

Enrollment No./Seat No.:

## GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - III EXAMINATION - WINTER 2025

Subject Code: BE03000171

Date: 17-12-2025

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
<b>Q.1 (a)</b> For the signal $x(t)$ , plot	03
$x\left(1 - \frac{t}{2}\right)$	
<b>(b)</b> Define periodic and aperiodic signal. Determine whether the following signals are periodic or not? If periodic determine the fundamental period.	04
1. $x(t) = \cos(4\pi t)$	
2. $x(n) = \cos\left(\frac{n}{6}\right) \cdot \cos\left(\frac{n\pi}{6}\right)$	
<b>(c)</b> Derive Fourier co-efficients of the Trigonometric Fourier series of an even symmetry periodic signal.	07
<b>Q.2 (a)</b> Define following systems.	03
1. Invertible system 2. FIR system 3. IIR system	
<b>(b)</b> Determine whether the following system is linear, stable, causal and time-invariant using appropriate test.	04
$y(t) = x(t^2)$	
<b>(c)</b> State and prove sampling theorem.	07

OR

<b>(c)</b> Explain reconstruction of a signal from its samples using interpolation process.	07
<b>Q.3 (a)</b> Define autocorrelation function of a signal. List its properties.	03
<b>(b)</b> State and prove a condition for a discrete time LTI system to be stable.	04

(c) The impulse response of the circuit is given as  $h(t) = e^{-2t}u(t)$ . This circuit is excited by an input of  $x(t) = e^{-4t}[u((t) - u((t - 2))]$ . Determine the output of the circuit. 07

**OR**

(a) For,  $x(n) = \delta(n) + 2\delta(n - 1) - \delta(n - 3)$  and 03  
 $h(n) = 2\delta(n + 1) - 2\delta(n - 1)$ .  
Compute  $y(n) = x(n) * h(n)$

(b) Determine whether the following system is linear, stable, causal and time-invariant using appropriate test. 04  
 $y(n) = x(n) - x(n - 1)$

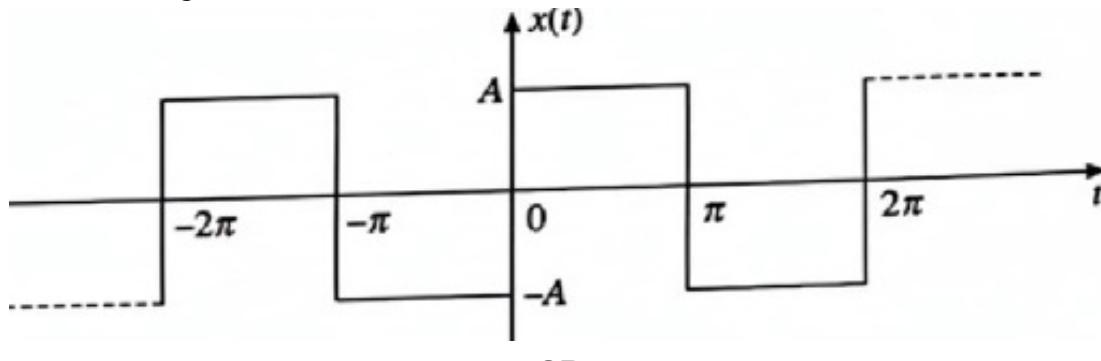
(c) Define convolution integral for a continuous time and a discrete time signals. List properties of convolution. 07

**Q.4** (a) State and prove time shifting property of Fourier transform. 03

(b) Find the Fourier transform of the following signal. 04

$$x(t) = \begin{cases} 2 & -4 \leq t \leq -2 \\ 2 & 2 \leq t \leq 4 \\ 0 & \text{otherwise} \end{cases}$$

(c) Obtain the trigonometric Fourier series for the waveform shown below. 07



**OR**

(a) State and prove differentiation in time domain properties of Fourier transform. 03

(b) Using properties of Fourier transform, find the Fourier transform of  $x(t) = e^{-3t}u(t - 2)$ . 04

(c) Using Fourier transform, find the convolution of the signals  $x_1(t) = e^{-2t}u(t)$  and 07  
 $x_2(t) = e^{-3t}u(t)$ .

**Q.5** (a) State and prove multiplication by exponential sequence property of z-transform. 03

(b) Using long division, determine the inverse z-transform of 04

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

(c) Determine the impulse response  $h(n)$  of the causal system described by the difference equation 07

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + \frac{1}{3}x(n-1).$$

**OR**

(a) Explain differentiation property in the z- domain. 03

(b) Using appropriate properties, find z-transform of 04

$$x(n) = n \left(\frac{1}{3}\right)^n u(n-2)$$

(c) Find the inverse z-transform of 07

$$X(z) = \frac{2z - 7}{z^2 - 5z + 6}; ROC; |z| < 2$$

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