

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

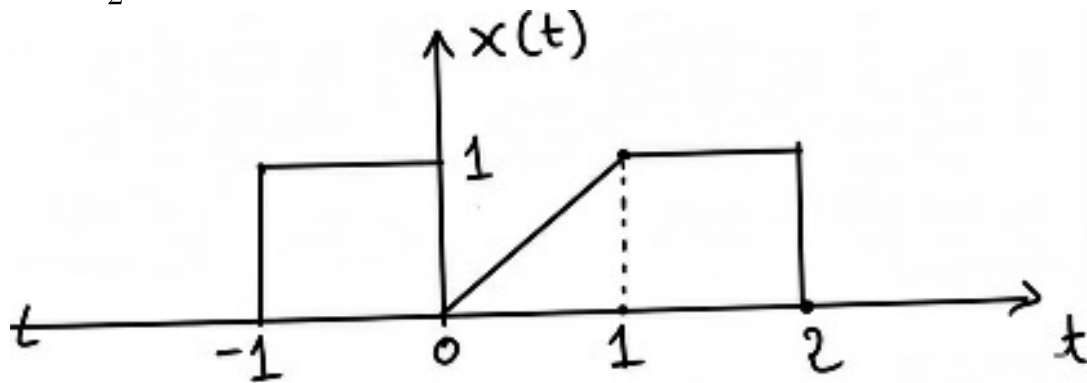
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

Marks

Q.1 (a) For the signal $x(t)$, plot

03

$$x\left(1 - \frac{t}{2}\right)$$



(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. $x(n) = \cos\left(\frac{n}{6}\right) \cdot \cos\left(\frac{n\pi}{6}\right)$

(c) Derive Fourier co-efficients of the Trigonometric Fourier series of a even symmetry periodic signal.

07

Q.2 (a) Define following systems.

03

1. Invertible system 2. FIR system 3. IIR system

(b) Determine whether the following system is linear, stable, causal and time-invariant using appropriate test.

04

$$y(t) = x(t^2)$$

(c) State and prove sampling theorem.

07

OR

(c) Explain reconstruction of a signal from its samples using interpolation process.

07

Q.3 (a) Define autocorrelation function of a signal. List its properties.

03

(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

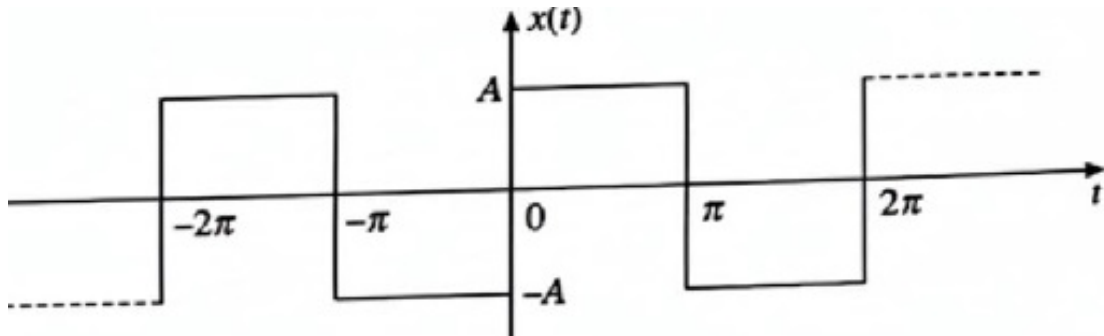
- (a) For, $x(n) = \delta(n) + 2\delta(n-1) - \delta(n-3)$ and $h(n) = 2\delta(n+1) - 2\delta(n-1)$. Compute $y(n) = x(n) * h(n)$ 03
- (b) Determine whether the following system is linear, stable, causal and time-invariant using appropriate test. 04
 $y(n) = x(n) - x(n-1)$
- (c) Define convolution integral 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 $x_2(t) = e^{-3t}u(t)$. 07

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

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

- (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

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