Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2022

Subject Code:2141005 Date:08-07-2022

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.**

Q-1 **(a)** Write the properties of the Dirac delta function. **03**

(b) Determine the Nyquist rate and Nyquist interval corresponding to each of the following signals **04**

(i) $x(t) = 1 + cos2000\pi t + sin4000\pi t$

(ii) $x(t) = \frac{\sin(4000\pi t)}{\pi t}$

(c) Check whether the following system is (i)Static or dynamic (ii)Linear or non-linear (iii) Causal or non-causal (iv) Time-invariant or time-variant **07**

$$\frac{d^3y(t)}{dt^3} + 2\frac{d^2y(t)}{dt^2} + 4\frac{dy(t)}{dt} + 3y^2(t) = x(t+1)$$

Q-2 **(a)** Prove that the power of the energy signal is zero over infinite time. **03**

(b) Find whether the following signals are even or odd. **04**

(i) $x(t) = e^{-3t}$ (ii) $x(t) = 3e^{j4\pi t}$

(c) Determine whether the following discrete-time signals are periodic or not? If periodic, determine the fundamental period. **07**

(i) $sin\frac{2\pi n}{3} + cos\frac{2\pi n}{5}$ (ii) $\cos(\frac{\pi}{2} + 0.3n)$

OR

(c) Write different properties of CT-LTI systems. **07**

Q-3 **(a)** Define exponential Fourier series for a periodic signal. **03**

(b) Check the stability of the system defined by **04**

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

(c) Find the complex exponential Fourier series representation of the Following signals: **07**

(i) $x(t) = 3sin4\omega_0 t$ (ii) $x(t) = cos^2$t

OR

Q-3 **(a)** State the conditions for the existence of Fourier transform. **03**

(b) Find the convolution of the signals $x_1(t) = e^{-at}u(t)$; $x_2(t) = e^{-bt}u(t)$ using Fourier transform. **04**

(c) Find the impulse and step response of the following system. **07**

$$H(s) = \frac{5}{s^2 + 4s + 5}$$

Q-4 **(a)** Find the inverse Laplace transform of the following. **03**

$$\frac{s}{(s+2)^2 + 1}$$

(b) Obtain the relation between Laplace transform and Fourier transform. **04**

(c) Find the Laplace transform of the signal $x(t) = e^{-a|t|}$ and find ROC. **07**

OR

Q-4 **(a)** Find the Z transform of the following sequence. **03**

$$y(n) = x(n-2)u(n)$$

(b) State and prove the time scaling property and the time reversal property for Laplace transform. **04**

(c) Find the Z-transform of the sequence **07**

$x(n) = (\frac{1}{4})^n \cos(\frac{\pi}{3}n)u(n)$ Also sketch the ROC and pole-zero location.

Q-5 **(a)** Derive the relation between Laplace and Z-transforms. **03**

(b) (i)Define DFT of a discrete-time sequence. **04**
(ii)Define Inverse discrete -time Fourier transform.

(c) Find the inverse Z-transform of **07**

$$X(z) = \frac{2+z^3+3z^{-4}}{z^2+4z+3}\text{; ROC; } |z| > 0$$

OR

Q-5 **(a)** Find the DTFT of $x(n) = \{1, -2, 2, 3\}$ **03**

(b) State and prove integration and differentiation properties of Z-transform. **04**

(c) Find the transfer function and impulse response of the system described by the difference equation **07**

$$y(n) - \frac{1}{3}y(n-1) = 4x(n-1)$$

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