Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2022

Subject Code:2171003 Date:16-01-2023

Subject Name:Digital Signal Processing

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)**	Represent the sequence x (n) = {0.5, 3, 0, 1) into a sum of weighted impulse sequences.	**03**
	(b)	What is Nyquist criteria for sampling? What will happen if sampling process do not follow the Nyquist criteria?	**04**
	(c)	The impulse response of a linear time-invariant system is h (n) = {1, 2, 1,0,1}. Determine by graphical method, response of the ↑ System to the input signal x (n) = {1, 2, 3, 1}.	**07**
Q.2	**(a)**	A discrete-time signal x (n) is defined as: $$x\,(n) = \begin{cases} 1 + \frac{n}{3}, & -3 \le n \le -1 \\ 1, & 0 \le n \le 3 \\ 0, & elsewhere \end{cases}$$ Determine its values and sketch the signal x (n).	**03**
	(b)	State and prove frequency shifting and convolution properties of z-transform.	**04**
	(c)	Consider a system with impulse response $$h\,(n) \begin{cases} \left(\frac{1}{2}\right)^n, & 0 \le n \le 4 \\ 0, & elsewhere \end{cases}$$ Determine the input x (n) for $0 \le n \le 8$ that will generate the output sequence $y(n) = \{1, 2, 2.5, 3, 3, 3, 2, 1, 0, \ldots\}$	**07**
		OR	
	(c)	A LTI system is characterized by the system function $$H\,(Z) = \frac{1}{1 - \frac{1}{2}z^{-1}} + \frac{2}{1 - 3z^{-1}}$$ Specify the ROC of H(z) and determine h(n) for the following conditions: i) The system is stable. ii) The system is causal. iii) The system is anticausal.	**07**
Q.3	**(a)**	Draw nature of Region of Convergence (ROC) in Z-plane for infinite duration causal, anticausal and two-sided sequence.	**03**
	(b)	Determine the response of the system	**04**

$$y\,(n) = \frac{5}{6}\,y(n-1) - \frac{1}{6}\,y\,(n-2) + x(n)$$

to the input signal $x\,(n) = \delta\,(n) - \frac{1}{3}\delta\,(n-1)$.

(c) Obtain the direct form I and direct form II structures for the following system: **07**

$$H\,(Z) = \frac{1 + 0.875\,z^{-1}}{(1 + 0.2\,z^{-1} + 0.9\,z^{-2})(1 - 0.7\,z^{-1})}$$

OR

Q.3 **(a)** Consider the signal **03**

$$x\,(n) = \{-1, 2, -3, 2, -1\}$$
$$\uparrow$$

with Fourier transform $X\,(\omega)$. Compute $\int_{-\pi}^{\pi} |X(\omega)|^2\ d\omega$.

(b) Compute the 4-point DFT of a discrete time sequence {1, 0, 2, 1}. **04**

(c) Determine the zeros for the following FIR systems and indicate whether the system is minimum phase, maximum phase, or mixed phase. **07**

$$H_1(Z) = 6 + z^{-1} - z^{-2}$$
$$H_2(Z) = 1 - z^{-1} - 6z^{-2}$$
$$H_3(Z) = 1 - \frac{5}{2}z^{-1} - \frac{3}{2}z^{-2}$$
$$H_4(Z) = 1 + \frac{5}{3}z^{-1} - \frac{2}{3}z^{-2}$$

Q.4 **(a)** Explain how circular convolution can be converted to linear convolution by zero padding. **03**

(b) Using decimation in time algorithm, compute 4-point DFT of the sequence x(n)={0, 1, 2, 3} **04**

(c) 4-point DFT of a sequence x(n) is {1,0,1,0}. By using butterfly diagram as in DIT-FFT, find x(n). **07**

OR

Q.4 **(a)** Explain necessity of windowing in FIR filter design. **03**

(b) Find out H (Z) for the given $H\,(S) = \frac{2}{S^2+3S+2}$ using impulse invariance method. Assume T=1s. **04**

(c) Consider input sequence $x\,(n) = \{1, 2, 3\}$ and impulse response of a system$h\,(n) = \{1, 1\}$. Find the linear convolution using graphical circular convolution method. Match result of same using tabulation/ matrix method. **07**

Q.5 **(a)** Explain need of anti-aliasing filter in a down sampler. **03**

(b) Explain how to achieve sampling rate conversion by rational factor L/M. Where L and M are constant. **04**

(c) List and explain the application of Multirate Signal Processing. **07**

OR

Q.5 **(a)** Explain how echo cancellation is achieved using adaptive filters. **03**

(b) Compare Up sampling and Down Sampling. **04**

(c) Explain pipelining and MAC architecture of Digital Signal Processor. **07**

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