

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER- IV(NEW) EXAMINATION – SUMMER 2023****Subject Code:2141005****Date:25-07-2023****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.

	Marks
Q.1 (a) Define a signal and a system stating examples of each.	03
(b) Find the following sequences are periodic or not. If periodic, find the fundamental period.	04
i) $x(t) = \sin 15\pi t + \sin 20\pi t$	
ii) $x(n) = e^{j(\pi/4)n}$	
(c) Explain the Classification of Systems.	07
Q.2 (a) State Sampling Theorem. Determine the sampling rate of a television signal having a bandwidth of 4.5 MHz.	03
(b) Compare Energy and Power Signals with example of each.	04
(c) For a given systems, determine and justify whether each of them is: i) Memoryless ii) Stable iii) Causal iv) Linear and v) TIV	07
i) $y(n) = e^{x(n)}$ ii) $y(t) = x(t^2)$	
OR	
(c) For $x(n) = \{3, 2, 1, 0, 1, 2, 3\}$ and $y(n) = \{-1, -1, -1, -1, 0, 1, 1, 1, 1\}$	07
Compute: i) $x(n-2) + y(n+2)$ ii) $x(n+2)y(6-n)$ iii) $x(3-n)y(n)$	
Q.3 (a) Define Laplace Transform and determine the Laplace Transform of $x(t) = t^2 e^{-3t} u(t)$	03
(b) State and prove time scaling property of Laplace Transform.	04
(c) Compute Linear Convolution using graphical method for $x(n) = h(n) = \{1, 2, -1, 3\}$	07
OR	
Q.3 (a) Define Fourier Transform and give its relation with Laplace Transform.	03
(b) State and prove differentiation property of Fourier Transform.	04
(c) For an LTI system with the unit impulse response $h(t) = e^{-2t} u(t)$, determine the output to the input $x(t) = e^{-t} u(t)$	07
Q.4 (a) Define DTFT and give its relation with DFT.	03
(b) State and prove the time and frequency shifting properties of Fourier Transform.	04

- (c) Compute Circular Convolution of the sequence $x(n) = h(n) = \{1, 2, -1, 3\}$ and compare its result with linear convolution. **07**

OR

- Q.4** (a) Find the Fourier Transform of $x(t) = t^2 e^{-3t} u(t)$ **03**
 (b) Compute the DFT of $x(n) = \{-2, -1, 0, 1\}$ **04**
 (c) List the properties of ROC of Z transform and find the inverse Z-Transform of $X(Z) = \log(1 + aZ^{-1})$ **07**

- Q.5** (a) Define Z Transform and its ROC. **03**
 (b) State and prove differentiation property of Z Transform and find the Z transform of $x(n) = n u(n)$ **04**
 (c) Find the inverse Z-Transform of **07**

$$X(Z) = \frac{\frac{1}{4} z^{-1}}{\left(1 - \frac{1}{2} z^{-1}\right)\left(1 - \frac{1}{4} z^{-1}\right)} \quad \text{ROC} : |Z| > \frac{1}{2}$$

OR

- Q.5** (a) Derive the relationship between Z transform and Fourier transform. **03**
 (b) State and prove time reversal property of Z transform and determine the Z transform of $x(n) = a^n u(-n - 1)$ **04**
 (c) Find the inverse Z- Transform of **07**

$$X(z) = \frac{1}{(1 + z^{-1})(1 - z^{-1})^2}, \text{ROC} : |z| > 1$$
