

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER-V EXAMINATION – WINTER 2025****Subject Code:3150912****Date:21-11-2025****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) Explain the test signals. **03**
 (b) Sketch signal $x(t) = u(t+2) - u(t-2) + u(t+1) - u(t-1)$. **04**
 (c) Explain Even and Odd signals with examples. **07**
- Q.2** (a) Explain methods of representation of signals. **03**
 (b) If signal $\cos 10t + \sin 20t$ is periodic or not?
 If it is periodic then find its fundamental period. **04**
 (c) Classified different types of system with examples. **07**
- OR**
- (c) Determine whether the system is (i) Linear (ii) causal, (iii) time-invariant (iv) static. $y(n) = a^n u(n)$ **07**
- Q.3** (a) State and prove the Sampling Theorem. **03**
 (b) Explain the initial value and final value theorem. **04**
 (c) Find the convolution of the following sequences:
 $X(n) = 3\delta(n+1) - 2\delta(n) + \delta(n-1) + 4\delta(n-2)$
 $h(n) = 2\delta(n-1) + 5\delta(n-2) + 3\delta(n-3)$ **07**
- OR**
- Q.3** (a) Explain Aliasing and its effects and how to remove it **03**
 (b) Determine the Nyquist sampling rate and Nyquist sampling interval for $x(t) = 2\text{sinc}(100\pi t)$. **04**
 (c) Define convolution. Write properties of Convolution. **07**
- Q.4** (a) State and prove Time shifting and Linearity properties of continuous time Fourier transform. **03**
 (b) Write modulation property of Fourier Transform. Use frequency differentiation property to find the Fourier Transform of $X(t) = t e^{-at} u(t)$. **04**
 (c) Explain Time variant and Time invariant System with examples. **07**
- OR**
- Q.4** (a) Explain with linearity and time-shifting properties of the Fourier series. **03**
 (b) Write a short note on Arduino and Interfacing of the sensors **04**
 (c) Find Fourier Series representation of half wave rectified sine wave. **07**
- Q.5** (a) Find the Z-Transform of unit Step Signal. **03**
 (b) List the properties of the region of convergence (ROC) for the z-transform. **04**
 (c) Write a short note on the Internet of Things **07**
- OR**
- Q.5** (a) Write Differentiation in Z-domain property of z-transform. **03**
 (b) Determine the inverse Z-transform of the following $X(z)$ **04**
- $$X(z) = \frac{z}{2z^2 - 3z + 1}, |z| < \frac{1}{2}$$
- (c) Explain Types of sensors. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER-V (NEW) EXAMINATION – WINTER 2024****Subject Code:3150912****Date:02-12-2024****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.
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Marks

- Q.1** (a) Check linearity of a system described by $y[n] = x[n] + \frac{1}{2x[n-2]}$ **03**
- (b) Prove commutative, distributive and associative properties of convolution integral **04**
- (c) Convolve $x[n] = \{-1, 4, 3, 2, -2\}$ and $h[n] = \{1, 2, -1, 1\}$ **07**



- Q.2** (a) Define (i) Periodicity of a signal (ii) Non-causal signals (iii) Even signal and give example of each **03**
- (b) Check stability of a system described by $y[n] = x[n] + \frac{1}{2}x[n-1] + \frac{1}{4}x[n-2]$ **04**
- (c) Given impulse response of the system $h(t) = e^{-2t}u(t)$. Obtain the output of the system for $x(t) = e^{-4t}[u(t) - u(t-2)]$ **07**

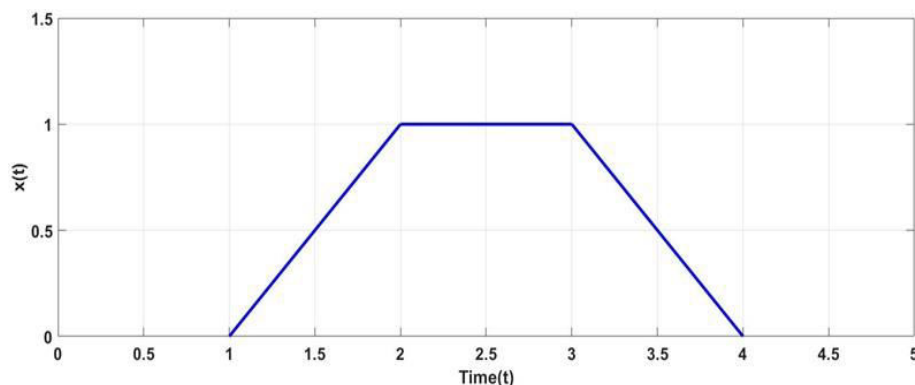
OR

- (c) Given impulse response of the system $h(t) = u(t-3)$. Obtain the output of the system for $x(t) = u(t+2)$ **07**

- Q.3** (a) Check causality of a system described by $y(t) = \int_{-\infty}^{3t} x(\tau) d\tau$ **03**
- (b) State and prove linearity and convolution property of z- transform **04**
- (c) Find Fourier transform of $x[n] = 2^n \sin[(\pi/4)n]u[-n]$ **07**

OR

- Q.3** (a) State Dirichlet conditions for existence of Fourier transform **03**
- (b) Obtain the energy of the signal $x(t)$ shown below **04**



- (c) Obtain Fourier transform of (a) $x(t) = e^{-2(t-1)}u(t-1)$ (b) $x(t) = \delta(t+2) + \delta(t-2)$ **07**
- Q.4** (a) Prove the nonexistence of Fourier series co-efficients a_0 and a_n for a periodic waveform with odd symmetry **03**
- (b) Obtain Laplace transform of $x(t) = e^{-at}u(t)$ by direct integration. **04**
- (c) Explain zero order hold with its mathematical representation. Write at least three advantages and disadvantages of zero order hold **07**
- OR**
- Q.4** (a) Compare Fourier series and Fourier transform **03**
- (b) Obtain Laplace transform of $x(t) = (e^{2t} - 2e^{-t})u(t)$ **04**
- (c) Explain aliasing by taking a suitable example **07**
- Q.5** (a) Explain signal reconstruction from its sampled form **03**
- (b) State and prove the final value theorem **04**
- (c) List at least four types of actuators used with Arduino with their application **07**
- OR**
- Q.5** (a) State and explain sampling theorem **03**
- (b) State the properties of ROC of z-transform **04**
- (c) List at least seven types of sensors used with Arduino with their application in brief **07**

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1. Attempt all questions.
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MARKS

- Q.1**
- | | | |
|-----|---|-----------|
| (a) | Define a periodic continuous time and discrete time signal. | 03 |
| (b) | Give examples of continuous time and discrete time causal systems. | 04 |
| (c) | (i) State whether the following system is linear and time-invariant?
$y(n)=u[n]^2$
(ii) State whether the following system is causal, stable and memoryless ?
$y[n]=nu[n]$ | 07 |
- Q.2**
- | | | |
|-----|---|-----------|
| (a) | Define energy signal and power signal. Give an example of each type. | 03 |
| (b) | Write the equations for coefficients C_n and C_{-n} of complex exponential Fourier series. | 04 |
| (c) | Obtain the complex exponential Fourier series expansion of the signal
$x(t)=2+3\cos 2\pi t +4 \sin 3\pi t$. | 07 |
- OR**
- | | | |
|-----|---|-----------|
| (c) | Find the Fourier transform of the signum function $\text{sgn}(t)$. | 07 |
|-----|---|-----------|
- Q.3**
- | | | |
|-----|---|-----------|
| (a) | State and prove time shifting property of Fourier transform. | 03 |
| (b) | Find the Laplace transform of $x(t)= tu(t)$. | 04 |
| (c) | Find the inverse Laplace transform of
$F(s)=(2s-1)/(s^2+2s+1)$ | 07 |
- OR**
- Q.3**
- | | | |
|-----|---|-----------|
| (a) | State and prove time scaling property of Fourier transform. | 03 |
| (b) | Find Fourier transform of $x(t)= 10 \sin \omega_0 t$. | 04 |
| (c) | Find the Fourier transform of a rectangular pulse with amplitude A and width T. | 07 |
- Q.4**
- | | | |
|-----|--|-----------|
| (a) | Define Z-transform and its ROC. | 03 |
| (b) | State the properties of ROC of Z-transform. | 04 |
| (c) | Find the Z-transform of $\sin \omega n u(n)$. | 07 |
- OR**
- Q.4**
- | | | |
|-----|---|-----------|
| (a) | State any three properties of Z-transform. | 03 |
| (b) | Find the Z-transform of $0.5^n u(n) + 0.33^n u(n)$ | 04 |
| (c) | Find the inverse Z-transform of $X(z)= z/(3z^2-4z+1)$ for ROC $ z >1$. | 07 |
- Q.5**
- | | | |
|-----|---|-----------|
| (a) | List the types of sensors. | 03 |
| (b) | State and prove the sampling theorem. | 04 |
| (c) | Give an example of Arduino based minor project. | 07 |
- OR**
- Q.5**
- | | | |
|-----|--|-----------|
| (a) | List the types of actuators. | 03 |
| (b) | Draw the spectra of sampled signal. Explain aliasing. | 04 |
| (c) | Explain interfacing of sensors and actuators with Arduino. | 07 |

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V (NEW) EXAMINATION – WINTER 2022****Subject Code:3150912****Date:09-01-2023****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.
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MARKS

- Q.1**
- (a) Find whether the given signals are periodic or not? If yes, give its fundamental period. **03**
 (i) $x(t) = 3 \sin 200\pi t + 4 \cos 100t$
 (ii) $x(n) = e^{j(\pi/2)n}$
- (b) Check whether the signal $x(t) = 2\cos(100\pi t) + 5\sin(50t)$ is periodic or not. **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**
 $\uparrow \qquad \qquad \qquad \uparrow$
- Q.2**
- (a) Determine the energy and power of a signal $x(t) = u(t)$. **03**
- (b) List and prove any two properties of convolution sum. **04**
- (c) Sketch signal $x(t) = u(t+2) - u(t-2) + u(t+1) - u(t-1)$. **07**
 Also sketch (i) $x(2t)$ (ii) $x(1-t)$ (iii) $x(t) \cdot u(t)$.

OR

- (c) Check whether the system described by the equation $y(t) = 10x(t) + 5$ is linear, static, time invariant, causal and stable. **07**
- Q.3**
- (a) State the linearity and time shifting property of Fourier transform. **03**
- (b) Prove convolution property of Fourier transform. **04**
- (c) Find inverse Fourier transform of **07**

$$X(\omega) = \frac{2j\omega}{(2+j\omega)^2}$$

OR

- Q.3**
- (a) Find the Fourier transform of the signal $x(t) = e^{-at} u(t)$. **03**
- (b) Explain the Differentiation property of Z-Transform. **04**
- (c) Explain working of any system based on Arduino. **07**
- Q.4**
- (a) Give the convolution sum and integral formulas. **03**
- (b) State and prove the time shifting property of the Z-transform. **04**
- (c) Define ROC and explain the property of ROC. **07**

OR

- Q.4**
- (a) Find DTFT of the sequence $x(n) = \{1, 0, 4, 2\}$. **03**
- (b) Determine the Z – Transform & ROC of the following sequence $X(n) = (3)^n u(n) - (2)^n u(-n-1)$. **04**
- (c) Solve the difference equation $y(n) - 0.5y(n-1) = \delta(n)$ using Z-transform. **07**

- Q.5** (a) Explain the reconstruction of a signal from its samples. **03**
(b) Find the DFT of the sequence $x(n) = \{1, 1, -2, -2\}$. **04**
(c) State & Prove Sampling Theorem. **07**

OR

- Q.5** (a) What is zero-order hold in sampling? **03**
(b) What are the effects of under sampling of a signal? **04**
(c) Describe various types of sensors used for IoT applications. **07**
