Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–IV (NEW) EXAMINATION – WINTER 2023

Subject Code:3141005   **Date:17-01-2024**
Subject Name:Signal & 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.

			Marks
Q.1	**(a)**	Find discrete Convolution of following pairs of signals. and $x(n) = \{1,3,5,7\}$ and $h(n) = \{2,4,6,8\}$	03
	(b)	Prove Commutative property of Convolution.	04
	(c)	What is ROC with respect to z- transform? What are its properties?	07
Q.2	**(a)**	Find the DFT of the sequence $x(n) = \{1, 1, -2, -2\}$	03
	(b)	Enlist frequency shifting and time differentiation properties of Fourier transform. Prove any one of them.	04
	(c)	State the sampling theorem. Also explain the reconstruction of a signal from its samples using interpolation.	07

OR

	(c)	Determine the Z – Transform & ROC of the following sequence $x(n) = (3)^n u(n) - (2)^n u(-n-1)$	07
Q.3	**(a)**	Explain Scaling property in the z -Domain.	03
	(b)	State Dirichlet condition for Fourier Series Representation	04
	(c)	Determine the convolution sum of two sequences using graphical method $x(n) = \{1, 4, 3, 2\}; h(n) = \{1, 3, 2, 1\}$ ↑ ↑	07

OR

Q.3	**(a)**	Find even and odd parts of $x(t)=u(t)$.	03
	(b)	Bring out difference between DFT and Fourier Transform (FT).	04
	(c)	Explain following property for the system $y(t) = 10\,x(t) + 5$. (i) Linearity (ii) Time-invariance (iii) Causality (iv) Dynamicity	07
Q.4	**(a)**	Explain the trigonometric Fourier series.	03
	(b)	Define energy and power. Hence, define energy signal and power signal.	04
	(c)	Calculate the DFT of a sequence $x[n]=\{1,1,0,0\}$ and check the validity of DFT by calculating its IDFT.	07

OR

Q.4	**(a)**	Explain the Differentiation property of Z-Transform.	03
	(b)	Determine whether the following system with impulse response $h(t) = e^{-3t} u(t)$ is stable or not.	04
	(c)	Find the Fourier series coefficients for the continuous time periodic signal $x(t) = 1.5$ for $0 \leq t < 1$ $= -1.5$ for $1 \leq t < 2$ with fundamental frequency $W_0 = \pi$.	07

Q.5 **(a)** State and prove a condition for a discrete time LTI system to be stable. **03**

(b) Find the natural response of the system described by difference equation **04**
$y(n) - 1.5\, y(n - 1) + 0.5\, y(n - 2) = x(n)$; $y(-1) = 1$; $y(-2) = 0$.

(c) Obtain the Fourier Transform of following signals: **07**
1. $x(t) = \cos\omega_0 t$
2. $x(t) = \sin\omega_c t\; u(t)$

<div align="center">OR</div>

Q.5 **(a)** Explain relation between Fourier transform and z transform using necessary **03**
equations.

(b) Prove that DT LTI system is causal if and only if $h(n) = 0$ for $n < 0$. **04**

(c) Find whether the given signals are periodic or not? If yes, give its fundamental **07**
period.
(i) $x(t) = 3 \sin 200\pi t + 4 \cos 100t$
(ii) $x(n) = e^{j(\pi/2)n}$

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