Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:2141005 Date:11/09/2021

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)**	Define discrete time signal. Enlist detailed classification of Discrete time signals.	**03**
	(b)	Sketch each of the following signals. (i) x[n] = 2u[n+2] - 2u[n - 3] (ii) x(t) = r(-t). u(t +3)	**04**
	(c)	Classify following systems as : (a) Causal or non-causal; (b) Linear or nonlinear and (c) Time invariant or time variant (i) y(n) = $\lvert x(n) \rvert$ (ii) y(n)= 2x(n+2) - x(n-2)	**07**
Q.2	**(a)**	For LTI systems , state and prove Time shifting property of Laplace transform.	**03**
	(b)	For LTI system, if input sequence is x(n) and impulse response is defined as h(n), derive equation for discrete time convolution sum y(n).	**04**
	(c)	Consider a causal LTI system with frequency response $H(w) = \frac{1}{jw+3}$. For a particular input x(t), this system observes output $y(t) = e^{-t}.u(t) - e^{-2t}u(t)$. Determine x (t).	**07**
		OR	
	(c)	LTI system is described by difference equation $y(n) - \frac{5}{6}y(n-1) + \frac{1}{6}y(n-2) = x(n)$ With y(-1)=1 and y(-2) =0. Determine forced response for an input $x(n) = (\frac{1}{4})^n u(n)$.	**07**
Q.3	**(a)**	Enlist different conditions for existence of Fourier transform.	**03**
	(b)	Find convolution of following two signals. $x(t) = e^{-2t}u(t)$ with $h(t) = e^{-4t}u(t)$	**04**
	(c)	Compute the Fourier transform for the signal x(t) in following figure:01	**07**

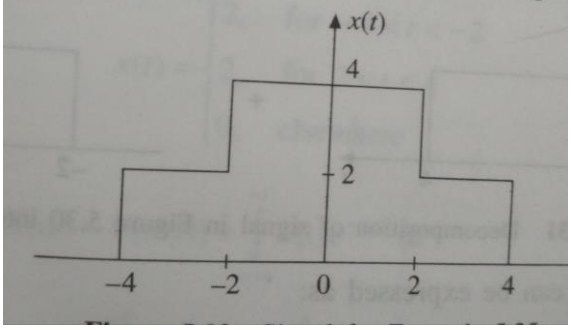

Figure :01

OR

Q.3 **(a)** Explain differentiation in time domain property of Fourier transform, **03**

(b) An LTI system has impulse response given by h(n)={1,2,3,4} . Find its response to input x(n)= {1,1,1}. **04**

(c) Compute the Fourier transform for the signal x(t) in following figure:02. Draw its magnitude spectrum. **07**

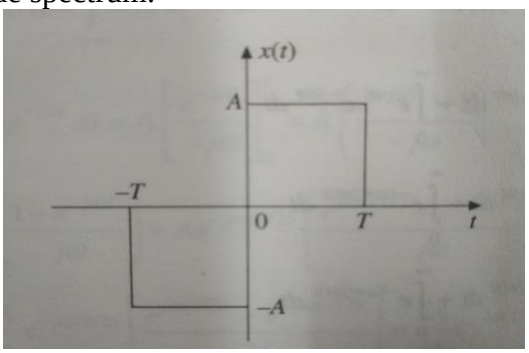

Figure :02

Q.4 **(a)** Prove that for causal sequences, the ROC of Z transform is exterior of a circle. **03**

(b) Find the Fourier transform of sine wave signal $\sin w_0 t$. Draw its magnitude spectrum. **04**

(c) State and prove (a) time reversal and (b) time scaling properties of LTI systems using Fourier transform. **07**

OR

Q.4 **(a)** Explain with suitable mathematical equations, relation between Laplace Transform and Fourier Transform, **03**

(b) Using properties of Z transform, compute Z transform for following signals. **04**

(i) x(n)= u(-n)

(ii) x(n)= u(-n+2)

(c) Find fourier transforms of rectangular pulse (gate pulse) defined as $rect(\frac{t}{\tau})$. **07**

Draw its magnitude spectrum.

Q.5 **(a)** Find inverse Z transform of **03**

$$X(z) = \frac{z^{-1}}{3 - 4z^{-1} + z^{-2}}; RoC|z| > 1$$

(b) Enlist and prove necessary and sufficient condition for stability of LTI system. **04**

(c) Determine steady state (forced) response for the system with the step input and characterized by difference equation **07**

$y(n) - 0.75y(n-1) + 0.125y(n-2) = x(n) + x(n-1)$

With initial conditions y(-1)=0 and y(-2)=-1

OR

Q.5 **(a)** Find inverse Z transform of **03**

$X(z) = 2z^3 + 3z^2 - z + 3 + 2z^{-1} + 3z^{-2} - 2z^{-3}$

(b) Enlist useful properties of ROC of X(z). **04**

(c) An LTI system is described by the difference equation **07**

$y(n) = x(n) + 0.81x(n-1) - 0.81x(n-2) - 0.45y(n-2)$

Determine transfer function of the system. Draw pole zero plot and assess stability.