Shree Sathyam
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Internal Assessment Test I

DEGREE:B.E.	**YEAR & SEMESTER:**II/III
BRANCH:ECE	**REGULATION:**2021
SUBJECT Code and NAME:EC3354 Signals and Systems	**DATE & SESSION: 25.09.2024 & AN**
TIME: 2 Hrs 15 Minutes	**Max. Marks:** 60

Answer ALLQuestions

PART A (5x2=10 marks)

		CO	BL	PO	PI
1.	Write the relationship between the unit impulse signal, unit step signal and ramp signal.	CO1	L1	1	1.4.1
2.	Give the conditions for a system to be LTI system.	CO1	L2	1	1.4.1
3.	State Initial and Final value Theorem of Laplace Transforms.	CO2	L1	1	1.4.1
4.	What are called Dirichlet conditions for Continuous Time Fourier Series and Continuous Time Fourier Transform?	CO2	L2	1	1.4.1
5.	Given the differential equation representation of the system $d^2y(t)/dt^2 + 2dy(t)/dt - 3y(t) = 2x(t)$. Find the frequency response.	CO3	L3	1	1.4.1

PART A (5x10=50 marks)

			CO	BL	PO	PI
6.	a)	(i) Write about elementary Continuous time Signals in detail. (7) (ii) Find whether the following signal is periodic. If periodic determine the fundamental period: $x(t)=3cost+4\cos(t/3)$. (3) (iii) Give the equation and draw the waveforms of discrete time real and complex exponential signals. (3)	CO1	L1 L3 L1	1,2	1.4.1, 2.1.3
		OR				
	b)	(i) Verify whether the following signal is periodic or not. (3) $x(t)=2\cos(10t+1)-\sin(4t-1)$ (ii)Evaluate the summation $\sum_{n=-\infty}^{\infty} e^{2n}\,\delta(n-2)$ (3) (iii) Find the fundamental period T of the continuous time signal. (7) (a) $y(t)=20\cos(10\pi t+\pi/6)$ (b) $x(n)=2cos(\pi n/4)+sin(\pi n/8)-2cos(\pi n/2+\pi/6)$	CO1	L3	1,2	1.4.1, 2.1.3
7.	a)	Justify that the following system are static or dynamic, linear or nonlinear, time invariant or not, causal or non-causal, stable or unstable. (i) y(n) = x(n) + n x(n+1) (7) (ii) $y(t) = \frac{d\,x(t)}{dt}$ (6)	CO1	L3	1,2	1.4.1, 2.1.3
		OR				

		OR				
	b)	Justify whether the following system are linear or nonlinear, time invariant or not, causal or noncausal, stable or unstable. (i) $y(t) = e^{t} x(t)$ (7) (ii) $y(n) = x(2n)$ (6)	CO1	L3	1,2	1.4.1, 2.1.3
8.	a)	Find the trigonometric Fourier series of half wave rectified sine wave with a period of $T=2\pi$.	CO2	L3	1,2	1.4.1, 2.1.3
		OR				
	b)	Find the trigonometric Fourier series of full wave rectified sine wave with a period of $T=\pi$.	CO2	L3	1,2	1.4.1, 2.1.3
9.	a)	State and Prove the following properties of Continuous Time Fourier Transform i) Time Shifting ii) Time Scaling iii) Integration in time domain iv) Parseval's theorem	CO2	L2	1,2	1.4.1, 2.1.3
		OR				
	b)	State and Prove the following properties of Continuous Time Fourier Transform i) Frequency Shifting ii) Differentiation in time domain iii) Differentiation in frequency domain iv) Convolution	CO2	L2	1,2	1.4.1, 2.1.3
10.	a)	The input-output of a causal LTI system are related by the differential equation $d^2y(t)/dt^2 + 6dy(t)/dt + 8y(t)= 2x(t)$ (i) Examine the impulse response of h(t). (7) (ii) Find the response y(t) of the system if x(t) = u(t) using Fourier Transform. (6)	CO3	L3	1,2	1.4.1, 2.1.3
		OR				
	b)	Examine the impulse response and step response of the system $H(S) = s+4/(s^2+5s+6)$.	CO3	L3	1,2	1.4.1, 2.1.3

CO Number	Weightage (Marks)	Weightage in %
CO1	44	40
CO2	44	40
CO3	22	20

24/09/2024
Faculty In-Charge

24/09/2024
HoD

Principal

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Internal Assessment Test II

DEGREE:B.E.	**YEAR & SEMESTER:**II/III
BRANCH:ECE	**REGULATION:**2021
SUBJECT Code and NAME:EC3354 Signals and Systems	**DATE & SESSION: 13.11.2024 & AN**
TIME: 2 Hrs 15 Minutes	**Max. Marks:** 60

Answer ALLQuestions

PART A (5x2=10 marks)

		CO	BL	PO	PI
1.	Two systems with impulse response $h_1(t) = e^{-2t}u(t)$ and $h_2(t) = \delta(t-1)$ are connected in series. What is the overall impulse response h(t) of the system?	CO3	L2	1	1.4.1
2.	The DTFT of a discrete time signal x(n) is given as $X(e^{j\omega}) = 2e^{2j\omega} + 3 + 4e^{-j\omega} - 2e^{-2j\omega}$. Find the time domain signal x(n).	CO4	L3	1	1.4.1
3.	The input $x(n) = \{1,2,3,4\}$ and $y(n) = \{0,1,2,3,4\}$. Find the impulse response h(n).	CO4	L3	1	1.4.1
4.	List the properties of linear convolution. What are recursive and non-recursive systems?	CO5	L2	1	1.4.1
5.	Given the system function $H(z) = \frac{z^{-1}}{z^{-2}+2z^{-1}+4}$. Find the difference equation representation of the system.	CO5	L3	1	1.4.1

PART A (5x10=50 marks)

			CO	BL	PO	PI
6.	a)	The system transfer function is given as, $H(S) = \frac{S}{S^2+5S+6}$. The input to the system is $x(t) = e^{-t}u(t)$. Determine the output assuming zero initial conditions.	CO3	L3	1,2	1.4.1, 2.1.3
		OR				
	b)	i) The differential equation of the system is given as , $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = -\frac{dx(t)}{dt}$. Using Fourier transform determine the impulse response of the system. ii) What is the relationship between Fourier transform and Laplace transform? iii) What is called ROC? Give its significances.	CO3	L3	1,2	1.4.1, 2.1.3
7.	a)	i) State and prove sampling theorem for a band limited signal. ii) Determine the nyquist sampling rate and nyquist sampling interval for the following signal: $x(t) = sinc(200\pi t) + 3sinc^2(120\pi t)$	CO4	L3	1,2	1.4.1, 2.1.3

		OR				
	b)	A) An analog signal $f(t) = \sin(480\pi t) + 3\sin(720\pi t)$ is sampled at 600 times per sec. Determine i) Nyquist rate ii) Folding frequency iii) What are the frequencies in radians resulting in the discrete time signal x(n)? iv) If x(n) is passed through an ideal digital to analog converter, what is the reconstructed signal y(t)? B) Determine the nyquist sampling rate and nyquist sampling interval for the following signal: $x(t) = sinc(100\pi t).sinc(200\pi t)$	CO4	L3	1,2	1.4.1, 2.1.3
8.	a)	State and prove the following properties of DTFT: i) Time shifting ii) Differentiation in Frequency domain iii) Convolution iv) Parseval's theorem for discrete time signals	CO4	L2	1	1.4.1
		OR				
	b)	State and prove the following properties of Z-transfrom: i) Time shifting ii) Differentiation in z-domain iii) Convolution iv) Time reversal	CO4	L2	1	1.4.1
9.	a)	Consider a discrete time LTI System $y(n) - \frac{3}{2}y(n-1) + \frac{1}{2}y(n-2) = 2x(n) + \frac{3}{2}x(n-1)$ where y(-1)=0, y(-2)=1 and $x(n) = (\frac{1}{4})^n u(n)$. Find output response using Z-transform. Draw its ROC of the transfer function and comment its causality of the system.	CO5	L3	1,2	1.4.1, 2.1.3
		OR				
	b)	Consider the following system function: $H(z) = \frac{z}{\left(z-\frac{1}{4}\right)\left(z+\frac{1}{4}\right)\left(z-\frac{1}{2}\right)}$. Find different possible ROCs, determine the causality, stability and the impulse response of the system.	CO5	L3	1,2	1.4.1, 2.1.3
10.	a)	A difference equation of the system is given as $y(n) = 0.5y(n-1) + x(n)$. Determine i) System function ii) Pole zero plot of the system function iii) Unit sample response of the system	CO5	L3	1,2	1.4.1, 2.1.3
		OR				
	b)	Find the Linear convolution of $x(n) = \{-1, 1, \underset{\uparrow}{2}, -2\}$ with $h(n) = \{0.5, 1, \underset{\uparrow}{-1}, 2, 0.75\}$ using tabulation method.	CO5	L3	1,2	1.4.1, 2.1.3

CO Number	Weightage (Marks)	Weightage in %
CO3	22	20
CO4	44	40
CO5	44	40

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PROGRAMME	:	B.E. – ECE
SEMESTER	:	III (ODD)
ACADEMIC YEAR	:	2024-2025
REGULATION	:	2021
COURSE CODE	:	EC3354
COURSE NAME	:	SIGNALS AND SYSTEMS
COURSE COMPONENT	:	CORE
NAME OF THE COURSE IN-CHARGE	:	Dr. P. KANNAN

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS

Syllabus: 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.

TABLE 1. UNIT I Assessment Questions

Bloom's Taxonomy Level: K1- remember, K2- Understand, K3- Apply, K4 - Analyze, K5- Evaluate, K6- Synthesize

Thinking Skills: LOTS – K1 & K2, IOTS – K3 & K4, HOTS – K5 & K6

Sl. No.	Questions	K-level	Thinking Skills
	Part A		
1	State the two properties of unit impulse function.	K1	LO
2	List the classification of Systems.	K1	LO
3	Show that $[n]=u[n]-u[n-1]$.	K2	LO
4	Draw the following signals (a) $u(t)-u(t-5)$ (b) y(n) = $u\,[n-1]$	K2	LO
5	Compute the periodicity of cos $(0.01\pi n)$.	K3	IO
6	Write the conditions for a system to be LTI Systems.	K2	LO
7	Explain when the system said to be memory less with an example.	K2	LO
8	Compare deterministic and random Signals.	K2	LO
9	Examine whether the given signal is energy or power signal and calculate its energy or power: $(t)=e^{2t}u(t)$.	K3	IO
10	Examine the following system is static or dynamic and also causal or non-causal system: $[n]=x[2n]$.	K3	IO
11	Verify that the discrete time signal $\sin[3n]$ is periodic.	K3	IO
12	Relate the impulse signal, step signal, ramp signal.	K3	IO

13	Write the mathematical and graphical representation of continuous time and discrete time impulse function.	K2	LO
14	Examine the fundamental period 'T' of the following signal, if they are periodic: $(t)=4cos5\pi t$.	K3	IO
15	Point out the condition for a discrete time signals to be periodic.	K4	IO
16	Distinguish between continuous time and discrete time signals.	K2	LO
17	Summarize energy and power signals.	K2	LO
18	Discuss symmetric and anti-symmetric signals.	K2	LO
19	Write any two properties of unit impulse signal.	K2	LO
20	Examine whether the given system described by the equation is linear and time invariant $(t)=x(t^2)$.	K3	IO
21	Sketch the signal $x(t)=\delta(t-t_0)$	K1	LO
22	Find whether the described as system y[n]=nx(n) is time invariant or not.	K3	IO
23	What are the major classification of signals?	K1	LO
24	Given x(n) = { 1, -4, 3,1, 5, 2}. Represent x(n) interms of weighted impulse functions.	K2	LO
25	Define a continuous time LTI system or Give the conditions for a system to be LTI system.	K1	LO
26	Find the fundamental period of the given signal x(n) = sin (6πn/7 + 1)	K3	LO
27	Sketch the following signal: x(t) = 2t and x(n) = x(2n – 3)	K1	LO
28	How the impulse response of a discrete time system is useful in determining stability and causality?	K3	LO
	Part B		
1	(i) Write about elementary Continuous time Signals in detail. (7) (ii) Find whether the following signal is periodic. If periodic determine the fundamental period: $x(t)=3cost+4\cos(t/3)$. (3) (iii) Give the equation and draw the waveforms of discrete time real and complex exponential signals. (3)	K2 K3 K1	LO IO LO
2	(i) Verify whether the following system are linear or not. (8) (a) $\frac{dy(t)}{dt} + 3ty(t) = t^2x(t)$ (b) y[n] = $2x[n]+1/x[n-1]$ (ii) Find the odd and even components of the following signals. (5) (a) $x(t) = \cos(t)+\sin(t)+\cos(t)\sin(t)$ (b) $x[n] = \{-2, 1, 2, -1, 3\}$	K3 K3	IO IO
3	(i) Examine whether the following system are time invariant or not. (7) (a) $y(t)=tx(t)$ (b) $y[n]=x[2n]$ (ii) Find the power and RMS value of the signal. (6) (a) $x(t)=Acos(\Omega_0 t+\theta)$ (b) $x(t)=Ae^{j\Omega_0}$	K3 IO	IO IO
4	(i) List the difference between the following (6) (a) Causal and Non-causal signals. (b) Deterministic and Random Signals. (ii) Draw the following signals (7) (a) $x(t)=-2r(t)$ (b) $\pi(t+2)$ (c) $u[-n+2]$	K2 K2	LO LO
5	(i) Find the power and RMS value of the following signals. (6) (a) $y(t)=5\cos(50t+\pi/3)$	K3	IO

	(b) $y(t)=10cos5t*cos10t$ (ii) Examin whether the following signals are energy signals or power signals (7) (a) $x[n]=(12)\,nu[n]$ (b) $x(t)=u(t)-u(t-5)$	K3	IO
6	(i) Verify whether the following signal is periodic or not. (3) $x(t)=2\cos(10t+1)-\sin(4t-1)$ (ii) Evaluate the summation $\sum_{n=-\infty}^{\infty} = (e^{2n})\delta[n-2]$ (3) (iii) Find the fundamental period T of the continuous time signal. (7) (a) $y(t)=20\cos(10\pi t+\pi/6)$ (b) $x(n)=2cos(\pi n/4)+sin(\pi n/8)-2cos(\pi n/2+\pi/6)$	K4 K5 K3	IO HO IO
7	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 the system is stable or unstable. (13)	K4	IO
8	(i) Verify the following for linearity, Time Invariance, Causality and Stability. (7) $y(n) = x(n) + nx(n+1)$ (ii) Find whether the following are periodic. (6) $x[n] = \sin\left(\left(\frac{6\pi n}{7}+1\right)\right)$ $x(n) = e^{j3\pi/5(n+\frac{1}{5})}$	K3 K3	IO IO
9	(i) Compute whether the following system is linear, time invariant, stable and invertible. (8) (a) $y(n) = x^2(n)$ (b) $y(n) = x(-n)$ (ii) Verify that the signal satisfies linearity, time invariance, causality and stability conditions. (5) $y(n) = x(n) + n\,x(n+1)$	K3 K3	IO IO
10	(i) Given $x(t) = 1/6\,(t+2)$, $-2 \le t \le 4$ (8) 0 , Otherwise Examine. (1) x(t) (2) x(t+1) (3) x(2t) (4) x(t/2) (ii)Analyze whether the discrete time sequence (5) $x[n]=\sin(3\pi/7n+\pi/4)+cos\pi/3n$ is periodic or not.	K3 K4	IO IO
11	Analyze whether the given systems are causal and stable. (i) h(t) =u(t) (4) (ii) h(n) =u(n+5) (4) (iii) $h(n) = (1/2)^n u(n)$ (5)	K4	IO
12	A trapezoidal pulse x(t) is defined by $x(t) = [5-t;\ 4\le t\le 5$ $1;\ -4\le t\le 4$ $t+5;\ -5\le t\le -4$ (i) Examine total energy of x(t). (5) (ii) Sketch x(2t-3). (3) (iii) If y(t) = dx(t)/dt. Examine total energy of x(t). (5)	K3	IO

13	Justify whether the following system are linear or nonlinear, time invariant or not, causal or noncausal, stable or unstable. (i) $y(t) = e^{t} x(t)$ (7) (ii) $y(n) = x(n)\, u(n)$ (6)	K5	HO
14	Justify that the following system are linear or nonlinear, time invariant or not, causal or noncausal, stable or unstable. (i) x(t)=x(n)-x[n-1] (7) (ii) y(t)=$d/dtx(t)$ (6)	K5	HO
	PART C		
1	A discrete time sequence x(n) = {-1, -0.5, 0.5, 1, 1, 1, 1, 0.5}. ↑ Evaluate carefully each of the following signals. (i) x(n-4) (ii) x(3-n) (iii) x(3n) (iv) x(3n+1) (15)	K3	IO
2	For the following systems (i) y(n) = Truncation of x(n) (ii) y(n) = Rounding of x(n) Propose whether the systems are static, linear, shift invariant, causal and stable. (15)	K5	HO
3	Sketch the following signals. (i) u(-t+2) (ii) r(-t+3) (iii) $2\delta(n+2) + \delta(n) - 2\delta(n-1) + 3\delta(n-3)$ (iv) u(n+2) u(-n+3) Where u(t), r(t), $\delta(n)$, u(n) represent continuous time unit step, continuous time ramp, discrete time impulse and discrete time step functions respectively. (15)	K2	LO
4	Determine the properties viz linearity, causality, time invariance and dynamicity of the given systems. (i) $d^2y(t)/dt^2+3tdy(t)/dt+y(t)=x(t)$ (ii) $y(n)=x(n^2)$ + x(n) (iii) $y(n)=\log x(n)$ (15)	K3	IO

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS

Syllabus: Fourier series for periodic signals - Fourier Transform – properties- Laplace transforms and properties.
TABLE 2. UNIT II Assessment Questions

Bloom's Taxonomy Level: K1- remember, K2- Understand, K3- Apply, K4 - Analyze, K5- Evaluate, K6- Synthesize

Thinking Skills: LOTS – K1 & K2, IOTS – K3 & K4, HOTS – K5 & K6

Sl. No.	Questions	K-level	Thinking Skills
	Part A		
1	Identify the Fourier Series coefficients of the signal x(t) =1+ sin2ωt + 2cos2ωt + cos(3ωt + $\pi/4$)	K1	LO
2	Write the synthesis and analysis equation of continuous time Fourier Transform.	K2	LO
3	Define ROC of the Laplace Transform.	K1	LO
4	State Initial and Final value Theorem of Laplace Transforms.	K1	LO
5	Find the Laplace Transform of the signal x(t) =e^{-2t} u(t).	K3	IO
6	Summarize Convolution property of Fourier Transform.	K2	IO
7	Explain the Relationship between Laplace Transform and Fourier Transform.	K3	IO
8	Compute the Transfer functions of the following a) An ideal integrator. b) An ideal delay of T seconds.	K3	IO
9	Find the Laplace transform of x(t) + $3e^{-2t}$u(t)-$2e^{-t}$u(t) with ROC.	K3	IO
10	Explain the Dirichlet's conditions of Fourier series.	K2	LO
11	Find the Laplace transform of the function x(t) =u(t)-u(t-2)	K3	IO
12	Write the equations for trigonometric& exponential Fourier series.	K2	LO
13	Compute the Laplace transform of δ(t) and u(t).	K3	IO
14	Find the Fourier transform of x(t)=$e^{j2\pi ft}$.	K3	IO
15	Distinguish unilateral and bilateral transform.	K2	LO
16	The output response y(t) of a continuous time LTI system is $2e^{-3t}$ u(t) when the input x(t) is u(t). Find the Transfer function.	K3	IO
17	Find the transfer function of an ideal differentiator.	K3	IO
18	Examine the differentiation and integration property of Laplace transform.	K3	IO
19	Discuss Parseval's theorem of Fourier series.	K2	LO
20	Find the poles and zeros of the given transfer function X(S) =S^2+3S+2/S^2−2S+2.	K3	IO
	Part B		
1	(i) Identify the difference between Fourier series analysis and Fourier transforms. (3) (ii) Find the trigonometric Fourier series of half wave Rectified Sine wave with a period of T=2π. (10)	K2 K3	LO IO
2	(i) Find Fourier transform of the following signal in terms of X(jω): x(t)=x(1-t) + x(-1-t) and x(t)=e^{-at} u(t) (6) (ii) Find the complex exponential Fourier series coefficient of the signal x(t)=2sin(2πt-3)+sin(6πt) (7)	K3 K3	IO IO
3	Find the Fourier transform of x(t) = $e-\|t\|$ and plot the Fourier spectrum. (13)	K3	IO
4	(i) State and Prove the properties of Fourier Transform. (6) (ii) Examine the Trigonometric Fourier series for the full wave rectified sine wave. (7)	K2 K3	LO IO

5	(i)Find the Laplace transform of the following signal (7) $x(t) = \sin(\pi t)u(t)$, $0 \leq t \leq 2$ $= 0$, otherwise (ii) Summarize the properties of Laplace Transforms. (6)	K3 K3	IO IO
6	(i) Find the Laplace Transform of the following. a) $x(t) = u(t-2)$ (3) b) $x(t) = t^2e^{-2t}u(t)$ (3) (ii) Find the Fourier Transform of Rectangular pulse. Sketch the amplitude spectrum of the given signal. (7)	K3 K3	IO IO
7	(i) Estimate the Fourier Transform of $x(t) = 1-e^{-\|t\|}\cos\omega ot$. (7) (ii)Summarize with inverse Laplace Transform of the function. $X(s) = \frac{1}{s^2+3s+2}$ ROC: $-2 < Re\{s\} < -1$	K3 K3	IO IO
8	(i)Compute the Laplace Transform and ROC of the signal $x(t)=e^{-3t}u(t)+e^{-2t}u(t)$ (7) (ii) State and Prove Convolution property and Parseval's relation of Fourier series. (6)	K3 K2	IO LO
9	(i) Solve the inverse Laplace transform of $x(s)=(s+3)/(s+1)(s+2)^2$ (7) (ii) Examine the initia1 value and final value of signal x(t) whose Laplace Transform is. (6) $X(s) = \frac{2s+5}{s(s+3)}$	K3 K3	IO IO
10	(i) Find the inverse Laplace Transform of $x(s) = 3s^2/(s+1)$ (7) (ii) Examine the initial and final value of a signal $x(t)= \sin 4t\, u(t)$. (6)	K3	IO
11	Find the inverse Laplace transform of $x(s) = 1/(s+5)(s-3)$ for the ROCs (i) $Re(s) \geq 3$ (ii) $-5 \leq Re(s)$ (iii) $-5 \leq Re(s) \leq 3$. (13)	K3	IO
12	Examine the fourier transform of $x(t) = e^{jat^2}$ and hence find the fourier transform of the functions $\cos at^2$, $\sin at^2$. (13)	K3	IO
13	Find the Laplace Transform of the following signals with their ROC. (i) $x(t)=3-6e^{-4t}$ (7) (ii) $x(t)=e^{-3t}u(t)+e^{-t}u(-t)$ (6)	K3	IO
14	Find the exponential Fourier series for the signal $f(t) = e^{-t}$, $0 \leq t \leq 0.5$ and also plot the magnitude and phase spectrum. (13)	K3	IO
	PART C		
1	Find the inverse Fourier transform of the following signals. (i) $X(\omega)=1$, $-W \leq \omega \leq W$ (5) (ii) $(j\omega)=6j\omega+16/(j\omega)^2+5j\omega+6$. (5) (iii) $X(j\omega)=j\omega+3/(j\omega+1)^2$ (5)	K3	IO
2	Calculate the trigonometric Fourier series over the interval (-1, 1) for the signal $x(t) = t^2$. (15)	K3	IO
3	Examine the Laplace transform of $x(t) = e^{-b\|t\|}$ for the cases of $b<0$ and $b>0$. (15)	K3	IO
4	Find the Fourier transform of Gaussian pulse. (15)	K3	IO

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS

Syllabus: Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

TABLE 3. UNIT III Assessment Questions

Bloom's Taxonomy Level: K1- remember, K2- Understand, K3- Apply, K4 - Analyze, K5- Evaluate, K6- Synthesize

Thinking Skills: LOTS – K1 & K2, IOTS – K3 & K4, HOTS – K5 & K6

Sl. No.	Questions	K-level	Thinking Skills
	Part A		
1	State the condition for LTI system to be stable and causal.	K1	LO
2	Given the differential equation representation of the system $d^2y(t)/dt^2 +2dy(t)/dt -3y(t)=2x(t)$. Find the frequency response.	K3	IO
3	Draw the block diagram of the LTI system described by $dy(t)/dt + y(t) = 0.1x(t)$.	K1	LO
4	Define block diagram representation of the system.	K1	LO
5	Write the properties for convolution integral.	K2	LO
6	Discuss impulse response of an LTI system.	K2	LO
7	Draw the basic elements of block diagram representation of the continuous time system.	K1	LO
8	Given $H(s) = 1/s^2+2s+1$. Express the differential equation representation of the system.	K2	LO
9	Explain the block diagram representing the system H(s)= s/s+1	K2	LO
10	Find the step response of a CT LTI system for the given h(t).	K3	IO
11	Apply the causality of the system with impulse response $h(t)=e^{-t} u(t)$.	K3	IO
12	Compute the unit step response of the system given by $h(t)=1/RC\ e^{-t}/RC\ u(t)$.	K3	IO
13	Solve the impulse response of the system given by H(S) = 1/(s+9).	K3	IO
14	Find the expression of convolution integral.	K3	IO
15	Differentiate natural response and forced response.	K2	LO
16	Point out the different types of system realization.	K2	LO
17	Examine the causality of the system with response $h(t)= e^{-t} u(t)$.	K3	IO
18	Find the impulse response of two LTI systems when connected in parallel.	K3	IO
19	Write the N^{th} order differential equation.	K2	LO
20	Convolve the following signals u(t-1) and δ(t-1).	K3	IO
	Part B		
1	Find the Convolution of following signals.(13) $x(t)= e^{-3t} u(t)$ and $h(t)= u(t-1)$	K3	IO
2	i) Explain convolution Integral and describe its equation. (6) ii) A stable LTI system is characterized by the differential equation $d^2y(t)/dt^2 + 4dy(t)/dt + 3y(t) = dx(t)/dt + 2x(t)$. Find the frequency response & impulse response using Fourier transform. (7)	K2 K3	LO IO
3	(i) Find 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. (7) (ii) Demonstrate the Direct Form-I realization of $d^2y(t)/dt^2 + 5dy(t)/dt + 4y(t) = dx(t)/dt$. (6)	K3 K3	IO IO

4	Find the output response 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 $x(t) = u(t)$ and the initial conditions are $y(0+)=1, dy(0+)/dt = 1$. (13)	K3	IO
5	The system produces the output $y(t) = e^{-t}u(t)$ for an input $x(t) = e^{-2t}u(t)$. Find i) frequency response ii) the impulse response. (13)	K3	IO
6	(i) Demonstrate the parallel form realization of the system $H(s) = s(s+1)/(s+2)(s+3)(s+4)$ (6) (ii) Using Laplace transform, Find the impulse response of an LTI sysem described by the differential equation. $d^2y(t)/dt^2 - dy(t)/dt - 2y(t) = x(t)$. (7)	K3 K3	IO IO
7	(i) Find the transfer function of the system for the impulse response $h(t) = \delta(t) + e^{-3t}u(t) + 2e^{-t}u(t)$ (6) (ii) Find the impulse response for the differential equation $RC\, dy(t)/dt + y(t) = x(t)$. (7)	K3 K3	IO IO
8	Compute & illustrate the convolution y(t) of the given signals. (i) $x(t)=\cos t\, u(t)$, $h(t)=u(t)$ (7) (ii) $x(t)=u(t)$, $h(t)= R/Le^{-tR/L}u(t)$ (6)	K3	IO
9	(i) Draw the following in Direct form-II $d^3y(t)/dt^3 + 2d^2y(t)/dt^2 + 4dy(t)/dt + 6y(t) = 3d^2x(t)/dt^2 + 5dx(t)/dt + 7x(t)$. (7) (ii) Calculate the step response of the system $h(t) = e^{-4t}u(t)$. (6)	K3 K3	IO IO
10	The input-output of a causal LTI system are related by the differential equation $d^2y(t)/dt^2 + 6dy(t)/dt + 8y(t) = 2x(t)$ (i) Examine the impulse response of h(t). (7) (ii) Find the response y(t) of the system if $x(t)=u(t)$ using Fourier Transform. (6)	K3	IO
11	Detect the output response of the following systems (i) $x(t) = u(t)$, $h(t)=2e^{-3t}u(t)$. (7) (ii) $x(t)= e^{-t}u(t)$ $h(t)=e^{-2t}u(t)$. (6)	K3	IO
12	Examine the impulse response and step response of the system $H(S) = s+4/(s2+5s+6)$.	K3	IO
13	An LTI system is represented by $d^2y(t)/dt^2 + 5\, dy(t)/dt + 6y(t) = dx(t)/dt + x(t)$ with initial conditions $y(0)=1$, $y'(0)=3$. Conclude the output of the system, when the input is $x(t)= u(t)$. (13)	K3	IO
14	(i) The system transfer function is given as $H(s)= s/(s2+5s+6)$. The input to the system is $x(t)=e^{-t}\, u(t)$. Estimate the output assuming zero initial conditions. (7) (ii) Find the system function for the system with output response $y(t) = 2e^{-3t}u(t)$ and input $x(t) = u(t)$. (6)	K3 K3	IO IO
	PART C		
1	Find the response y(t) of a continuous time system using Laplace transform with transfer function $H(s) = 1/(s+2)(s+3)$ for an input $x(t)= e^{-t}u(t)$. (15)	K3	IO
2	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 the output signal y(t) for $x(t) = \delta(t)$. (15)	K3	IO
3	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). Find x(t). (15)	K3	IO
4	Design the direct form, cascade form and parallel form of a system with system function $H(s) = 1/(s+1)(s+2)$. (15)	K3	IO

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS

Syllabus: Baseband signal Sampling – Fourier Transform of discrete time signals (DTFT) – Properties of DTFT - Z Transform & Properties.

TABLE 4. UNIT IV Assessment Questions

Bloom's Taxonomy Level: K1- remember, K2- Understand, K3- Apply, K4 - Analyze, K5- Evaluate, K6- Synthesize

Thinking Skills: LOTS – K1 & K2, IOTS – K3 & K4, HOTS – K5 & K6

Sl. No.	Questions	K-level	Thinking Skills
	Part A		
1	Define convolution integral of continuous time system.	K1	LO
2	State the need for sampling.	K1	LO
3	Write the condition for existence of DTFT.	K2	LO
4	List the properties of DTFT.	K1	LO
5	Discuss the circularly folded sequences.	K2	LO
6	Prove the time folding property of Z-transform.	K2	LO
7	Write the sufficient condition for the existence of DTFT for an aperiodic sequence.	K2	LO
8	Express one sided Z-transform and two sided Z transform.	K2	LO
9	Write the main condition to avoid aliasing.	K2	LO
10	Summarize the methods of obtaining inverse Z transform.	K2	LO
11	Solve the inverse z transform of $x(z)=1/z-a$, $\|z\|>\|a\|$.	K3	IO
12	Find the system function for the given difference equation $y(n) = 0.5\ y(n-1)+ x(n)$.	K3	IO
13	Calculate Z transform of $x(n)=\{1,2,3,4\}$.	K3	IO
14	Find the convolution of two sequence $x(n)=\{1,1,1,1\}$ $h(n)=\{2,2\}$.	K3	IO
15	Write sufficient condition for the existence of DTFT for an aperiodic sequence.	K2	LO
16	State and prove the convolution property of Z-transform.	K2	LO
17	Discuss Parseval's relation for discrete time aperiodic signals.	K2	LO
18	Examine whether the system with system function is causal or non-causal $H(z)=1/(1-1/2z-1)$.	K3	IO
19	Find Z transform of sequence $x(n)=a^n u(n)$.	K3	IO
20	Prove that DTFT[x(n)*] =DTFT[x*(n)].	K2	LO
	Part B		
1	(i) State and explain sampling theorem both in time and frequency domains with necessary quantitative analysis and illustrations. (8) (ii)Describe the effects of under sampling and the steps to eliminate aliasing. (5)	K2	LO
2	(i) List any four properties of DTFT. (8) (ii) Write the transfer function of a zero order hold. (5)	K1 K2	LO
3	(i) Prove the sampling theorem and explain how the original signal can be reconstructed from the sampled version. (8) (ii) Discuss the initial and final value theorem. (5)	K2 K2	LO
4	(i) Explain the following properties of Z transform (a) Time and frequency convolution property. (3) (b) Parsevals theorem. (3) (ii)Discuss the frequency spectrum of discrete time signal. (7)	K2 K2	LO

5	(i) Explain the properties of ROC. (7) (ii) Explain the contour integration method with an example. (6)	K2	LO
6	(i) Use convolution theorem, find the inverse Z-transform of $y(z)= z / (z-1)^3$. (7) (ii) Find the inverse Z-transform for the following sequences. (a) $x(z)= Z/(Z-0.5)(Z+0.7)$ (3) (b) $x(z)= Z/(Z+1.2)(Z+0.7)$ (3)	K3	IO
7	(i) Find the convolution of two signals using DTFT. $x_1(n) = (1/2)^n u(n)$ and $x_2(n) = (1/4)^n u(n)$. (7) (ii) Find the DTFT of $x(n)= 3^n u(n)$ and $x(n)=(3)^n u(-n)$. (6)	K3	IO
8	(i) Find the Z transform and ROC of the sequence x(n)=u(n)-u(n-3). (7) (ii) Discuss the relationship between DTFT and Z transform. (6)	K3 K2	IO LO
9	(i) Compute the DTFT of $(1/2)^n u(n)$. Draw its spectrum. (7) (ii) Find the Z transform of $x(n) = r^n (\sin\omega 0n)\, u(n)$. (6)	K3	IO
10	(i) State and Prove the convolution property of Z Transform. (5) (ii) Find the Z-transform of $x(n) = \cos(\omega_o n)\, u(n)$. (8)	K2 K3	LO IO
11	Find the inverse Z-transform of $x(z)=(1+3z^{-1})/ 1+3z^{-1}+2z^{-2}$ using (i) Residue method. (7) (ii) Convolution method. (6)	K3	IO
12	(i) Find the output y(n) of a linear time invariant discrete time system specified by the equation $y(n)- 3/2y(n-1) +1/2\, y(n-2) =2x(n)+3/2x(n-1)$ (7) (ii)Find the Z-transform of the sequences x(n)={5,3,2,4}.	K3	IO
13	(i) Find the initial value of $x(z)=z+2/(z+1)(z+3)$. (6) (ii) Evaluate the Z-transform, ROC and plot pole zero locations of x(z) for $x(n) = (2/3)^n u(n)+(-1/2)^n u(n)$. (7)	K3	IO
14	Draw the pole-zero pattern and determine which of the following systems are stable. (i) y(n)=y(n-1)-0.5y(n-2) + x(n)+x(n-1). (7) (ii) y(n)=1.8y(n-1)-0.72y(n-2) + x(n)+0.5x(n-1). (6)	K3	IO
PART C			
1	Find DTFT of the following signals (i) $x_1(n) = (n-1)^2 x(n)$. (5) (ii) $x_2(n) = x(1-n)$. (5) (iii) $x(n)= A$ for $\|n\| \le N$ (5) 0 for $\|n\| > N$	K3	IO
2	Calculate the Z transform and prepare the pole zero plot with ROC for each of the following signals. (i) $x(n) = (0.5)^n u(n) – (1/3)n\, u(n)$. (8) (ii) $x(n) = (1/2)^n u(n) + (1/3)n\, u(n-1)$. (7)	K3	IO
3	Determine inverse z-transform of $x(z) = z^{-1}/1-0.25z^{-1}-0.375z^{-2}$ (15) For (i) ROC $\|z\|> 0.75$ (ii)ROC $\|z\|< 0.5$	K3	IO
4	(i) State and prove time shifting property of discrete time Fourier Transform. (8) (ii) Find the Z-transform of x(n) = nu(n) (7)	K2 K3	LO IO

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS

Syllabus: Impulse response – Difference equations - Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

TABLE 5. UNIT V Assessment Questions

Bloom's Taxonomy Level: K1- remember, K2- Understand, K3- Apply, K4 - Analyze, K5- Evaluate, K6- Synthesize

Thinking Skills: LOTS – K1 & K2, IOTS – K3 & K4, HOTS – K5 & K6

Sl. No.	Questions	K-level	Thinking Skills
	Part A		
1	Define natural response and forced response.	K1	LO
2	Distinguish between the non-recursive and recursive systems.	K2	LO
3	In terms of ROC, state the condition for an LTI discrete time system to be causal and stable.	K1	LO
4	Write the overall impulse response h (n) when two systems h_1 (n) and h_2 (n) are in parallel and are in series.	K2	LO
5	Write the difference equation for recursive systems.	K2	LO
6	Write the convolution sum with its equation $x_1(n)$ & $x_2(n)$ are two input sequence.	K2	LO
7	State the relationship between impulse response and transfer function of a DT-LTI system.	K1	LO
8	Exaimine the impulse response of a linear time invariant system as $h(n)=\sin \pi n$. Research whether the system is stable or not.	K3	IO
9	If u (n) is the impulse response of the system, Find step response.	K3	IO
10	Calculate that 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.	K3	IO
11	Compute the convolution of given two sequences x(n)= {1,1,1,1} and h(n)= {2,2}.	K3	IO
12	Convolve the two sequences x(n)= {1,2,3} and h(n)= {5,4,6,2}.	K3	IO
13	If X(ω) is the DTFT of x(n), compute the DTFT of x*(-n).	K3	IO
14	A causal LTI system has impulse response h (n), for which the Z-transform is $H(z)=(1+z^{-1})/(1-0.5z^{-1})(1+0.25z^{-1})$. Examine the system is stable or not.	K4	IO
15	Test whether the system with system function $H(z) = (1/1-0.5z^{-1}) + (1/1-2z^{-1})$ with ROC $\|z\| < 0.5$ is causal and stable.	K4	IO
16	Using Z-transform inspect the LTI system given by H (z) = z/z-1 is stable or not.	K4	IO
17	Find the system function of the discrete time system described by the difference equation. y(n) = 0.5y(n-1) +x(n).	K3	IO
18	Estimate the convolution of (a) x(n) * δ(n). (b) x(n) * [h_1(n)+h_2(n)].	K3	IO
19	Is the discrete time system described by the difference equation y(n)=x (-n) causal?	K4	IO
20	Compose the following system using direct form–II method y(n)-0.5y(n-1) =x(n) +0.5x(n-1).	K3	IO
	Part B		
1	(i) Explain the block diagram representation for LTI discrete time systems. (10) (ii) Define the pole zero pattern of transfer function. (3)	K2 K1	LO
2	(i) Write the properties of convolution sum. (8) (ii) List and explain the steps of methods to compute the convolution sum. (5)	K2	LO

3	(i) Explain the discrete Fourier analysis for recursive and non-recursive systems. (8) (ii) State system function and sketch the Pole locations of the corresponding impulse response. (5)	K2	LO
4	(i) Explain the Z transform for analysis of recursive and non-recursive systems. (7) (ii) Draw the magnitude and phase response of y(n)=1/2x(n)+1/2x(n-1). (6)	K2	LO
5	In 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) Observe the transfer function of the system. (7) (ii) Find the impulse response of the system. (6)	K3	IO
6	(i) Find the forced response of the system described by the difference equation y(n)-1.2y(n-1) +0.5y(n-2) =x(n) for an input signal x(n)=3^n u(n). (10) (ii) Summarize the advantages and disadvantages of cascade realization. (3)	K3 K2	IO LO
7	Consider a causal and stable LTI system whose input x(n) and output y(n) are related through the second order difference equation y(n)-1/6y(n-1)-1/6y(n-2) =x(n). Find (i) Frequency response of the system. (6) (ii) Impulse response of the system. (5) (iii) The system output for the input $(1/4)^n$ u(n). (2)	K3	IO
8	(i) Compute the impulse response of the discrete time system described by the difference equation y(n-2)-3y(n-1) +2y(n)=x(n-1). (8) (ii) Find the autocorrelation of {1,2,1,3}. (5)	K3	IO
9	(i) Solve 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 (-1) =1, y(-2)=0. (10) (ii) Using Z transform, produce y(n) if x(n)=u(n). (3)	K3	IO
10	(i) Using the difference equation, Find pole zero pattern and Determine the given system is stable or not. y(n)-y(n-1) +0.8y(n-2) =x(n)+2x(n-1) +2x(n-2). (7) (ii) Find the convolution of the following sequence. (6) x(n) = δ(n)+ 2δ(n-1) + 3δ(n-2) +2δ(n-3). h(n) = δ(n)+ 2δ(n-1) + 2δ(n-2).	K3	IO
11	(i) Obtain the parallel realization of y(n)-1/4y(n-1)-1/8y(n-2) =x(n)+3x(n-1) +2x(n-2). (8) (ii) Compare the relationship between DTFT and Z-transforms. (5)	K3 K2	IO LO
12	(i) Examine the system function of LTI system which is given by H(z)=$(3-4z^{-1})/(1-3.5z^{-1}+1.5z^{-2})$ Specify the ROC of H(z) and classify h(n) for the following condition (a) Stable system. (b) Causal system. (7) (ii) Draw the discrete form II structure for (6) y(n)-3/4y(n-1) +1/8y(n-2) =x(n)+1/2x(n-1).	K3	IO
13	(i) Find 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). (7) (ii) Find the cross correlation of two finite length sequences x(n)= {1,2,3,4} and y(n) = {1,1,2,1}. (6)	K3	IO
14	For the system described by the difference equation y(n)-5/6 y(n-1)-1/6y(n-2)-1/24y(n-3)-1/16y(n-4) =x(n)+5/6x(n-1) +x(n-2)+13/36x(n-3)+1/6x(n-4). Develop the	K3	IO

	(i) Cascade realization. (6) (ii) Parallel realization. (7)		
PART C			
1	Consider the causal linear shift invariant filter with system function $H(z) = (1+0.875z^{-1}) / (1+0.2z^{-1}+0.9z^{-2}) (1-0.7z^{-1})$. Deduce the following realization structures of the system. (i) Direct form-II. (7) (ii) Parallel form. (8)	K3	IO
2	Formulate the linear convolution of x(n)= {1,1,1,1} and h(n)= {2,2} using graphical representation. (15)	K3	IO
3	Find the impulse and step response of the system described by the following difference equation y(n)+1/3y(n-1) = x(n). (15)	K3	IO
4	Find the output response of the system whose linear constant coefficient difference equation is given by y(n)-0.1y(n-1)-0.12y(n-2) = x(n)-0.4x(n-1) with y(-1) = y(-2) = 2 and x(n) = (0.4)n u(n). (15)	K3	IO