

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER– VII (NEW) EXAMINATION – WINTER 2021****Subject Code:2171003****Date:03/12/2021****Subject Name:Digital Signal Processing****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.
4. Simple and non-programmable scientific calculators are allowed.

		MARKS
Q.1	(a) What are the basic operations on discrete time signal. Explain with suitable example and graphical representations.	03
	(b) Find whether the following signal are energy, power signal, neither energy nor power signal. Calculate the power and energy in each case.	04
	$x(n) = \sin\left(\frac{\pi}{3}n\right)$	
	(c) Find the convolution of the signal	07
	$x(n) = \begin{cases} 2 & n = -2, 0, 1 \\ 3 & n = -1 \\ 0 & \text{elsewhere} \end{cases}$	
	Using graphical method and Analytical method	
Q.2	(a) Check whether following system are	03
	a. Static or dynamic b. Linear or Non linear c. Causal or non causal d. Shift variant or non variant	
	$Y(n) y(n) = \log_{10} x(n) $	
	(b) State and prove the time shifting and frequency shifting properties of DTFT	04
	(c) What is the input signal $x(n)$ that will generate the output sequence $y(n) = \{1, 1, 2, 0, 2, 1\}$ for the system with impulse response $h(n) = \{1, -1, 1\}$	07
	OR	
	(c) Find the response of the system described by the difference equation	07
	$y(n) + 2y(n - 1) + y(n - 2) = x(n) + x(n - 1)$	
	For the input signal $x(n) = \left(\frac{1}{2}\right)^n u(n)$ with initial condition $y(-1) = y(-2) = 1$	
Q.3	(a) Derive the property of Time convolution and Time shifting of Z transform	03
	(b) Describe the limitation of Direct form I. Compare Direct form I and Direct form II structure realization for FIR filter design	04
	(c) Using long division method determine inverse Z transform of the following	07
	$X(Z) = \frac{z^2 + 2z}{z^3 - 3z^2 + 4z + 1} \quad \text{ROC } z > 1$	
	OR	
Q.3	(a) State and prove Parseval's theorem for discrete aperiodic signal	03
	(b) Derive differentiation property of Z domain	04
	(c) Find the z transform of the sequence also find out its ROC	07
	$x(n) = \left(\frac{1}{4}\right)^n \cos\left(\frac{\pi n}{3}\right) u(n)$	

- Q.4** (a) Find Inverse Discrete Fourier transform(IDFT) of $X[k] = \{4,2,0,4\}$ using DFT algorithm **03**
 (b) Realize the system given by the difference equation **04**
 $y(n) = -0.1y(n-1) + 0.72y(n-2) + 0.7x(n) - 0.252x(n-2)$ in parallel structure realization.
 (c) Find the 8 point DFT of $x(n) = \{1,1,0,0,0,0,0,0\}$. Use the property of conjugate symmetry. **07**

OR

- Q.4** (a) Find Inverse Discrete Fourier Transform (IDFT) using Decimation In Time radix 2 (DIT-FFT) algorithm **03**
 $X[k] = \{1, 1-2j, -1, 1+2j\}$
 (b) Realize the system with difference equation using cascade structure realization **04**

$$y(n) = \frac{3}{4}y(n-1) - \frac{1}{8}y(n-2) + x(n) + \frac{1}{3}x(n-1)$$

 (c) Perform the circular convolution of following sequence using DFT and IDFT formula **07**
 $x_1(n) = \{1,2,1,2\}$ and $x_2(n) = \{4,3,2,1\}$

- Q.5** (a) Explain the followings in context of DSP processor architecture: **03**
 (1) MAC (2) Pipelining
 (b) Consider a ramp sequence and sketch interpolated and decimated version with the factor of 3. **04**

$$r(n) = \begin{cases} nu(n) & \text{for } n \geq 0 \\ 0, & \text{elsewhere} \end{cases}$$

- (c) For analog transfer function **07**

$$H_a(s) = \frac{2}{(s+1)(s+3)}$$

Determine $H(z)$ if $T=1s$ using impulse invariance method

OR

- Q.5** (a) Write a short critical note on Harvard architecture of DSP processor. **03**
 (b) Define multirate system. Where multirate digital signal processing require? **04**
 What are the advantages of multirate signal processing?
 (c) A digital filter with 3dB bandwidth of 0.4π is designed from the analog filter **07**
 whose system response is

$$H(s) = \frac{\Omega_c}{s + \Omega_c}$$

Use the bilinear transformation and obtain $H(z)$
