Enrolment No./Seat No_____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE- SEMESTER–IV EXAMINATION – WINTER 2025**

**Subject Code:3141005 Date:15-11-2025**

**Subject Name:Signal & Systems**

**Time:02:30 PM TO 05:00 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.**

| | | | |
|---|---|---|---|
| **Q.1** | **(a)** | Define periodic & nonperiodic signal. Determine which of the following signals are periodic. (a) $x_1(t) = sin15\pi t$ (b) $x_2(t) = sin20\pi t$ | **03** |
| | **(b)** | Explain energy signal and power signal. Obtain energy of $x(n) = a^n u(n)$ where $\|a\| \leq 1$. | **04** |
| | **(c)** | Determine whether the system given as $y(t) = 5x(t) + 2$ is Static, Causal, Linear, or Time invariant? | **07** |
| **Q.2** | **(a)** | State and explain associative property of convolution sum. | **03** |
| | **(b)** | Find the natural response of the system described by difference equation $y(n) - 1.5y(n-1) + 0.5y(n-2) = x(n)$ $y(-1) = 1 \quad and y(-2) = 0$ | **04** |
| | **(c)** | Determine the convolution sum of two sequences using graphical method $x(n) = \{1, 4, 3, 2\}; \quad h(n) = \{1, 3, 2, 1\}$ $\uparrow \qquad\qquad \uparrow$ | **07** |
| | | **OR** | |
| | **(c)** | Compute the convolution sum $y(n) = x(n) * h(n)$ 1. $x(n) = \delta(n) - \delta(n-2) \ \ and \ \ h(n) = u(n)$ 2. $x(n) = u(n) \ \ and \ \ h(n) = u(n)$ | **07** |
| **Q.3** | **(a)** | State and prove time shifting property of Fourier transform. | **03** |
| | **(b)** | Determine whether the following system with impulse response $h(n) = 2^n u(-n)$ is stable or not. | **04** |
| | **(c)** | Compute the Fourier transform of $x(n) = (1)^n u(n)$. Also give applications of Fourier transform. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | State and prove time scaling property of Fourier transform. | **03** |
| | **(b)** | State and prove a condition for a discrete time LTI system to be stable. | **04** |
| | **(c)** | Enlist and explain properties of Fourier transform. | **07** |
| **Q.4** | **(a)** | Determine the Z – Transform & ROC of the following sequence $x(n) = 3^n u(n) - 4^n u(-n-1)$. | **03** |
| | **(b)** | Determine 2-point DFT of a sequence, $x(t) = u(n) - u(n-2)$. | **04** |
| | **(c)** | Find the inverse Z-transform of $X(z) = 1/(1 - 1.5z^{-1} + 0.5z^{-2})$ for (a) ROC: $\|z\| \geq 1$ and (b) ROC: $\|z\| < 0.5$ | **07** |

**OR**

**Q.4** **(a)** Find the z-transform of the signal $x(n) = \left(-\frac{1}{5}\right)^n u(n) + 5\left(\frac{1}{2}\right)^n u(-n-1)$. **03**

**(b)** Explain the time shifting property of Fourier Transform. **04**

**(c)** Using partial fraction expansion find the inverse z-transform of **07**

$$X(z) = 1 - \frac{1}{3}z^{-1}/(1 - z^{-1})(1 + 2z^{-1}) \ , \quad |z| > 2$$

**Q.5** **(a)** Find 4-point DFT of the sequence $x(n) = \{1, 3, 4, -2\}$. **03**

**(b)** List out the difficulties faced during signal reconstruction. **04**

**(c)** State and prove differentiation property of z-transform. **07**

**OR**

**Q.5** **(a)** Explain aliasing effect. **03**

**(b)** Explain signal reconstruction using interpolation technique. **04**

**(c)** State and prove Sampling theorem. **07**

**********

Enrolment No./Seat No_____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE- SEMESTER–IV (NEW) EXAMINATION – WINTER 2024**

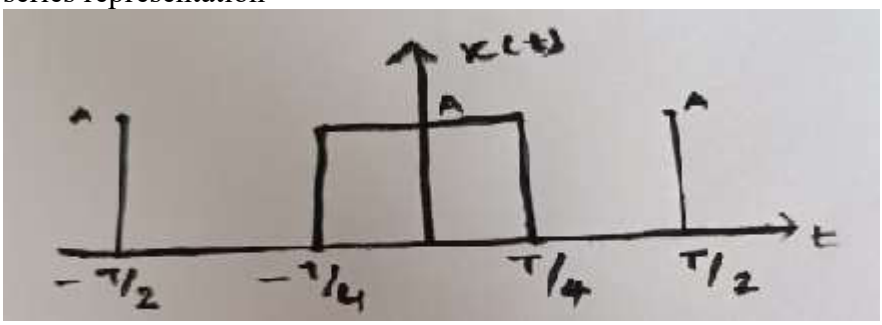
**Subject Code:3141005** **Date:21-11-2024**

**Subject Name:Signal & Systems**

**Time:02:30 PM TO 05:00 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)** | Compare Energy and power signals with example. | **03** |
| | **(b)** | Determine whether the following systems are linear or not<br>1) $\frac{dy(t)}{dt} + 5\,y(t) + 2 = x(t)$<br>2) $5.\frac{dy(t)}{dt} + \ y(t) = 5.x(t)$ | **04** |
| | **(c)** | What ROC in z-transform, how ROC change with causality and stability of the system? Mention any four properties of the z-transform. | **07** |
| **Q.2** | **(a)** | Define DFT and IDFT. | **03** |
| | **(b)** | Prove the following:<br>1) $\delta(n) = u(n) - u(n-1)$<br>2) $u(n) = \sum_{k=-\infty}^{\infty} \delta(k)$ | **04** |
| | **(c)** | Determine the following system described by y(t)= sin[x(t+2)] is memory less, causal, linear, time-invariance or stable? | **07** |
| | | **OR** | |
| | **(c)** | Find weather the following sequences are periodic?, if yes then find out its fundamental period.<br>1) $X1(n) = \sin\left(\frac{6\pi n}{7}\right)$<br>2) $X2(n) = \sin\left(\frac{n}{8}\right)$ | **07** |
| **Q.3** | **(a)** | List out properties of convolution. | **03** |
| | **(b)** | State and prove time scaling and time shifting property of Fourier transform | **04** |
| | **(c)** | Figure shows the periodic rectangular waveform, obtain the Fourier series representation<br> | **07** |

**OR**

| | | | |
|---|---|---|---|
| **Q.3** | **(a)** | Check the BIBO stability for the impulse response of a discrete time system given by h (n) = $\alpha^n u(n)$ | **03** |
| | **(b)** | Find the even and odd part of the signal: x(n) = $\alpha^n u(n)$ | **04** |
| | **(c)** | Obtain the Fourier transform of the rectangular pulse of the duration 2 seconds and having amplitude of 10 volts. | **07** |
| **Q.4** | **(a)** | Explain trigonometric Fourier series. | **03** |
| | **(b)** | Obtain the linear convolution of two sequences: x(n) = {1,2,1,2} and h(n) ={1,1,1} | **04** |
| | **(c)** | Find the Z -transform and sketch the ROC of: X(n) = $(-1)^n\ 2^{-n}\ u(n)$ | **07** |

**OR**

| | | | |
|---|---|---|---|
| **Q.4** | **(a)** | Define : Initial value theorem and final value theorem | **03** |
| | **(b)** | The impulse response of LTI system h(n)={1,2,1,-1}, determine the response of system to the input x(n) = {1,2,3,1} | **04** |
| | **(c)** | Determine Z- transform including ROC of the following: X(n)= $(\frac{1}{2})^n\ \{u(n) - u(n-10)\}$ | **07** |
| **Q.5** | **(a)** | What is aliasing? How can we eliminate Aliasing? | **03** |
| | **(b)** | An analog signal is expressed by the equation x(t) = 3 cos50πt + 10 sin300 πt – cos100 πt. Calculate the Nyquist rate for the signal. | **04** |
| | **(c)** | Use partial fraction expansion method to find the inverse z - transform of the following transfer function $H(z) = \frac{-4+8z^{-1}}{1+6z^{-1}+8z^{-2}}$ | **07** |

**OR**

| | | | |
|---|---|---|---|
| **Q.5** | **(a)** | Define Nyquist sampling theorem. | **03** |
| | **(b)** | Obtain relationship between Laplace and Fourier Transform. | **04** |
| | **(c)** | Find the Discrete Fourier transform of the sequence x(n)= {1,1,0,0} and find IDFT of Y(k) = {1,0,1,0} | **07** |

**********

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 $0 \le t < 1$ = -1.5 for $1 \le t < 2$ 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<br>$y(n) - 1.5\, y(n-1) + 0.5\, y(n-2) = x(n)$ ; $y(-1) = 1$; $y(-2) = 0$. | **04** |
| | **(c)** | Obtain the Fourier Transform of following signals:<br>1. $x(t) = \cos\omega_0 t$<br>2. $x(t) = \sin\omega_c t\ u(t)$ | **07** |

**OR**

| | | | |
|---|---|---|---|
| **Q.5** | **(a)** | Explain relation between Fourier transform and z transform using necessary equations. | **03** |
| | **(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 period.<br>(i) $x(t) = 3 \sin 200\pi t + 4 \cos 100t$<br>(ii) $x(n) = e^{j(\pi/2)n}$ | **07** |

*********

Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–IV(NEW) EXAMINATION – WINTER 2022**

**Subject Code:3141005 Date:14-12-2022**

**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)** | Compare Energy and Power Signals. | **03** |
| | **(b)** | If the given signal $x(t) = e^{-at}u(t)$. Draw the signals: $x(-t+2)$ and $x(-t-3)$. | **04** |
| | **(c)** | Determine whether the following systems are : (1) Memoryless (2) Causal (3) Stable (4)Time Invariant (5) Linear. (I) $y(t) = x(0.5t)$ (II) $y[n] = x[n-1] + x[n]$. | **07** |
| **Q.2** | **(a)** | State and prove a condition for a discrete time LTI system to be stable. | **03** |
| | **(b)** | Find the step response of the system whose impulse response is : (1) $\delta[n+2] + \delta[n-3]$ (2) $u[n]$ | **04** |
| | **(c)** | Obtain convolution integral of : $x(t) = 1 \ for \ -1 \leq t \leq 1$ and $h(t) = 1 \ for \ 0 \leq t \leq 2$ | **07** |
| | | **OR** | |
| | **(c)** | Obtain linear convolution of two discrete time signals given as : $x[n] = u[n]$ and $h[n] = a^n u[n], a < 1$. | **07** |
| **Q.3** | **(a)** | Give the difference between DFT and DTFT. | **03** |
| | **(b)** | Obtain Fourier Transform of a Unit Step Function. | **04** |
| | **(c)** | State convolution property of Fourier Transform and find Fourier Transform of the following signal : $y(t) = e^{-at}u(t) * u(t)$. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Define DFT and IDFT. | **03** |
| | **(b)** | Determine complex exponential Fourier series of $\cos(\omega_0 t)$ | **04** |
| | **(c)** | Determine the trigonometric Fourier Series of : $\delta_{T_0}(t) = \sum_{k=-\infty}^{\infty} \delta(t - kT_0)$ | **07** |
| **Q.4** | **(a)** | Define Sampling Theorem. | **03** |
| | **(b)** | Find the Nyquist rate and interval of $x(t) = 5\cos 1000\pi t \cos 4000\pi t$. | **04** |
| | **(c)** | State and Prove Time Shifting Property of Fourier transform. | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | What is aliasing? How can we eliminate Aliasing? | **03** |
| | **(b)** | A bandpass signal has a spectral range that extends from 20 kHz to 82 kHz. Find the sampling frequency. | **04** |
| | **(c)** | Define the continuous time Fourier Transform. State and prove Duality property of Fourier Transform. | **07** |
| **Q.5** | **(a)** | State and prove Time Shifting Property of z Transform. | **03** |
| | **(b)** | Determine z Transform of following sequences : (1) $x[n] = \alpha^{-\lvert n \rvert}, 0 < \alpha < 1$ (2) $x[n] = 2^n u[n] + 3^n u[-n-1]$ | **04** |

**(c)** Find the convolution of the signal using z Transform. **07**
$x_1[n] = a^n u[n]\ ,\ a < 1$ and $x_2[n] = u[n]$

**OR**

**Q.5** **(a)** State and prove Time Reversal Property of z Transform. **03**

**(b)** Find z Transform of $x[n] = na^n u[n]$. **04**

**(c)** Determine inverse z Transform of $X(z) = \frac{1}{1-1.5z^{-1}+0.5z^{-2}}$ **07**
If (1) ROC : $|z| > 1$ (2) ROC : $|z| < 0.5$ (3) ROC: $0.5 < |z| < 1$

**********