Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – WINTER 2021

Subject Code:3141005 Date:01/01/2022

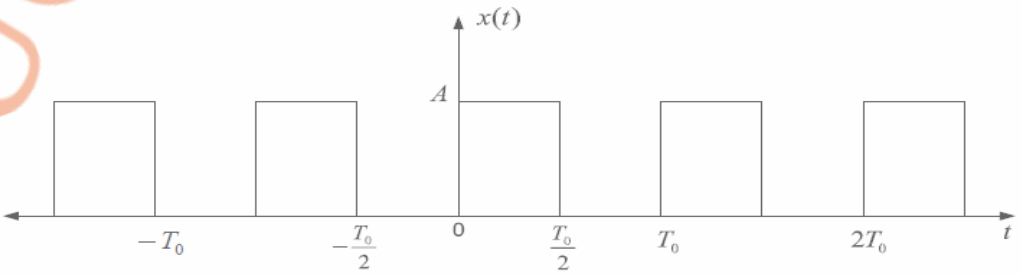
Subject Name:Signal & Systems

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)**	Find whether the given signals are periodic or not? If yes, give its fundamental period. (i) $x(t) = 3 \sin 200\pi t + 4 \cos 100t$ (ii) $x(n) = e^{j(\pi/2)n}$	**03**
	(b)	Find the even and odd components of the following signals. (i) $x(t) = 1 + 2t + 3t^2 + 4t^3$ (ii) $x(n) = \{-3, 1, 2, -4, 2\}$ ↑	**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**
Q.2	**(a)**	Determine the energy and power of a signal $x(t) = u(t)$.	**03**
	(b)	Find the natural response of the system described by difference equation $y(n) - 1.5\,y(n-1) + 0.5\,y(n-2) = x(n)$; $y(-1) = 1$; $y(-2) = 0$.	**04**
	(c)	Explain following property for the system $y(t) = 10\,x(t) + 5$. (i) Linearity (ii) Time-invariance (iii) Causality (iv) Dynamicity	**07**
		OR	
	(c)	Sketch signal $x(t) = u(t+2) - u(t-2) + u(t+1) - u(t-1)$. Also sketch (i) $x(2t)$ (ii) $x(1-t)$ (iii) $x(t)\,u(t)$.	**07**
Q.3	**(a)**	Prove that DT LTI system is causal if and only if $h(n) = 0$ for $n < 0$.	**03**
	(b)	Determine whether the following system with impulse response $h(t) = e^{-3t}\,u(t)$ is stable or not.	**04**
	(c)	Consider the periodic signal $x(t)$ shown below, determine its complex exponential Fourier series representation.	**07**



OR

Q.3 **(a)** State and prove a condition for a discrete time LTI system to be stable. **03**

(b) Prove Commutative property of Convolution. **04**

(c) Find the Fourier series coefficients for the continuous time periodic signal **07**

$x(t) = 1.5 \quad \text{for} \quad 0 \le t < 1$

$= -1.5 \quad \text{for} \quad 1 \le t < 2$

with fundamental frequency $W_0 = \pi$.

Q.4 **(a)** Determine the Z – Transform & ROC of the following sequence **03**

$x(n) = (-3)^n u(n) - (4)^n u(n)$

(b) Explain the Differentiation property of Z-Transform. **04**

(c) Define ROC and explain the property of ROC. **07**

OR

Q.4 **(a)** Find the Fourier transform of the signal **03**

$x(t) = e^{-at} u(t)$.

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

(c) By using partial fraction method, determine the inverse z-transform of **07**

$$X(Z) = \frac{\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)} \qquad \text{ROC} : |Z| > \frac{1}{2}$$

Q.5 **(a)** Find DTFT of the sequence $x(n) = \{1, 0, 4, 2\}$ **03**

(b) State Dirichlet condition for Fourier Series Representation. **04**

(c) Determine the impulse response h(n) for the system described by the difference equation $y(n) - 3/4\ y(n - 1) + 1/8\ y(n - 2) = x(n)$. **07**

OR

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

(b) Determine the Z – Transform & ROC of the following sequence **04**

$x(n) = (3)^n u(n) - (2)^n u(-n-1)$

(c) State & Prove Sampling Theorem. **07**