

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-IV(NEW) EXAMINATION – WINTER 2022****Subject Code:2141005****Date:20-12-2022****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.
4. Simple and non-programmable scientific calculators are allowed.

	MARKS
Q.1 (a) Discuss (i) Linear LTI systems (ii) Invertible systems (iii) Stable LTI systems	03
(b) Draw the following pulses.	04
(i) $2u(t)+2u(t-0.5)-u(t-1.5)-2u(t-2.5)-u(t-4)$	
(ii) $2u(t)+r(t-0.5)-r(t-1.5)-r(t-2.5)+r(t-3.5)-2u(t-4)$	
(iii) $2r(t)-2r(t-1)-u(t-2)-r(t-2)+r(t-3)$	
(iv) $2u(t)-u(t-0.5)+u(t-1.5)-2r(t-2.5)+2r(t-3.5)$	
(c) Determine the Trigonometric Fourier Series of the function shown in figure(1c).	07

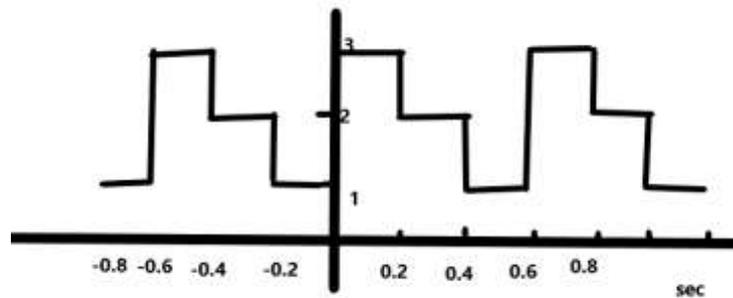


fig.1c

Q.2 (a) Compare Fourier Series with Fourier Transform. Obtain the C.T.F.T. of 'Right sided decaying exponential signal'	03
(b) For CTFT, show that the signal compression in the Time Domain will result in expansion in Frequency domain.	04
(c) (i) With required graphs and mathematical equations, discuss how to obtain the impulse response of a Continuous time LTI system. (ii) Consider a system with an impulse response $h[n] = \{2,1,2,1\}$. Determine the system response to $x[n]=1$.	07
OR	
(c) Discuss various properties of Convolution Integral. Also discuss how we can apply it for finding response of an LTI system for any given input if the impulse response is known.	07
Q.3 (a) Discuss the 'Duality in Fourier Transform' with suitable example.	03
(b) Using Fourier Transform, show that the Convolution in Time Domain is equivalent to multiplication in Frequency domain.	04
(c) (i) Explain the relation between Laplace Transform and Fourier Transform.	07

(ii) Enlist the properties of Fourier Transform. Discuss any two of them with suitable example.

OR

- Q.3 (a) State and discuss the Nyquist's criteria for sampling. 03
 (b) Identify various components of the following difference equation. 04

$$\sum_{k=0}^N a_k y[n-k] = \sum_{k=0}^M b_k x[n-k]$$

- (i) identify the input, output and their past and future versions of signals, if any.
 (ii) Write the order of the difference equation.
 (iii) identify the coefficients.
 (iv) which type of equation is this? Recursive or non recursive.
 (c) Draw the signals $\{u[n]-u[n-4]\}$ and $e^{-n} u[n]$. Also determine their convolution using Tabulation Method. 07

- Q.4 (a) Determine the Z.T. of $-a^n, n \leq -1$. Also draw the ROC. 03
 (b) State and Prove the 'Differentiation in Z domain' property of Z.T. Also mention the ROC. 04
 (c) Determine the inverse Z.T. using Partial Fraction Expansion. 07

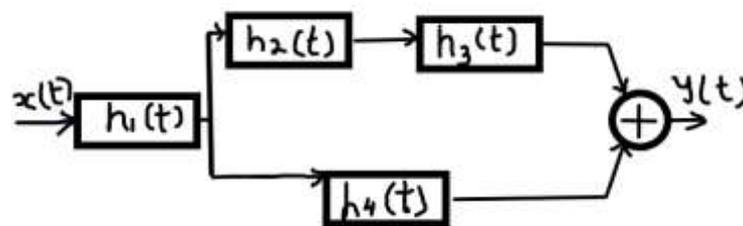
$$X(z) = \frac{1}{1 - z^{-1} + 0.16z^{-2}}, \text{ ROC} = |z| > 0.4, |z| < 0.2$$

OR

- Q.4 (a) Explain various properties of ROC of Z.T. 03
 (b) Solve the following equation using Z.T. 04

$$y[n] + 0.5 y[n-1] = 2 u[n]$$

- (c) For the given LTI system, Express the 07



system impulse response as a function of impulse response of the subsystems. Also draw the indicative block diagram for each step.

- Q.5 (a) State and Prove the Linearity Property of DTFT. 03
 (b) Determine the Magnitude and Phase spectrum of the DTFT 04

$$X(\omega) = \frac{1}{1 - \alpha e^{-j\omega}}$$

- (c) Discuss the difference between Fourier series, Fourier Transform, Laplace Transform and Z- Transform based on their application for 07

various signal types. Give at least one example of each with necessary figure.

OR

- Q.5** (a) Find the step response of the system whose impulse response is $u[n]$. **03**
(b) Find the Fourier Transform of $\sin(\omega_c t)u(t)$ with graphs. **04**
(c) Write mathematical expression for Unit impulse function. Also draw its waveform in time domain. Write the Properties of Unit impulse function. Explain how sampling of a signal can be done using impulse function and its properties with suitable mathematical expressions and waveforms. **07**
