Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV EXAMINATION – SUMMER 2020

Subject Code: 3141005 **Date:27/10/2020**

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.**

			Marks
Q.1	(a)	Sketch the following $x[n]$ signal. Also sketch $x[n-3]$ and $x[3-n]$. $$x[n]=4u[n+3]-2u[n]-2u[n-3]$$	03
	(b)	Find whether the following signal is periodic or not? If periodic determine the fundamental period: i. $x(t)=3\cos(t)+4\cos\left(\frac{t}{3}\right)$ ii. $x[n]=1+e^{j\left(\frac{4\pi}{7}\right)n}-e^{j\left(\frac{2\pi}{5}\right)n}$	04
	(c)	Define: System and determine whether the system $y(t)=x\left(\frac{t}{3}\right)$ is "Memoryless", "Linear", "Time invariant", "Causal", "Invertible". Justify your answers.	07
Q.2	(a)	Explain stability for LTI Systems. Derive the condition of stability for continuous time signal.	03
	(b)	Find discrete Convolution of following pairs of signals. $x[n]=\{1,3,5,7\}$ and $h[n]=\{2,4,6,8\}$	04
	(c)	For the input $x(t)$ and impulse response $h(t)$ are as shown in Figure - 1, find the output $y(t)$	07

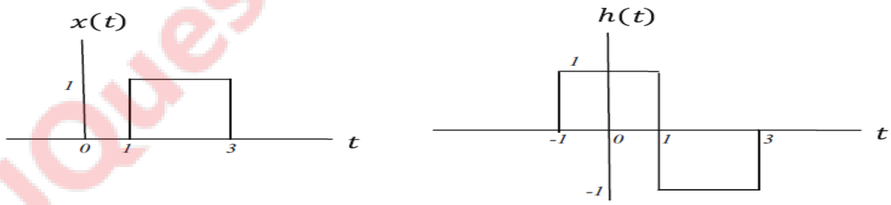

Figure 1

OR

	(c)	Perform the convolution $y(t)=x(t)*h(t)$, where $x(t)$ and $h(t)$ are as shown in Figure - 2.	07

Figure 2

Q.3	(a)	Explain the trigonometric Fourier series.	03
	(b)	Find Fourier series coefficients of the following signal. $$x[n]=1+\sin\left(\frac{2\pi}{N}\right)n+3\cos\left(\frac{2\pi}{N}\right)n+\cos\left(\frac{4\pi}{N}n+\frac{\pi}{2}\right)$$	04
	(c)	Find the Fourier series of the periodic signal shown in Figure - 3	07

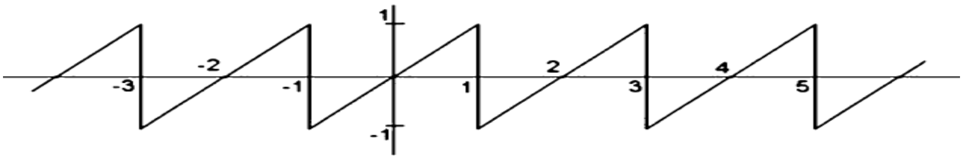

Figure 3

OR

Q.3 (a) Determine the Fourier transform of $x(t) = e^{-bt}\sin(\Omega t)u(t)$ where $b > 0$. 03

(b) Enlist frequency shifting and time differentiation properties of Fourier transform. Prove any one of them. 04

(c) Consider the Fourier transform $X(j\Omega)$ of a signal shown in Figure - 4. Find the inverse Fourier transform of it. 07

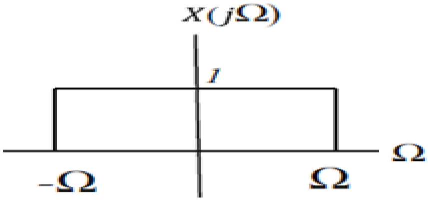

Figure 4

Q.4 (a) Explain Scaling property in the z-Domain. 03

(b) Find the z-transform of $x[n] = -u[-n-1]$. Also explain ROC. 04

(c) If $x[n]$ is a right-handed sequence, determine the inverse z-transform for the function: 07

$$X(z) = \frac{1 + 2z^{-1} + z^{-3}}{(1 - z^{-1})(1 - 0.5z^{-1})}$$

OR

Q.4 (a) Explain Differentiation property in the z-Domain. 03

(b) Find the z-transform of the sequence $x[n] = u[n] - u[n-5]$ 04

(c) Assuming $h[n]$ to be causal, find the inverse z-transform of the following: 07

$$H(z) = \frac{z^2 + 2z + 1}{z^2 + 0.4z - 0.12}$$

Q.5 (a) Explain relation between Fourier transform and z transform using necessary equations. 03

(b) Find the even and odd parts of the following functions. 04

i. $x(t) = tu(t+2) - tu(t-1)$

ii. $g(t) = \cos(t) + \sin(t) + \cos(t)\sin(t)$

(c) State the sampling theorem. Also explain the reconstruction of a signal from its samples using interpolation. 07

OR

Q.5 (a) Explain sampling theorem and determine the Nyquist rate corresponding the following signal. $x(t) = 1 + \cos(2000\pi t) + \sin(4000\pi t)$ 03

(b) The following are the impulse responses of discrete-time LTI systems. Determine whether each system is causal and/or stable. Justify your answers. 04

i. $h[n] = \left(\frac{1}{5}\right)^n u[n]$

ii. $h[n] = (5)^n u[3-n]$

(c) A causal LTI system is represented by the following difference equation. 07

$$y[n] - ay[n-1] = x[n-1]$$

Find the impulse response of the system $h[n]$, as a function of parameter a.