Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–V (NEW) EXAMINATION – WINTER 2020

Subject Code:3150912 Date:01/02/2021

Subject Name:Signals and Systems

Time:10:30 AM TO 12:30 PM Total Marks: 56

Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			Marks
Q.1	**(a)**	Compare Analog Signal and Digital Signal	**03**
	(b)	Differentiate between continuous and discrete time signal.	**04**
	(c)	Explain with Example following properties of system. (1) Linearity (2) Homogeneity (3) Additivity (4) Casuality (5) Shift invariance (6) Stability (7) Realizability	**07**
Q.2	**(a)**	Determine the energy and power of a unit step signal.	**03**
	(b)	State and prove the frequency differentiation property of Fourier transform.	**04**
	(c)	Define Laplace transform. Prove linearity property for Laplace transform. State how ROC of Laplace transform is useful in defining stability of systems.	**07**
Q.3	**(a)**	Obtain the DFT of unit impulse δ(n)	**03**
	(b)	Prove the duality or symmetry property of fourier transform.	**04**
	(c)	Find the fourier transform of the periodic signal x(t)=cos($2\pi f_0 t$) $u(t)$	**07**
Q.4	**(a)**	State and prove a condition for a discrete time LTI system to be invertible.	**03**
	(b)	State and prove the time scaling property of Laplace transform.	**04**
	(c)	Find the convolution of two signals X_1(t) and X_2(t) X`(t)= $e^{-4t}u(t)$ X2(t)= $u(t-4)$	**07**
Q.5	**(a)**	State the condition for existence of Fourier integral.	**03**
	(b)	Prove that when a periodic signal is time shifted, then the magnitude of its fourier series coefficient remains unchanged. (|an|=|bn|)	**04**
	(c)	Determine the homogeneous solution of the system described by: $y(n) - 3y(n-1)$ - $4y(n-2) = x(n)$	**07**
Q.6	**(a)**	State and prove the initial value theorem.	**03**
	(b)	State and prove the Final value theorem.	**04**
	(c)	Explain the trigonometric fourier series with suitable example.	**07**
Q.7	**(a)**	Explain discrete Fourier transform and enlist its features.	**03**
	(b)	Define the region of convergence with respect to z-transform.	**04**
	(c)	Define: The Z transform. State and prove Time shifting and Time reversal properties of Z transform	**07**
Q.8	**(a)**	Determine the z-transform of following finite duration	**03**

sequence X(n)={1,2,4,5,0, 7}

(b) Calculate the DFT of the sequence, $x(n) = \{1,1,0,0\}$. Verify your answer with IDFT. **04**

(c) Determine if the following systems described by **07**

i. y(t) = sin[x(t+2)];
ii. y(n)=x[2-n]

are memoryless, causal, linear, time invariant, stable

Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2021

Subject Code:3150912 Date:27/12/2021

Subject Name:Signals and Systems

Time:02:30 PM TO 05:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Give expression of trigonometric Fourier Series. Define coefficients of DC, fundamental and harmonics.	**03**
	(b)	Check whether the signal $x(t)=2\cos(100\pi t)+5\sin(50t)$ is periodic or not.	**04**
	(c)	Obtain complex exponential Fourier series for $\sin \omega t$ and $\cos \omega t$. Assume ω to be constant.	**07**
Q.2	**(a)**	Find even part of signal $x(n)=u(n)-u(n-4)$.	**03**
	(b)	Define energy signal. Find the energy of the signal $x(t)=5e^{-4t}u(t)$	**04**
	(c)	Check whether the system described by the equation $y(t)=10x(t)+5$ is linear, static, time invariant, causal and stable.	**07**
		OR	
	(c)	Check whether the system described by the equation $y(n)=x(n)u(n)$ is linear, static, time invariant, causal and stable.	**07**
Q.3	**(a)**	Give the convolution sum and integral formulas.	**03**
	(b)	List and prove any two properties of convolution sum.	**04**
	(c)	Convolve $x(t)=e^{-3t}[u(t)-u(t-2)]$ and $h(t)=e^{-t}u(t)$.	**07**
		OR	
Q.3	**(a)**	State the linearity and time shifting property of Fourier transform.	**03**
	(b)	Prove convolution property of Fourier transform.	**04**
	(c)	Find inverse Fourier transform of $$X(\omega)=\frac{2j\omega}{(2+j\omega)^2}$$	**07**
Q.4	**(a)**	Define Z-transform. What is ROC?	**03**
	(b)	Find the Z-transform of $4^n u(n)$.	**04**
	(c)	Find inverse Z-transform of $$X(z)=\frac{(z+4)}{(z^2-4z+3)}$$ Assume right-sided sequence.	**07**
		OR	
Q.4	**(a)**	State any three properties of ROC of Z-transform.	**03**
	(b)	State and prove the time shifting property of the Z-transform.	**04**
	(c)	Solve the difference equation $y(n)-0.5y(n-1)=\delta(n)$ using Z-transform.	**07**
Q.5	**(a)**	What is zero-order hold in sampling?	**03**

	(b)	What are the effects of under sampling of a signal ?	**04**
	(c)	Describe various types of sensors used for IoT applications.	**07**

OR

Q.5	**(a)**	Explain the reconstruction of a signal from its samples.	**03**
	(b)	Explain any one practical application of Signals and Systems theory.	**04**
	(c)	Explain working of any system based on Arduino.	**07**

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Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – SUMMER 2021

Subject Code:3150912 Date:15/09/2021

Subject Name:Signals and Systems

Time:10:30 AM TO 01:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1 (a) Determine the energy and power of a unit step signal. **03**

(b) Determine whether or not the following signals is periodic. If a signal is periodic, determine its fundamental period. **04**

(i) $x(t) = \cos t + sin\sqrt{2}t$

(ii) $x[n] = e^{j\left(\frac{\pi}{4}\right)n}$

(c) Write the properties of convolution and explain them with suitable example. **07**

Q.2 (a) Consider an analog pulse **03**

$$x(t) = \begin{cases} 1 & 0 \le t \le 1 \\ 0 & Otherwise \end{cases}$$

Find mathematical expression for (t) delayed by 2, advanced by 2, and the reflected signal $x(-t)$.

(b) Consider the following signal **04**

X(t)= $Ae^{\alpha t}u(t)$, $\alpha > 0$

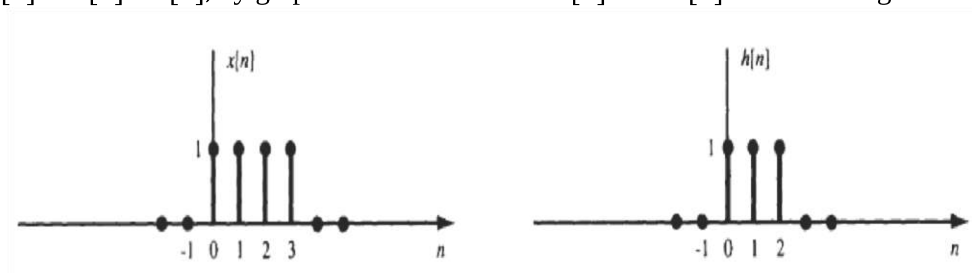
Is X(t) an energy signal or power signal as $\alpha \to 0$ what is the nature of signal?

(c) Determine natural response of the first order system governed by the equation, **07**

$$\frac{dy(t)}{dt} + 3y(t) = x(t); y(0) = 2$$

OR

(c) Evaluate $[n] = x[n] * h[n]$, by graphical method. where $x[n]$ and $h[n]$ are shown figure below. **07**

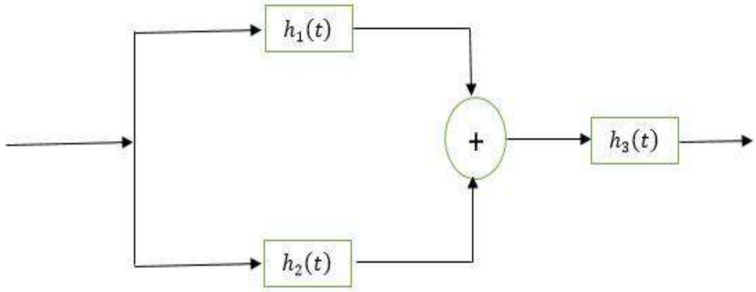


Q.3 (a) Prove that a DT LTI system is causal if and only if h(n)=0 for n<0. **03**

(b) Explain time shifting and periodicity property of laplace transform. **04**

(c) Find the overall impulse response of the system shown in figure below. **07**

Take, $h_1(t) = tu(t)$; $h_2(t) = 3u(t)$; $h_3(t) = 2u(t)$;



OR

Q.3 **(a)** State and prove the initial value theorem. **03**

(b) Consider a discrete-time LTI system with impulse response $h[n]$ given by $h[n] = \alpha^n u[n]$ **04**

i. Is this system causal?

ii. Is this system BIBO stable?

(c) Obtain the convolution integral of **07**

X(t)=1 for $-1 \le t \le 1$

H(t)=1 for $0 \le t \le 2$

Q.4 **(a)** Consider the system described by **03**

Y'(t) + 2 y(t) = x(t) + x'(t)

Find the impulse response h(t) of the system.

(b) Explain sampling and quantization. **04**

(c) Define Z-transform. Explain region of convergence and their properties. **07**

OR

Q.4 **(a)** Determine the z-transform of $x(n) = (n-3)$u(n) **03**

(b) Determine the inverse z-transform of **04**

$(z) = \log(1 + az^{-1})$; $|z| > |a|$.

(c) Derive the Convolution integral for CTS. Find out the even and odd part. **07**

Q.5 **(a)** Test the following systems for linearity. $y(t) = 4x(t) + 2\frac{dx(t)}{dt}$. **03**

(b) State and prove the time scaling property of Laplace transform. **04**

(c) A system has impulse response h(n) given by, $h(n) = -0.25\delta(n+1) + 0.5\delta(n) - 0.25\delta(n-1)$. **07**

i. Is the system BIBO stable?

ii. Is the system causal? Justify your answer.

OR

Q.5 **(a)** State and prove the initial value theorem. **03**

(b) Prove the duality or symmetry property of fourier transform. **04**

(c) Explain the property of continuous time and discrete time Systems. **07**

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Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V(NEW) EXAMINATION – SUMMER 2022

Subject Code:3150912 Date:07/06/2022

Subject Name:Signals and Systems

Time:02:30 PM TO 05:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Explain odd and even signals with diagram.	**03**
	(b)	Define the following: Energy signal, Causal System, Analog signal, Periodic signal.	**04**
	(c)	Explain the Standard / Elementary signals in signal processing in continuous and discrete time.	**07**
Q.2	**(a)**	A 100 Hz sinusoid x(t) is sampled at 240 Hz. Has aliasing occurred? Also state the minimum sampling frequency.	**03**
	(b)	What is a system? Explain different types of system in brief.	**04**
	(c)	Determine whether the following system given as y(t)= 10x(t) +5 is static, causal, linear, time invariant and stable.	**07**
		OR	
	(c)	For LTI system with unit impulse response h(t)= e^{-2t} u(t), determine output to the input x(t)= e^{-t} u(t).	**07**
Q.3	**(a)**	Find Z transform for sequence x(n)={1,2,4,5,0,7} and specify ROC.	**03**
	(b)	Explain trigonometric fourier series with all equations.	**04**
	(c)	Sketch the following signals if x(n)= { 1,1,1,1,1,1/2} ↑ 1. x(n-4) 2. x(n).u(2-n) 3. x(n-1) + δ(n-3)	**07**
		OR	
Q.3	**(a)**	State and prove the time shifting property of Fourier transform.	**03**
	(b)	Find Fourier transform of unit step function.	**04**
	(c)	Find inverse Z transform of X(z)= 1 / (1-1.5z^{-1}+0.5z^{-2}) for 1. ROC: |z| >1, 2. ROC: |z| < 0.5.	**07**
Q.4	**(a)**	Find the energy or power of the signal x(n)= u(n) .	**03**
	(b)	Explain any two properties of convolution sum.	**04**
	(c)	Find the linear convolution of : x(n)= {1,1,1,1} and h(n)={2,2} ↑ ↑ using basic convolution equation or graphical method.	**07**
		OR	
Q.4	**(a)**	Define Laplace transform and prove its linearity property.	**03**
	(b)	Obtain Fourier transform of a rectangular pulse given as : x(t)= A rect (t/T).	**04**
	(c)	The difference equation of system is given as below: y(n)= 0.5y(n-1) +x(n). Determine the system function and the impulse response h (n) of the system.	**07**

Q.5	**(a)**	Find Z transform of $x(n)= (1/3)^n u(n)$ and also sketch its ROC.	**03**
	(b)	State and prove any two properties of Z transform.	**04**
	(c)	Give equation for Z transform. What is ROC for Z transform? State the properties of ROC.	**07**
		OR	
Q.5	**(a)**	State and explain sampling theorem with necessary equations.	**03**
	(b)	Explain any three sensors used in Internet of Things.	**04**
	(c)	Find Z transform of $x(n)= \cos(\omega n) u(n)$	**07**

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