Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV (New) EXAMINATION – WINTER 2019

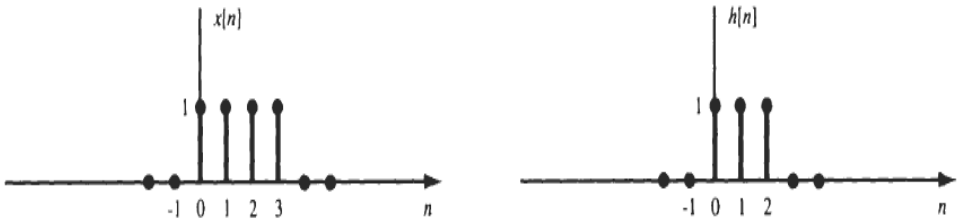
Subject Code: 2141005 Date: 17/12/2019

Subject Name: Signals and Systems

Time: 10:30 AM TO 01:00 PM Total Marks: 70

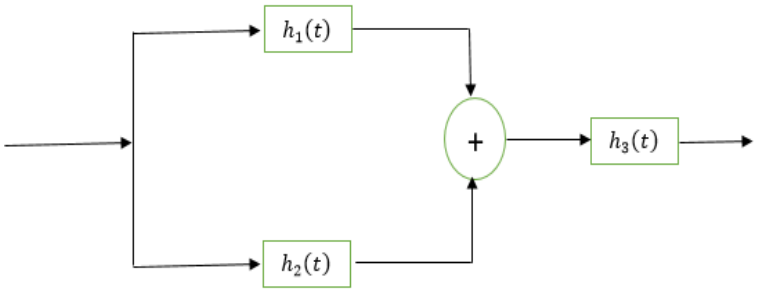
Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	**(a)**	Consider an analog pulse $$x(t) = \begin{cases} 1 & 0 \le t \le 1 \\ 0 & Otherwise \end{cases}$$ Find mathematical expression for $x(t)$delayed by 2, advanced by 2, and the reflected signal $x(-t)$.	**03**
	(b)	Determine whether or not the following signals is periodic. If a signal is periodic, determine its fundamental period. i. $x(t) = \cos t + sin\sqrt{2}\, t$ ii. $x[n] = e^{j\left(\frac{\pi}{4}\right)n}$	**04**
	(c)	Evaluate $y[n] = x[n] * h[n]$, by graphical method. where $x[n]$ and $h[n]$ are shown figure below. 	**07**
Q.2	**(a)**	Determine the energy and power of a unit step signal.	**03**
	(b)	Consider a discrete-time LTI system with impulse response $h[n]$ given by $$h[n] = \alpha^n u[n]$$ i. Is this system causal? ii. Is this system BIBO stable?	**04**
	(c)	Determine natural response of the first order system governed by the equation, $$\frac{dy(t)}{dt} + 3y(t) = x(t); y(0) = 2$$	**07**

OR

(c) Find the overall impulse response of the system shown in figure below. **07**
Take, $h_1(t) = tu(t);\ h_2(t) = 3u(t);\ h_3(t) = 2u(t);$

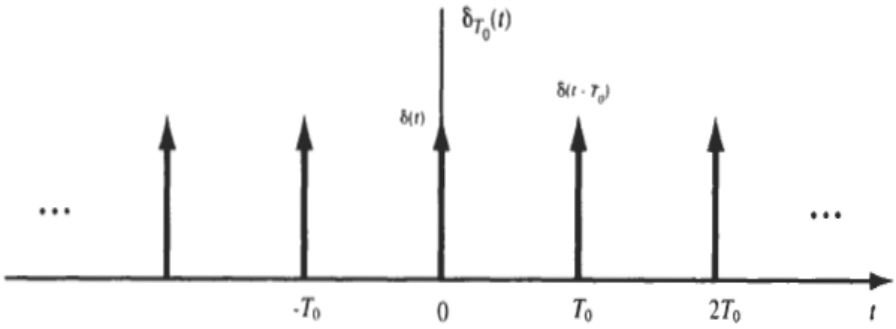


Q.3 **(a)** Find the Laplace transform of $x(t) = sin^2 t$. **03**

(b) Determine the complex exponential Fourier series representation for the signals $x(t) = \cos\left(2t + \frac{\pi}{4}\right)$. **04**

(c) Determine the trigonometric Fourier series of periodic impulse train **07**

$$\delta_{T_0}(t) = \sum_{k=-\infty}^{\infty} \delta(t - kT_0)$$



OR

Q.3 **(a)** State and prove the frequency differentiation property of Fourier transform. **03**

(b) Find the Fourier transform of **04**

$$x(n) = \{\ 2,\ 1,\ 2\ \}.$$

(c) Determine the frequency response of the LTI system defined by, **07**

$$y(n) = x(n) + by(n-1)$$

Q.4 **(a)** Determine the z-transform of **03**

$$x(n) = (n-3)\text{u(n)}$$

(b) State and prove shifting property for one sided z-transform. **04**

(c) Determine the inverse z-transform of **07**

$X(z) = \frac{1}{1-0.8z^{-1}+0.12z^{-2}}$ for ROC, $|z| > 0.6$.

OR

Q.4 **(a)** Find the even part of signal **03**

$$x(n) = u(n) + u(-n).$$

(b) Determine the inverse z-transform of **04**

$$X(z) = \log(1 + az^{-1})\ \ ;\ \ |z| > |a|.$$

(c) Determine the impulse response h(n) for the system described by the second order difference equation, **07**

$$y(n) - 4y(n-1) + 4y(n-2) = x(n-1)$$

Q.5 **(a)** Test the following systems for linearity. **03**

$$y(t) = 4x(t) + 2\frac{dx(t)}{dt}.$$

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

(c) A system has impulse response h(n) given by, **07**

$$h(n) = -0.25\delta(n+1) + 0.5\delta(n) - 0.25\delta(n-1).$$

i. Is the system BIBO stable?

ii. Is the system causal? Justify your answer.

OR

Q.5 **(a)** i. Define Fourier transform. **03**

ii. State the condition for existence of Fourier integral.

(b) Calculate the DFT of the sequence, **04**

$$x(n) = \{1,1,-2,-2\}$$

(c) Define ROC for z-transform. List the property of ROC. **07**

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