Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 3131705 **Date: 28/11/2019**

Subject Name: Dynamics of Linear Systems

Time: 02:30 PM TO 05:00 PM **Total Marks: 70**

Instructions:

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

Marks

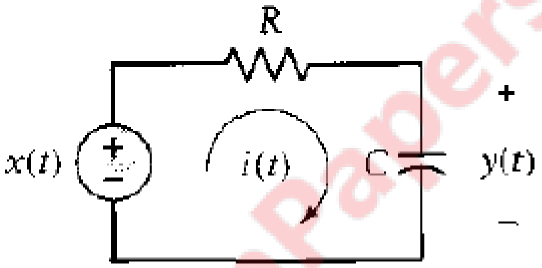
Q.1 **(a)** (i) Define system. **03**

(ii) List out the types of system.

(b) Explain convolution property of z-transform. **04**

(c) Consider the RC circuit given in the figure below. Assume that the circuit's time constant is RC = 1 s. The impulse response of this circuit is given by $h(t) = e^{-t}u(t)$. **07**

Determine the voltage across the capacitor, y(t), resulting from an input voltage x(t) = u(t) – u(t-2).



Q.2 **(a)** Use the convolution property to find the FT of the system output Y(jω) for the following inputs and system impulse response: **03**

$$x(t) = 3e^{-t}u(t) \ and \ h(t) = 2e^{-2t}u(t)$$

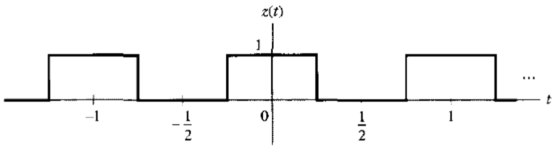
(b) Use the convolution property to find the time-domain signal corresponding to the following frequency-domain representation: **04**

$$X(e^{j\Omega}) = \left(\frac{1}{1-\left(\frac{1}{2}\right)e^{-j\Omega}}\right)\left(\frac{1}{1+\left(\frac{1}{2}\right)e^{-j\Omega}}\right)$$

(c) Evaluate the periodic convolution of the sinusoidal signal **07**

$$z(t) = 2\cos(2\pi t) + \sin(4\pi t)$$

with the periodic square wave x(t) as shown below:



OR

(c) The output of an LTI system in response to an input $x(t) = e^{-2t}u(t)$ is $y(t) = e^{-t}u(t)$. Find the frequency response and the impulse response of this system. **07**

Q.3 **(a)** Find the DTFT of $x[n] = \delta[n]$ **03**

	(b)	Determine the Fourier Series coefficients for the signal defined by $$x(t) = \sum_{t=-\infty}^{\infty} \delta(t-4l)$$	**04**
	(c)	Prove the following properties in context of Continuous Time Fourier Transform: (i) Time shifting (ii) Time and frequency scaling	**07**
		OR	
Q.3	**(a)**	State Dirichlet condition for Fourier series representation.	**03**
	(b)	Prove the duality property of Fourier transform.	**04**
	(c)	Determine the appropriate Fourier representations of the following time domain signals: (i) $x(t) = e^{-t}\cos(2\pi t)u(t)$ (ii) $x(t) = \lvert\sin(2\pi t)\rvert$	**07**
Q.4	**(a)**	Explain the linearity property of Laplace transform.	**03**
	(b)	Derive the relationship between Laplace transform and Fourier transform.	**04**
	(c)	Analyze the role of Region of Convergence (ROC) for defining the stability of system in the context of Laplace transform.	**07**
		OR	
Q.4	**(a)**	Explain the modulation property in context of Fourier transform.	**03**
	(b)	Explain the differencing and summation property of discrete Fourier transform.	**04**
	(c)	Find the inverse Discrete Time Fourier Transform (DTFT) of $$X(e^{j\Omega}) = \frac{-\frac{5}{6}e^{-j\Omega} + 5}{1 + \frac{1}{6}e^{-j\Omega} - \frac{1}{6}e^{-j\Omega 2}}$$	**07**
Q.5	**(a)**	Explain the linearity property of z-transform.	**03**
	(b)	Explain the concept of poles and zeros with respect to z-transform.	**04**
	(c)	Determine the z-transform of the signal $$x[n] = -u[-n-1] + \left(\frac{1}{2}\right)^n u[n]$$ Depict the ROC and the locations of poles and zeros of X(z) in the z-plane.	**07**
		OR	
Q.5	**(a)**	Explain the initial value theorem in conext of z-transform.	**03**
	(b)	Determine the z-transform of the signal $$x[n] = \alpha^n u[n]$$	**04**
	(c)	Find the inverse z-transform of $$X(z) = \frac{2 + z^{-1}}{1 - \frac{1}{2}z^{-1}}$$ with ROC $\lvert z\rvert > \frac{1}{2}$	**07**

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