SRM VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

QUESTION BANK

SUBJECT : EC8352/ Signals and Systems

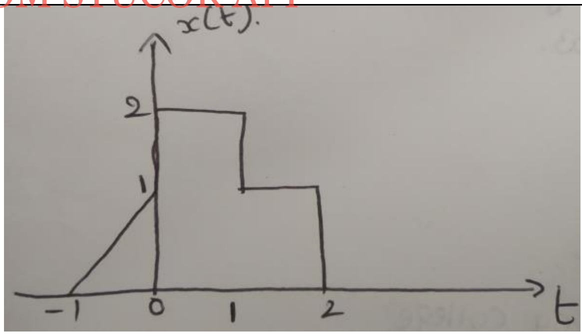
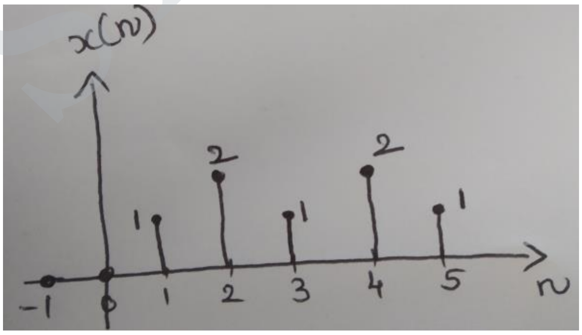
SEM / YEAR: III/ II Year ECE

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**	**BT Level**	**Competence**
1.	State the two properties of unit impulse function.	**BTL 1**	**Remembering**
2.	Identify the even and odd part of the step Signal.	**BTL 1**	**Remembering**
3.	Show that $x[n] = u[n] - u[n-1]$.	**BTL 1**	**Remembering**
4.	Draw the following signals (a)$u(t) - u(t-5)$ (b)$(1/3)^n u[n-1]$	**BTL 1**	**Remembering**
5.	Define the periodicity of $\cos(0.01\pi n)$.	**BTL 1**	**Remembering**
6.	Write the conditions for a system to be LTI Systems.	**BTL 1**	**Remembering**
7.	Explain when the system said to be memory less with an example.	**BTL 2**	**Understanding**
8.	Illustrate whether the given discrete time sequence is periodic or not. If the sequence is periodic ,find the fundamental period x[n]=cos($\frac{n}{8}$) cos($\frac{\pi n}{8}$)	**BTL 2**	**Understanding**
9.	Estimate whether the following system is Time Invariant/Time variant and also causal/non causal: $y(t) = x(\frac{t}{3})$.	**BTL 2**	**Understanding**
10.	Observe the following system is static or dynamic and also causal or non-causal system: $y[n] = x[2n]$.	**BTL 2**	**Understanding**
11.	Verify the discrete time signal sin[$3n$] is periodic.	**BTL 3**	**Applying**
12.	Relate the impulse signal, step signal, ramp signal.	**BTL 3**	**Applying**

13.	Give the mathematical and graphical representation of a discrete time ramp sequence.	**BTL 3**	**Applying**
14.	Examine the fundamental period 'T' of the following signal, if they are periodic: $\left(x(n) = \sin(\frac{6\pi n}{7} + 1)\right)$.	**BTL 4**	**Analyzing**
15.	Compare energy and power signals.	**BTL 4**	**Analyzing**
16.	Distinguish between continuous time and discrete time signals.	**BTL 4**	**Analyzing**
17.	Evaluate the energy and power of a unit step signal.	**BTL 5**	**Evaluating**
18.	Conclude the following integral $\int_{-1}^{1}(2t+3)\delta(t)\,dt$	**BTL 5**	**Evaluating**
19.	Create the mathematical and graphical representation of continuous time and discrete time impulse function.	**BTL 6**	**Creating**
20.	Formulate whether the given system described by the equation is linear and time invariant $y(t) = x(t^2)$.	**BTL 6**	**Creating**

Part-B(13 Marks)

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: a) $x(t) = \cos\left(\frac{\pi}{3}t\right) + \sin\left(\frac{\pi}{4}t\right)$ b) $x(n) = \cos\left(\frac{n}{4}\right)$ (6)	**BTL 1**	**Remembering**
2.	(i) Identify whether the following system are linear or not. (8) (a) $\frac{dy}{dt} + 3ty(t) = t^2x(t)$ (b) $y[n] = 2x[n] + \frac{1}{x[n-1]}$ (ii) Name the odd and even components of the following signals. (5) (a) $x(t) = \cos(t) + \sin(t) + \cos(t)\sin(t)$ (b) $x[n] = \{-2,1,2,-1,3\}$	**BTL 1**	**Remembering**
3.	(i) Examine whether the following system are time invariant or not. (7) (a) $y(t) = tx(t)$ (b) $y[n] = x[2n]$ (ii) Recognize the power and RMS value of the signal. (6) (a) $x(t) = A\cos(\Omega_0 t + \theta)$ (b) $y(t) = 10\cos5t * \cos10t$	**BTL 1**	**Remembering**
4.	(i) A Continuous time signal x(t) is shown in figure below, Sketch and label each of the following signals x(t-2),x(2t+3) ,x(1.5t) and x(-t+1) (5)	**BTL 1**	**Remembering**

	 (ii) Determine the energy and power of the given Signal x[n]=cos[$\frac{\pi}{4}n$] (4) (iii) State whether the given system is linear/nonlinear. Time variant/Time Invariant, Casual/Non Casual y[n]=x[n]-x[n-1] (4)		
5.	Estimate whether the following signals are energy signals or power signals (a) $x[n] = (\frac{1}{2})^n u[n]$ (4) (b) $x(t) = u(t) - u(t-5)$ (5) (c) $x(t) = e^{-2t}u(t)$ (4)	**BTL 2**	**Understanding**
6.	(i) Predict whether the following signal is periodic or not. (3) $x(t) = 2\cos(10t+1) - \sin(4t-1)$ (ii) Estimate the summation (3) $\sum_{n=-\infty}^{\infty}(e^{2n})\delta[n-2]$ (iii)Estimate the fundamental period T of the continuous time signal. (7) (a) $y(t) = 20\cos(10\pi t + \pi/6)$ (b) $x(n) = 2cos\left(\frac{\pi n}{4}\right) + sin\left(\frac{\pi n}{8}\right) - 2cos\left(\frac{\pi n}{2} + \frac{\pi}{6}\right)$	**BTL 2**	**Understanding**
7.	A discrete time signal x(n) is shown below. (2+2+2+2+2+3)  Plot the following Signals. (i)x(n-2) (ii) x(n+1) (iii) x(-n) (iv) x(-n+1) (v) x(2n) (vi) x(-2n+1)	**BTL 2**	**Understanding**

8.	(i) Experiment the following signal for linearity, Time Invariance, memoryless, Causality and Stability. (7) $y(n) = 2x(n-2)$ (ii) Discover whether the following are periodic. (6) $x[n] = \sin\left(\left(\frac{6\pi n}{7} + 1\right)\right)$ $x(n) = e^{j3\pi/5(n+\frac{1}{5})}$	**BTL 3**	**Applying**
9.	(i) Compute whether the following system is linear, time invariant, stable and invertible. (4+4) (a) $y(n) = x^2(n)$ (b) $y(n) = x(-n)$ (ii) Demonstrate that the signal satisfies linearity, time invariance, causality and stability conditions. (5) (a) $y(n) = x(n) + n\, x(n+1)$	**BTL 3**	**Applying**
10.	(i) Given $x(t) = \frac{1}{6}(t+2)$, $-2 \le t \le 4$ (8) 0, Otherwise Examine. (1) x(t) (2) x(t+1) (3) x(2t) (4) x(t/2) (ii) Judge the discrete time sequence $x[n]=\sin(\frac{3\pi}{7}n + \frac{\pi}{4}) + \cos\frac{\pi}{3}n$ is periodic or not. (5)	**BTL 4**	**Analyzing**
11.	A Continuous time system has the input-output relation given by y(t)= t x(t-1) Analyze whether the system is (3+3+3+2+2) (i)Linear (ii) Time Invariant (iii) Stable (iv) Memory less (v)Casual	**BTL 4**	**Analyzing**
12.	A trapezoidal pulse x(t) is defined by $x(t) = \begin{cases} 5-t; & 4 \le t \le 5 \\ 1; & -4 \le t \le 4 \\ t+5; & -5 \le t \le -4 \end{cases}$ (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)	**BTL 4**	**Analyzing**
13.	(i) Conclude and draw the waveforms represented by the following step function (6) $f_1(t)=2u(t-1)$ $f_2(t)= -2u(t-2)$ $f(t)= f_1(t)+ f_2(t)$ $f(t)= f_1(t)- f_2(t)$. (ii) Determine the energy and power of the given signal x(t)= t u(t) . (4) (iii)Check whether the given system is linear or not $y(t)= x^2(t)$. (3)	**BTL 5**	**Evaluating**
14.	Generate 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) $y(t)=\frac{d}{dt}x(t)$ (6)	**BTL 6**	**Creating**
Part-C (15 Marks)			
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) (3+3+3+4)	**BTL 5**	**Evaluating**

2.	For the following systems (i) y(n) = x(n).x(n-1) (7) (ii) y(n) = $\frac{1}{3}$ [x(n-1)+x(n)+x(n+1)] (8) Invent whether the systems are static, linear, shift invariant, causal and stable	**BTL 6**	**Creating**
3.	Sketch the following signals. (3+4+4+4) (i) u(-t+2) (ii) r(-t+3) (iii) 2δ(n +2) +δ(n)-2δ(n-1)+ 3δ(n-3) (iv) u(n+2)u(-n+3) where u(t),r(t),δ(n),u(n) represent continuous time unit step, continuous time ramp, discrete time impulse and discrete time step functions respectively.	**BTL 5**	**Evaluating**
4.	Formulate the properties linearity, causality, time invariance and dynamicity of the given systems. (i) $\frac{d^2y(t)}{dt^2} + 3t\frac{dy(t)}{dt} + y(t) = x(t)$ (5) (ii) $y(n) = x(n^2)$+x(n) (5) (iii) $y(n) = \log x(n)$ (5)	**BTL 6**	**Creating**

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS			
Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and properties			
PART A			
Q. No	**Questions**	**BT Level**	**Competence**
1.	Identify the Fourier Series coefficients of the signal x(t) =1+ sin2ωt + 2cos2ωt + cos(3ωt + $\frac{\pi}{4}$)	**BTL 1**	**Remembering**
2.	Write the equations for trigonometric& exponential Fourier series.	**BTL 1**	**Remembering**
3.	Describe the Dirichlet's conditions of Fourier series.	**BTL 1**	**Remembering**
4.	Estimate the exponential fourier series representation of $x(t) = sin^2(t)$	**BTL 2**	**Understanding**
5.	Discuss the fourier series representation of the signal $x(t) = \cos(\frac{2\pi}{3}t)$	**BTL 2**	**Understanding**
6.	If X(jΩ) is the fourier transform of the signal x(t),.Examine the fourier transform of the signal x(3t) in terms of X(jΩ).	**BTL 4**	**Analyzing**
7.	Show the Fourier transform of x(t)=e^{-at}u(t)	**BTL 1**	**Remembering**
8.	Summarize the fourier series coefficients for the given signal x(t)=[1+cos($2\pi t$)][sin$\left(10\pi t + \frac{\pi}{6}\right)$]	**BTL 5**	**Evaluating**
9.	Evaluate the fourier transform of x(t)=$e^{-3\|t\|}$ u(t)	**BTL 5**	**Evaluating**
10.	Develop the synthesis and analysis equation of continuous time Fourier Transform	**BTL 6**	**Creating**
11.	Calculate the Laplace transform of the function x(t) =u(t)-u(t-2)	**BTL 3**	**Applying**
12.	Relate the Laplace transform of x(t) = 3e^{-2t}u(t)-2e^{-t}u(t) with ROC	**BTL 2**	**Understanding**
13.	Solve the Laplace transform of δ(t) and u(t).	**BTL 3**	**Applying**
14.	What is the Relationship between Laplace Transform and Fourier Transform?	**BTL 1**	**Remembering**
15.	Point out any four properties of Fourier Transform.	**BTL 3**	**Applying**
16.	Analyze ROC of the Laplace Transform.	**BTL 4**	**Analyzing**
17.	Analyze the parseval's relation of continuous time fourier transform	**BTL 4**	**Analyzing**
18.	Illustrate the Laplace Transform of the signal x(t) =e^{-2t} u(t).	**BTL 2**	**Understanding**
19.	Describe the differentiation and integration property of Laplace transform.	**BTL 1**	**Remembering**
20.	Design the poles and zeros of the given transfer function X(S) = (S^2+3s+2)/(S^2+2s+2)	**BTL 6**	**Creating**
Part-B(13 Marks)			
1.	Identify 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	**BTL 1**	**Remembering**

	(i)δ(t-5) (ii)e^{-at}u(t) a real, positive (13)		
2.	(i) Find the Fourier transform of x(t)=e^{-at} u(-t) (6) (ii) Cite the Fourier series representation of the signal x(t)=2+cos(4t)+sin(6t) (7)	**BTL 1**	**Remembering**
3.	Express the exponential Fourier series for the signal (13) f(t) = e^{-t} ,$0 \le t \le 0.5$ and also plot the magnitude and phase spectrum.	**BTL 2**	**Understanding**
4.	Examine the Fourier transform of x(t) = $e^{-a\|t\|}$ and plot the Fourier spectrum. (13)	**BTL 1**	**Remembering**
5.	(i) Write the properties of CT Fourier Transform. (6) (ii) Outline the Trigonometric Fourier series for the full wave rectified sine wave. (7)	**BTL 1**	**Remembering**
6.	(i) Estimate the Fourier Transform of x(t) = 1-$e^{-\|t\|}$cosω_0t . (7) (ii) Describe the Fourier Transform of Rectangular pulse. Sketch the signal. (6)	**BTL 2**	**Understanding**
7.	Predict 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)	**BTL 2**	**Understanding**
8.	(i) Calculate the Laplace Transform and ROC of the signal $x(t)=e^{-3t}u(t)+e^{-2t}u(t)$ (7) (ii) Illustrate Convolution property of Laplace transform. (6)	**BTL 3**	**Applying**
9.	(i) Solve the inverse Laplace transform of x(s)=$\frac{(s+3)}{(s+1)(s+2)^2}$ (7) (ii) Discover the initia1 value and final value of signal x(t) whose Laplace Transform is X(S) = $\frac{2s+5}{s(s+3)}$. (6)	**BTL 3**	**Applying**
10.	(i) Detect the inverse Laplace Transform of X(S) = $\frac{3}{s^2(s+1)}$ (7) (ii) Test the initial and final value of a signal x(t)=sin4tu(t). (6)	**BTL 4**	**Analyzing**
11.	Analyze the inverse Laplace transform of x(s)=$\frac{4}{(s+2)(s+4)}$for ROCs (i)Re(s) < -4 (ii) Re(s) > -2 (iii) -2 > Re(s) > -4. (13)	**BTL 4**	**Analyzing**
12.	Examine the Laplace transform of x(t)=$e^{-a\|t\|}$,a>0 and its associated ROC and indicate whether the Fourier transform X(jΩ) exists (13)	**BTL 4**	**Analyzing**
13.	Evaluate 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)	**BTL 5**	**Evaluating**
14.	(i) Create the Laplace Transform of $x(t)$ = t^2e^{-2t}u(t) (7) (ii) Estimate the inverse Laplace Transform of the function	**BTL 6**	**Creating**

	$X(S) = \frac{2S+4}{(s+3)(s+1)}$ ROC: -3 < Re{s} < -1 ,Re(s) < -3 (6)		
Part-C(15 Marks)			
1.	(i) Interpret the inverse Fourier transform of X(ω)=δ(ω) (5) (ii) Evaluate the Fourier transform of Gaussian pulse. (10)	**BTL 5**	**Evaluating**
2.	Formulate the trigonometric Fourier series over the interval (-1, 1) for the signal $x(t) = t^2$. (15)	**BTL 6**	**Creating**
3.	Evaluate the Laplace transform of $x(t) = e^{-b\|t\|}$ for the cases of b<0 and b>0. (15)	**BTL 5**	**Evaluating**
4.	Invent the inverse Laplace transform of the following function (a) $X(S) = \frac{1}{s^2+3s+2}$ $ROC: -2 < Re(s) < -1$ (7) (b) $X(S) = \frac{1}{(s+5)(s-3)}$ $ROC: -5 < Re(s) < 3$,Re(s)>3 (8)	**BTL 6**	**Creating**

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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	BT Level	Domain
1.	Write the condition for LTI system to be stable and causal.	BTL 1	Remembering
2.	Given the differential equation representation of the system $d^2y(t)/dt^2 +2dy(t)/dt -3y(t)=2x(t)$.Examine the frequency response.	BTL 1	Remembering
3.	Identify the differential equation relating the input and output a CT system represented by $H(j\Omega) = \frac{1}{(j\Omega)^2+8(j\Omega)+1}$	BTL 1	Remembering
4.	Given the input x(t) =u(t) and h(t) = δ(t-1).find the response y(t).	BTL 1	Remembering
5.	List the properties for convolution integral.	BTL 1	Remembering
6.	What is S-Plane?	BTL 1	Remembering
7.	Summarize impulse response of an LTI system.	BTL 2	Understanding
8.	Given H(s) = $\frac{1}{s^2+2s+1}$ .Express the differential equation representation of the system.	BTL 2	Understanding
9.	Estimate whether the causal system with transfer function $H(s) = 1/(s-2)$.	BTL 2	Understanding
10.	Predict the step response of a CT LTI system for the given h(t).	BTL 2	Understanding
11.	If the system function $H(s) = 4 - \frac{3}{s+2}$; Re(s)>-2 , find the impulse response h(t)	BTL 3	Applying
12.	Calculate the unit step response of the system given by $h(t) = 1/RC\, e^{-\frac{t}{RC}}\, u(t)$.	BTL 3	Applying
13.	Solve the impulse response of the system given by $H(s) = 1/(s+9)$.	BTL 3	Applying
14.	Analyze the expression of convolution integral.	BTL 4	Analyzing
15.	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 system?	BTL 4	Analyzing
16.	If two LTI systems with impulse responses $h_1(t) = e^{-at}\, u(t)$ and $h_2(t) = e^{-bt}\, u(t)$ are connected in cascade, what will be the overall impulse response of cascaded system?	BTL 4	Analyzing
17.	Evaluate the causality of the system with response $h(t)= e^{-t}\, u(t)$.	BTL 5	Evaluating
18.	Deduce the impulse response of two LTI systems when connected in parallel.	BTL 5	Evaluating

19.	Create the N^{th} order differential equation.	BTL 6	Creating
20.	Combine the following signals using Convolution u(t-1) and δ(t-1).	BTL 6	Creating
PART B(13 Marks)			
1.	Examine the Convolution of following signals. (13) $x(t)= e^{-3t}$ u(t)and h(t)= u(t-1)	BTL 1	Remembering
2.	i) Define convolution Integral and describe its equation. (6) ii) A stable LTI system is characterized by the differential equation $d^2y(t)/dt^2 + 4dy(t)/dt + 3y(t) = dx(t)/dt + 2x(t)$. Write the frequency response & impulse response using Fourier transform. (7)	BTL 1	Remembering
3.	(i) Identify 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) Describe 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. (6)	BTL 1	Remembering
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)	BTL 1	Remembering
5.	The system produces the output y(t) = e^{-t}u(t) for an input x(t) =e^{-2t}u(t). Predict i) frequency response ii) the impulse response. (13)	BTL 2	Understanding
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). (6) (ii) Using Laplace transform, observe 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)	BTL 2	Understanding
7.	(i) Express the transfer function of the system for the impulse response h(t)= δ(t) + e^{-3t}u(t) +2e^{-t}u(t) (6) (ii) Interpret the impulse response for the differential equation RCdy(t)/dt + y(t) =x(t). (7)	BTL 2	Understanding
8.	Examine the convolution y(t) of the given signals. (i) x(t)=cost u(t) ,h(t)=u(t) (7) (ii) x(t)=u(t), h(t)= $\frac{R}{L}e^{-tR/L}$u(t) (6)	BTL 3	Applying
9.	(i) Using graphical method, Discover the output y[t] for the LTI system whose response h[t] = u(t-3) and input x[t]= u(t+1) (7) (ii) Calculate the step response of the system h(t) = e^{-4t} u(t). (6)	BTL 3	Applying
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) Detect the impulse response of h(t). (7) (ii)Analyze the response y(t) of the system if x(t)=u(t) using Fourier Transform. (6)	BTL 4	Analyzing
11.	Detect the output y(t) of the system $H(s) = \frac{1}{s+2}$: Re{s}>-2 for the input $x(t) = e^{--3t}u(t)$ (13)	BTL 4	Analyzing
12.	Examine the impulse response and step response of the system $H(s) = \frac{s+4}{s^2+5s+6}$ (13)	BTL 4	Analyzing

13.	A causal LTI system satisfies the linear differential equation $d^2y(t)/dt^2 + 7\,dy(t)/dt + 12y(t) = dx(t)/dt + 2x(t)$ (i) Find the frequency response $H(j\Omega)$ of the system (6) (ii) Find the output y(t) of the system for the input $x(t)= e^{-2t}u(t)$ (7)	**BTL 5**	**Evaluating**
14.	(i) The system transfer function is given as $H(s)= s/(s^2+5s+6)$. The input to the system is $x(t)=e^{-t}u(t)$. Develop the output assuming zero initial conditions. (7) (ii) Estimate the system function for the system with output response $y(t) = 2e^{-3t}u(t)$ and input $x(t) = u(t)$. (6)	**BTL 6**	**Creating**
	Part-C(15 Marks)		
1.	Evaluate the response y(t) of a continuous time system using Laplace transform with transfer function $H(s) = \frac{1}{(s+2)(s+3)}$ for an input $x(t)= e^{-t}u(t)$. (15)	**BTL 5**	**Evaluating**
2.	A system is described by the differential equation $d^2y(t)/dt^2 + 6dy(t)/dt + 8y(t) = dx(t)/dt + x(t)$. Create the transfer function and the output signal y(t) for $x(t) = \delta(t)$. (15)	**BTL 6**	**Creating**
3.	A causal LTI system having a frequency response $H(j\Omega)=\frac{1}{j\Omega+3}$ is producing an output $y(t) = e^{-3t}u(t)-e^{-4t}u(t)$ for a particular input x(t). Deduce x(t). (15)	**BTL 5**	**Evaluating**
4.	A continuous time LTI system is represented by the following differential equation. $\frac{d^2}{dt^2}y(t) + 3\frac{d}{dt}y(t) + 2y(t) = 2x(t)$. Invent the impulse response of the system using Fourier transform. (15)	**BTL 6**	**Creating**

UNIT IV
ANALYSIS OF DISCRETE TIME SIGNALS

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

PART A

Q.No	Questions	BT Level	Competence
1.	Find the DTFT of $x(n)= \delta(n)+ \delta(n-1)$.	**BTL 1**	**Remembering**
2.	Identify the need for sampling.	**BTL 1**	**Remembering**
3.	Write the condition for existence of DTFT.	**BTL 1**	**Remembering**
4.	Define DTFT and Inverse DTFT.	**BTL 1**	**Remembering**
5.	What is aliasing?	**BTL 1**	**Remembering**
6.	Describe the time folding property of Z-transform.	**BTL 1**	**Remembering**
7.	If $X(\omega)$ is the DTFT of x(n),Estimate the DTFT of $x^*(-1)$?	**BTL 2**	**Understanding**
8.	Express one sided Z-transform and two sided Z transform.	**BTL 2**	**Understanding**
9.	Discuss the main condition to avoid aliasing.	**BTL 2**	**Understanding**

10.	Summarize the methods of obtaining inverse Z transform.	**BTL 2**	**Understanding**
11.	Solve the DTFT of u(n).	**BTL 3**	**Applying**
12.	A continuous time signal $x(t)$ has the following real Fourier transform $$X(j\Omega) = \begin{cases} 1 \ ; for\|\Omega\| \leq 10\pi \\ 0 \ ; otherwise \end{cases}$$ Is $x(t)$ band limited? If so, find the Nyquist rate	**BTL 3**	**Applying**
13.	Calculate the Z transform of x(n)={1,2,3,4}.	**BTL 3**	**Applying**
14.	Analyze the Parseval's relation for discrete time aperiodic signals.	**BTL 4**	**Analyzing**
15.	Explain the mulplication property of DTFT.	**BTL 4**	**Analyzing**
16.	Contrast the convolution property of Z-transform.	**BTL 4**	**Analyzing**
17.	Conclude antialiasing filter.	**BTL 5**	**Evaluating**
18.	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 impulse response h(n)	**BTL 5**	**Evaluating**
19.	Design the Z transform of sequence x(n)=a^n u(n) and its ROC.	**BTL 6**	**Creating**
20.	Invent the z-transform of δ(n+K).	**BTL 6**	**Creating**
	PART –B (13 Marks)		
1.	(i) Consider an analog signal x(t) = 5cos200πt. (a) Examine the minimum sampling rate to avoid sampling. (4) (b) If sampling rate Fs =400Hz.What is the Discrete time signal after sampling? (5) (ii) Quote the initial and final value theorem. (4)	**BTL 1**	**Remembering**
2.	(i) List any four properties of DTFT. (8) (ii) Write the transfer function of a zero order hold. (5)	**BTL 1**	**Remembering**
3.	(i) Prove the sampling theorem and explain how the original signal can be reconstructed from the sampled version. (8) (ii) Describe the effects of under sampling and the steps to eliminate aliasing. (5)	**BTL 1**	**Remembering**
4.	Identify and explain the following properties of Z transform (i) Time and frequency convolution property. (8) (ii) Parsevals theorem. (5)	**BTL 1**	**Remembering**
5.	(i) Summarize the properties of ROC. (7) (ii) Explain the contour integration method with an example. (6)	**BTL 2**	**Understanding**
6.	(i) Use convolution theorem,express the inverse Z-transform of $X(Z) = \frac{Z}{(Z-1)^3}$. (7) (ii) Estimate the inverse Z-transform for the following sequences. (a) X(Z)= $\frac{Z}{(Z-0.5)(Z+0.7)}$ (3) (b) X(Z)= $\frac{Z}{(Z+1.2)(Z+0.7)}$ (3)	**BTL 2**	**Understanding**
	o 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)	BTL 2	Understanding
8.	(i)Solve the Z transform and ROC of x(n)=u(n)-u(n-3). (7) (ii)Relate DTFT and Z transform. (6)	BTL 3	Applying
9.	Discover the Z transform of the following sequence $x(n) = \sin(\omega_0 n)u(n)$ .Also specify its ROC (13)	BTL 3	Applying
10.	(i) Inspect the convolution property of Z Transform. (5) (ii) Point out the Z-transform of $x(n) = \cos(\omega_o n)u(n)$. (8)	BTL 4	Analyzing
11.	Let $X(e^{jw})$ be the Fourier transform of the sequence $x(n)$. Determine interms of $x(n)$ the sequence corresponding to the following transforms using the properties of DTFT. Also prove the properties used. (i) $X(e^{j(w-wo)})$ (5) (ii) $X^*(e^{-jw})$ (4) (iii) $jd/dwX(e^{jw})$ (4)	BTL 4	Analyzing
12.	(i) Infer the Z-transform and ROC of $x[n] = 2^n u(n)+3^n u(-n-1)$. (7) (ii) Experiment the Z-transform of the sequences x(n)={5,3,2,4}. (6)	BTL 4	Analyzing
13.	(i) Deduce the initial value of $X(Z) = \frac{Z+2}{(Z+1)(Z+3)}$ (6) (ii) Evaluate the Z-transform of $x(n)=(2/3)^n u(n)+(-1/2)^n u(n)$. (7)	BTL 5	Evaluating
14.	Consider the analog signal x(t) = 2cos2000πt + 5sin4000πt + 12cos2000πt. (i) Invent the Nyquist sampling rate. (6) (ii) If the analog signal is sampled at Fs = 5000Hz, formulate the discrete time signal obtained by sampling. (7)	BTL 6	Creating
	Part-C (15 Marks)		
1.	The input output relationship of a discrete time system is given by $y(n) - \frac{1}{4}y(n-1) = x(n)$. Find the response $y(n)$ if the Fourier transform of the input $x(n)$ is given as $X(e^{jw}) = \frac{1}{1-\frac{1}{2}e^{-jw}}$ (15)	BTL 5	Evaluating
2.	Formulate 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)	BTL 6	Creating
3.	Evaluate the inverse z-transform of $x(z)=\frac{z^{-1}}{1-0.25z^{-1}-0.375z^{-2}}$ For (i) ROC |z|> 0.75 (ii)ROC |z|< 0.5 (15)	BTL 5	Evaluating
4.	(i) Create the Z transform of the sequence	BTL 6	Creating

	$x[n] = a^n u[n] + b^n u[-n-1]$ considering the two conditioned a>b and a<b. (8) (ii) Invent the Z-transform of x(n) = nu(n) s(7)		

UNIT **V**

LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS

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.

PART A

Q.No	Questions	BT Level	Competence
1.	Define natural response and forced response.	**BTL 1**	**Remembering**
2.	Describe the non-recursive and recursive systems.	**BTL 1**	**Remembering**
3.	State the condition for an LTI discrete time system to be causal and stable in terms of ROC,	**BTL 1**	**Remembering**
4.	Identify the overall impulse response h (n) when two systems h_1 (n) and h_2 (n) are in parallel and are in series.	**BTL 1**	**Remembering**
5.	What is meant by system response?	**BTL 1**	**Remembering**
6.	Write the convolution sum with its equation $x_1(n)$ & $x_2(n)$ as two input sequence.	**BTL 1**	**Remembering**
7.	Illustrate the relationship between impulse response and transfer function of a DT-LTI system.	**BTL 2**	**Understanding**
8.	Give the impulse response of a linear time invariant system as $h(n)=\sin \pi n$. Express whether the system is stable or not.	**BTL 2**	**Understanding**
9.	Estimate the initial and final values of the function $X(z) = (1+z^{-1}) / (1-0.25z^{-2})$	**BTL 2**	**Understanding**
10.	Interpret 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.	**BTL 2**	**Understanding**
11.	Solve the convolution of given two sequences x(n)={1,1,1,1} and h(n)={2,2}.	**BTL 3**	**Applying**
12.	Apply the Z-transform to the following two signals. Note that the Z-transforms for both have the same algebraic expression and differ only in the ROC. $x_1(n) = (1/2)^n u(n)$ and $x_2(n) = -(1/2)^n u(-n-1)$	**BTL 3**	**Applying**
13.	Show the n^{th} order difference equation.	**BTL 3**	**Applying**

14.	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} . Analyze the impulse response due to these functions.	**BTL 4**	**Analyzing**
15.	Check whether the system with system function $H(z) = \frac{1}{1-0.5z^{-1}} + \frac{1}{1-2z^{-1}}$ with ROC |z| < 0.5 is causal and stable.	**BTL 4**	**Analyzing**
16.	Using Z-transform inspect if the LTI system given by H (z) = z/(z-1) is stable or not.	**BTL 4**	**Analyzing**
17.	Evaluate the system function of the discrete time system described by the difference equation. y(n) = 0.5y(n-1)+x(n).	**BTL 5**	**Evaluating**
18.	Determine the convolution of (a) x(n) * δ(n). (b) x(n) * [h_1(n)+h_2(n)].	**BTL 5**	**Evaluating**
19.	Is the discrete time system described by the difference equation y(n)=x (-n) causal?	**BTL 6**	**Creating**
20.	Design 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.	**BTL 6**	**Creating**
	PART –B (13 Marks)		
1.	The input output relationship of a discrete system is given by Y(n) – (¼) y(n-1) = x(n). Find the response y(n) if the fourier transform of the input x(n) is given by $X(e^{jw}) = 1/[1-(1/2)e^{-jw}]$	**BTL 1**	**Remembering**
2.	(i) Write the properties of convolution sum. (8) (ii) List the steps of methods to compute the convolution sum. (5)	**BTL 1**	**Remembering**
3.	Show the results of the linear convolution of x(n)={1,1,1,1} and h(n)={2,2}using graphical representation. (13)	**BTL 1**	**Remembering**
4.	(i) Find the DFT of x(n) = a^n , for 0≤ n≤ N-1 (5) (ii) Identify the magnitude and phase response of y(n)=1/2x(n)+1/2x(n-1). (8)	**BTL 1**	**Remembering**
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) Express the impulse response of the system. (6)	**BTL 2**	**Understanding**
6.	(i) Estimate 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). (13)	**BTL 2**	**Understanding**
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).	**BTL 3**	**Understanding**

	Predict (i) Frequency response of the system. (4) (ii) Impulse response of the system. (4) (iii) The system output for the input $(1/4)^n$ u(n). (5)		
8.	(i) Calculate 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) Discover the autocorrelation of {1,2,1,3}. (5)	**BTL 3**	**Applying**
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, Examine y(n) if x(n)=u(n). (3)	**BTL 3**	**Applying**
10.	(i) Analyze the difference equation & 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) Examine 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).	**BTL 4**	**Analyzing**
11.	The system function H(Z) $=\frac{z^2}{(z-\frac{1}{3})(z-\frac{1}{2})}$ ROC:$\|z\|>\frac{1}{2}$ .Select the step response and impulse response of the system. (13)	**BTL 4**	**Analyzing**
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) Using graphical method, point out the output sequence y[n] for the LTI system whose response h[n] = {1,1,1} and input x[n] ={0.5,2}. (6)	**BTL 4**	**Analyzing**
13.	(i) Deduce 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) Evaluate the cross correlation of two finite length sequences x(n)={1,2,3,4} and y(n) = {1,1,2,1}. (6)	**BTL 5**	**Evaluating**
14.	Develop the system function H(z) the pole-zero pattern and determine if the following system is stable. (i) y(n-2) - (7/10)y(n-1) + (1/10)y(n) = x(n) (7) (ii) y(n)=1.8y(n-1)-0.72y(n-2)+x(n)+0.5x(n-1). (6)	**BTL 6**	**Creating**
	Part-C (15 Marks)		
1.	Determine the system function and output response y(n) of a linear time invariant discrete time system specified by the equation	**BTL 5**	**Evaluating**

	$y(n)-\frac{3}{2}y(n-1)+\frac{1}{2}y(n-2)=2x(n)+\frac{3}{2}x(n-1)$ (15)		
2.	Examine the impulse response of a discrete time LTI system $h(n) = [-2(1/3)^n + 3(1/2)^n]\, u(n)$. (15) (i) Find the system Function H(z) of the system. (ii) Find the difference equation representation of the system (iii) Find the step response of the system	**BTL 6**	**Creating**
3.	Evaluate the impulse and step response of the system described by the following difference equation y(n)+1/3y(n-1) = x(n). (15)	**BTL 5**	**Evaluating**
4.	Generate 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)	**BTL 6**	**Creating**