differential equation $d^2y(t)/dt^2 + 5\,dy(t)/dt + 6y(t) = dx(t)/dt + x(t)$, $dy(0^-)/dt = 3$, $y(0) = 1$, $x(t) = u(t)$. Find the transfer function and output signal y(t).	(16)	CO3	BTL 3	Applying
14.	The LTI system, initially at rest is described by the differential equation $d^2y/dt^2 + 3\,dy/dt + 2y = dx/dt + 3x$. Estimate the system function H(s) and impulse response h(t).	(16)	CO3	BTL 4	Analyzing
15.	Solve and draw the direct form-I and II implementation of the system described by the following differential equation $dy(t)/dt + 5y(t) = 3\,x(t)$.	(16)	CO3	BTL 4	Analyzing
16.	An LTI system is represented by $\frac{d^2y(t)}{d^2t} + 4\frac{dy(t)}{dt} + 4\,y(t) = x(t)$ with initial conditions $y(0^-) = 0$; $y'(0^-) = 1$. Determine the output of the system when the input is $x(t) = e^{-t}u(t)$.	(16)	CO3	BTL 4	Analyzing
17.	Examine the overall impulse response of the following system shown below. Here $h_1(t) = e^{-2t}u(t)$ $h_2(t) = \delta(t) - \delta(t-1)$ $h_3(t) = \delta(t)$ Also find the output of the system for the input x(t) = u(t) using convolution integral.  	(16)	CO3	BTL 4	Analyzing

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS				
Baseband signal Sampling – Fourier Transform of discrete time signals (DTFT) - Inverse DTFT- Properties of DTFT - Z Transform Inverse Z Transform - & Properties.				
PART – A				
Q. No	Questions	CO	BT Level	Competence
1.	State Sampling theorem.	CO4	BTL 1	Remembering
2.	Find the DTFT of x(n)= δ(n)+ δ(n-1).	CO4	BTL 1	Remembering
3.	What is the main condition to avoid aliasing?	CO4	BTL 1	Remembering
4.	Write the condition for existence of DTFT.	CO4	BTL 1	Remembering
5.	Define DTFT and Inverse DTFT.	CO4	BTL 1	Remembering
6.	Outline the time folding property of Z-transform.	CO4	BTL 1	Remembering
7.	If $X(\omega)$ is the DTFT of x(n), find the DTFT of x(n-k)?	CO4	BTL 2	Understanding
8.	Write the expression for one sided Z-transform and two sided Z transform.	CO4	BTL 2	Understanding
9.	Solve for the the Nyquist rate of the signal x(t)=cos200πt + sin400πt.	CO4	BTL 2	Understanding
10.	List the methods of obtaining inverse Z transform.	CO4	BTL 2	Understanding
11.	Find the DTFT of u(n).	CO4	BTL 2	Understanding
12.	Summarize the initial value theorem of Z-transform.	CO4	BTL 2	Understanding
13.	Explain the Z transform of x(n)= {1,2,3,4}.	CO4	BTL 2	Understanding
14.	State the Parseval's relation for discrete time aperiodic signals.	CO4	BTL 2	Understanding
15.	Express the multiplication property of DTFT.	CO4	BTL 2	Understanding
16.	Infer about the convolution property of Z-transform.	CO4	BTL 2	Understanding
17.	Discuss the Z- transform and its associated ROC for the signal x[n]= 3δ[n+2]+2δ[n]+δ[n-1]- δ[n-2].	CO4	BTL 2	Understanding
18.	Explain the inverse Fourier transform of $X(\omega) = 1+ e^{-j\omega} + 2e^{-4j\omega}$.	CO4	BTL 1	Remembering
19.	Discuss the Z transform of sequence $x(n)=a^n u(n)$ and its ROC.	CO4	BTL 1	Remembering
20.	Explain the z-transform of δ(n+K).	CO4	BTL 2	Understanding
21	Distinguish the relationship between Z-transform and Fourier transform.	CO4	BTL 1	Remembering
22	Explain the Z-transform of x(n)= δ[n]- 0.95 δ[n-6].	CO4	BTL 1	Remembering
23	Discuss the inverse Z- transform of $X(z) = \frac{1}{z-a}$ for |z|>|a|.	CO4	BTL 1	Remembering
24	A signal having a spectrum ranging from near to 50 KHz is to be sampled and converted to discrete form. What is the number of samples per second that must be taken to ensure recovery?	CO4	BTL 1	Remembering

PART- B					
1.	(i) Consider an analog signal x(t) = 4sin100πt. (a) Calculate the minimum sampling rate to avoid aliasing. (b) If sampling rate Fs =400Hz, what is the discrete time signal after sampling? (ii) Solve the initial and final value theorem of Z- Transform.	(5) (5) (6)	CO4	BTL 3	Applying
2.	(i) Derive any four properties of DTFT. (ii) Examine the transfer function of a zero-order hold and	(8) (8)	CO4	BTL 3	Applying

	explain.				
3.	(i) Solve for the Nyquist rate and the Nyquist interval for the signal x(t)= ¼π $cos(5000\pi t)cos(2000\pi t)$. (ii) State and prove the Parseval's theorem for DTFT.	(10) (6)	CO4	BTL 3	Applying
4.	(i) State and prove the sampling theorem and explain how the original signal can be reconstructed from the sampled version with necessary illustrations. (ii) Calculate the effects of under sampling and the steps to eliminate aliasing.	(8) (8)	CO4	BTL 4	Analyzing
5.	Discuss the following properties of Z transform (i) Time and frequency convolution property. (ii) Parseval's theorem.	 (8) (8)	CO4	BTL 4	Analyzing
6.	(i) Analyse the properties of ROC. (ii) Explain the contour integration method and find x(n) using this method for $X(Z) = \frac{Z}{(Z-1)3}$.	(8) (8)	CO4	BTL 4	Analyzing
7.	(i) Use convolution method to determine the inverse Z-transform of $X(Z) = \frac{Z^2}{(Z-2)(Z-3)}$. (ii)Solve the inverse Z-transform for the following sequences. X(Z)= $3Z^2+Z+2-3Z^{-1}+2Z^{-2}$	(10) (6)	CO4	BTL 4	Analyzing
8.	(i) Examine the convolution of two signals $x_1(n) = (1/2)^n u(n)$ and $x_2(n) = (1/4)^n u(n)$ using DTFT. (ii) Find the DTFT of $x(n) = 2 (3)^n u(-n)$.	(8) (8)	CO4	BTL 3	Applying
9.	(i) Determine Z transform and ROC of x(n) = u(-n) - u(n-3). (ii) Relate DTFT and Z transform with explanations.	(8) (8)	CO4	BTL 3	Applying
10.	Solve the Z transform and analyse the ROC of the following sequences: (i) $x(n) = sin\ sin\ (\omega_0 n)\ u(n)$ (ii) $x(n) = -a^n u(-n-1)$ Also specify its ROC	(8) (8)	CO4	BTL 4	Analyzing
11.	Solve the following DTFT properties: (i) Time shifting property (ii) Differentiation in the frequency domain	(8) (8)	CO4	BTL 3	Applying
12.	(i) Analyze the Z-transform and ROC of $x[n] = 2^n u(n)+3^n u(-n-1)$. (ii) Explain the Z-transform of the sequences x(n)= n u(n).	(8) (8)	CO4	BTL 4	Analyzing
13.	(i) Deduce the initial value of $X(Z) = \frac{Z+2}{(Z+1)(Z+3)}$ (ii)Solve for the Z-transform of $x(n) = (2/3)^n u(n)+(-1/2)^n u(n)$.	(8) (8)	CO4	BTL 4	Analyzing
14.	Consider the analog signal $x(t) = 2cos2000\pi t + 5sin4000\pi t + 12cos2000\pi t$. (i) Obtain the Nyquist sampling rate. (ii) If the analog signal is sampled at Fs = 5000Hz, formulate the discrete time signal obtained by sampling.	(8) (8)	CO4	BTL 4	Analyzing

15.	Find the Z-transform and ROC of the following signals: (i) $x(n) = a^n u(n)$ (ii) $x(n) = a^{n-2} u(n-2)$	 (8) (8)	CO4	BTL 3	Applying
16.	(i) Distingui between Continuous Time Fourier Transform & Discrete Time Fourier Transform. (ii) Solve the DTFT of $x(n) = (\frac{1}{2})^n$ and plot its magnitude and phase spectrum.	(6) (10)	CO4	BTL 3	Applying
17.	Find the inverse Z- transform of $\frac{z^{-1}}{3-4Z^{-1}+Z^{-2}}$ using Partial fraction method.	(16)	CO4	BTL 3	Applying

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS				
Impulse response -Convolution sum- Difference equations -Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.				
PART - A				
Q. No	Questions	CO	BT Level	Competence
1.	Define the non-recursive and recursive systems.	CO5	BTL 1	Remembering
2.	State the condition for an LTI discrete time system to be causal and stable in terms of ROC.	CO5	BTL 1	Remembering
3.	What is the overall impulse response h(n) when two systems $h_1(n)$ and $h_2(n)$ are in parallel and are in series?	CO5	BTL 1	Remembering
4.	Find the stability of the system whose impulse response is $h(n)=2^n u(n)$	CO5	BTL 1	Remembering
5.	Write the convolution sum with its equation $x_1(n)$ & $x_2(n)$ as two input sequence.	CO5	BTL 1	Remembering
6.	Mention the condition for stability in Z-domain?	CO5	BTL 1	Remembering
7.	Find the impulse response of a linear time invariant system as $h(n)=\sin \pi n$. Express whether the system is stable or not.	CO5	BTL 2	Understanding
8.	Is the discrete time system described by the difference equation y(n) = x(-n) is causal?	CO5	BTL 2	Understanding
9.	Find out the range of values of the parameter 'a' for which the linear time invariant system with impulse response $h(n) = a^n u(n)$ is stable.	CO5	BTL 2	Understanding
10.	Discuss whether the following system is a recursive system or not and justify your answer y[n] = 2x[n] + 3x[n-1] – 2x[n-2].	CO5	BTL 2	Understanding
11.	Find the convolution of the following signals: x[n] = {1, 2, 3}, h[n] = {1,2}.	CO5	BTL 2	Understanding
12.	Find the convolution of the input signal {1,2} and its impulse response {1,1} using Z transform.	CO5	BTL 2	Understanding
13.	Identify for the initial values of the given function $X(z) = (1+z^{-1}) / (1-0.25z^{-2})$	CO5	BTL 1	Remembering
14.	Check whether the system with system function	CO5	BTL 2	Understanding

	$H(z) = \frac{1}{1-0.5z^{-1}} + \frac{1}{1-2z^{-1}}$ with ROC $\lvert z\rvert < 0.5$ is causal and stable.				
15.	Using Z-transform inspect if the LTI system given by H (z) = z/(z-1) is stable or not.		CO5	BTL 2	Understanding
16.	Discuss the system function of the discrete time system described by the difference equation, y(n) = 0.5y(n-1) + x(n).		CO5	BTL 2	Understanding
17.	Find the convolution of (a) x(n) * δ(n) (b) x(n) * [h_1(n) + h_2(n)].		CO5	BTL 1	Remembering
18.	Identify the final values of the given function $X(z) = (1+z^{-1}) / (1-0.25z^{-2})$		CO5	BTL 1	Remembering
19.	The input x(n) and output y(n) of a discrete time LTI system is given by x(n) = {1,2,3,4} and y(n) = {0,1,2,3,4}. Find the impulse response due to these functions.		CO5	BTL 1	Remembering
20.	Find the overall impulse response h(n) when two systems h_1(n) =u(n) and h_2(n)= δ(n) +2 δ(n-1) are in series.		CO5	BTL 1	Remembering
21	Given the system function $H(z) = z^{-1}/(z^{-2}+2z^{-1}+4)$. Find the difference equation of the system.		CO5	BTL 2	Understanding
22	Illustrate Z-transform of unit impulse signal δ[n] and sketch its ROC		CO5	BTL 2	Understanding
23	Find the transfer function of the system described by the equation y(n-2)-3y(n- 1) + 2y(n) = x(n-1)		CO5	BTL 1	Remembering
24	Interpret the difference equation y[n] = x[n] - 3x[n-1] in direct form I.		CO5	BTL 2	Understanding
	PART- B				
1.	The input output relationship of a discrete system is given by y(n) – (¼)y(n-1) = x(n). Examine the response y(n) if the Fourier transform of the input x(n) is given by $X(e^{j\omega}) = 1/ [1-(1/2) e^{-j\omega}]$.	(16)	CO5	BTL 4	Analyzing
2.	(i) Write the properties of convolution sum. (ii) Analyze the methods to compute the convolution sum along with steps. (iii) Compute the linear convolution of x(n)={1, 2, 3, 4, 5, 6, 7} with h(n)={2, 4, 6, 8}	(5) (5) (6)	CO5	BTL 3	Applying
3.	Determine the linear convolution of x(n) = {1,1,1,1} and h(n)= {2,2} using graphical representation.	(16)	CO5	BTL 3	Applying
4.	Analyze the impulse response, frequency response, magnitude response and phase response of the second order system $y(n) - y(n-1) + \frac{3}{16} y(n-2) = x(n) - \frac{1}{2} x(n-1)$	(16)	CO5	BTL 4	Analyzing
5.	The LTI discrete time system y(n)=(3/2) y(n-1)-(1/2)y(n-2)+x(n)+x(n-1) is given an input x(n) = u(n). (i) Determine the transfer function of the system. (ii) Explain the impulse response of the system.	(9) (7)	CO5	BTL 4	Analyzing
6.	Examine the impulse and step response of the system described by the following difference equation y(n)+(1/ 3) y(n-1) = x(n).	(16)	CO5	BTL 4	Analyzing
7.	Solve the system function and output response y(n) of a linear time	(16)	CO5	BTL 3	Applying

	invariant discrete time system specified by the equation $y(n) - \frac{3}{2} y(n-1) + \frac{1}{2} y(n-2) = 2x(n) + \frac{3}{2}\boldsymbol{x(n-1)}$.				
8.	(i) Determine the impulse response of the discrete time system described by the difference equation y(n-2) - 3y(n-1) + 2y(n) = x(n-1). (ii) Find the autocorrelation of {1,2,1,3}.	(11) (5)	CO5	BTL 3	Applying
9.	Analyze the system response described by the difference equation y(n) - 2y(n-1) -3y(n-2) = x(n) when the input signal $x(n)=2^n$ u(n) with initial conditions y(-1)=1, y(-2) = 0.	(16)	CO5	BTL 4	Analyzing
10.	Explain the convolution between the signals, $x[n] = \alpha^n$ u[n] and h[n] = u [n-1].	(16)	CO5	BTL 4	Analyzing
11.	Consider a DT LTI system whose system function H(Z) is given by H(Z) = $\frac{z}{(z-0.5)}$: |z| > 0.5. Find the step response of the system.	(16)	CO5	BTL 3	Applying
12.	Determine the impulse response for cascade of two LTI systems having impulse responses $h_1(n)=\left(\frac{1}{3}\right)^n$u(n) and $h_2(n)=\left(\frac{1}{9}\right)^n$ u(n).	(16)	CO5	BTL 3	Applying
13.	The input output relationship of a discrete system is given by y(n) – (¼)y(n-1) = x(n). Analyze the response y(n) if the Fourier transform of the input x(n) is given by $X(e^{j\omega})=1/ [1-(1/2) e^{-j\omega}]$.	(16)	CO5	BTL 4	Analyzing
14.	Determine the system function H(z) in the pole-zero pattern for the following systems and also check their stability. (i) y(n-2) - (7/10) y(n-1) + (1/10) y(n) = x(n). (ii) y(n)=1.8y(n-1)-0.72y(n-2) + x(n)+0.5x(n-1).	 (8) (8)	CO5	BTL 3	Applying
15.	(i)Solve y(n) = x(n)* h(n) where $x(n) = (1/2)^{-n}$ u(n-2) and h(n) = u(n-2) . (ii)Solve the convolution sum between x(n) = {1,4,3,2) and h(n) = {1,3,2,1}.	(8) (8)	CO5	BTL 3	Applying
16.	A discrete time causal system has a transfer function H(z) as, $H(z) = \frac{1- z^{-1}}{1-0.2\, z^{-1}-0.15z^{-2}}$ (i) Determine the difference equation of the system. (ii) Show pole-zero diagram and hence find magnitude at $\boldsymbol{\omega}= 0$ and $\boldsymbol{\omega}= \pi$. (iii) Find the impulse response of the system.	 (6) (5) (5)	CO5	BTL 3	Applying
17.	LTI discrete time system y(n) = 3/2 y(n-1)-1/2 y(n-2) + x(n) + x(n-1) is given by an input x(n)= u(n). (i)Find the transfer function of the system. (ii)Find the impulse response of the system.	 (8) (8)	CO5	BTL 4	Analyzing