Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3141005 **Date:27-06-2022**

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)**	Define (1) Signal (2) System (3) Deterministic Signal.	**03**
	(b)	(1) Describe Inverse System. (2) Describe Time-Invariant System.	**04**
	(c)	Determine if the following systems described by (1) $y(t) = \sin[x(t+2)]$; (2) $y[n] = x[2-n]$ are memoryless, causal, linear, time invariant, stable.	**07**
Q.2	**(a)**	Write any three properties of Convolution Integral.	**03**
	(b)	(1) Write the relation between Unit Step and Impulse function. (2) Write the relation between Unit Step and Ramp function.	**04**
	(c)	Determine the response of the system with impulse response $h(t) = u(t)$ for the input $x(t) = e^{-2t}u(t)$.	**07**
		OR	
	(c)	The impulse response of the relaxed LTI system is given as, $h[n] = a^n u[n]$ and $\lvert a\rvert < 1$. Determine the response of this system if it is excited by unit step sequence.	**07**
Q.3	**(a)**	State equations for trigonometric Fourier Series and exponential Fourier Series.	**03**
	(b)	Bring out the difference between DFT and Fourier Transform.	**04**
	(c)	Use definition of the Fourier Series to determine the time domain signal represented by the following Fourier series coefficients: $X[k] = j\delta[k-1] - j\delta[k+1] + \delta[k-3] + \delta[k+3].\ \omega_0 = 2\pi$	**07**
		OR	
Q.3	**(a)**	State frequency shifting, time shifting and time scaling properties of Fourier Transform.	**03**
	(b)	Obtain the Fourier Transform of following functions: (1) $x(t) = 1$ (2) $x(t) = sgn\ (t)$.	**04**
	(c)	Obtain the Fourier Transform of following functions: (1) $x(t) = \cos\omega_0\, t$ (2) $x(t) = \cos\omega_c\, t\, u(t)$.	**07**
Q.4	**(a)**	Evaluate the convolution $x[n] * \delta[n-n_0]$.	**03**
	(b)	Explain (1) Time Shifting and (2) Time Scaling operation with neat figures.	**04**
	(c)	Determine 2 – point and 4 – point DFT of a sequence $x[n] = u[n] - u[n-2]$.	**07**
		OR	
Q.4	**(a)**	Discuss Causality and Stability of LTI systems using z – transform.	**03**
	(b)	Prove the duality property of Fourier Transform.	**04**

	(c)	Define Convolution sum. Show that (1) $x[n] * \delta[n] = x[n]$ (2) $x[n] * u[n - n_0] = \sum_{k=-\infty}^{n-n_0} x[k]$	**07**
Q.5	**(a)**	State final value and initial value theorem for z – transform.	**03**
	(b)	Write any four properties of ROC with respect to z – transform.	**04**
	(c)	Determine z – transform of $x[n] = \cos(\Omega_0 n)\, u[n]$	**07**
		OR	
Q.5	**(a)**	State any three properties of z – transform.	**03**
	(b)	Find the z – transform and ROC of the following sequence: $$x[n] = \frac{1}{2}\delta[n+1] + 5\left(\frac{1}{2}\right)^{-n} u[n] + 4^n u[-n-1]$$	**04**
	(c)	Determine the inverse z – transform of the following $X(z)$ by partial fraction expansion method, $X(z) = \frac{(z+2)}{2z^2-7z+3}$ if the ROCs are (1) $\lvert z\rvert > 3$ (2) $\lvert z\rvert < \frac{1}{2}$ and (3) $\frac{1}{2} < \lvert z\rvert < 3$.	**07**

****