GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VII (NEW) EXAMINATION – SUMMER 2022
Subject Code:2171003   **Date:14/06/2022**
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)**	Determine the Nyquist sampling frequency and Nyquist interval for the signal, $x(t) = \left[\dfrac{\sin 200\pi t}{\pi t}\right]^2$.	**03**
	(b)	Compare the direct form and linear phase structures of an Nth order FIR system.	**04**
	(c)	What is Digital Signal Processing? List the unique architectural features of DSP processors.	**07**
Q.2	**(a)**	In an LTI system the impulse response $h(n) = C^n$ for $n \leq 0$. Determine the range of values of C, for which the system is stable.	**03**
	(b)	List the properties of Butterworth lowpass filters.	**04**
	(c)	Using z-transform, perform deconvolution of response $y(n) = \{-2, 5, -5, 2, 1\}$ and impulse response $h(n) = \{1, -1, 1\}$, to extract the input $x(n)$.	**07**

OR

	(c)	Explain the decimation and interpolation process with an example.	**07**
Q.3	**(a)**	Find the z-transform of $e^{-anT} u(n)$.	**03**
	(b)	Determine the regions of convergence of right-sided, left-sided, infinite-duration two-sided and finite-duration two-sided sequences.	**04**
	(c)	Determine the impulse response $h(n)$ for the system described by the second order difference equation, $$y(n) - 4\,y(n-1) + 4\,y(n-2) = x(n-1).$$	**07**

OR

Q.3	**(a)**	List the application of an adaptive filter. Briefly explain any one of it.	**03**
	(b)	What do you mean by frequency wrapping?	**04**
	(c)	Discuss design steps of IIR filter using bilinear transformation.	**07**
Q.4	**(a)**	What are the factors that influence the choice of structure for realization of an LTI system?	**03**
	(b)	Find the Fourier transform of, $$x(n) = -a^n\, u(-n-1), \text{ where } |a| < 1,$$	**04**
	(c)	Discuss in brief: Radix-2 Decimation-in-Time FFT algorithms.	**07**

OR

Q.4	**(a)**	What is Gibbs phenomenon?	**03**

(b) State and prove, the property "Differentiation in frequency domain" for Fourier Transform of discreate time signals. **04**

(c) Compute circular convolution of the following two sequences using DFT. **07**

$$x(n) = \{1, 0.5\} \text{ and } h(n) = \{0.5, 1\}.$$

Q.5 (a) With block diagram explain the element of digital signal processing system. **03**

(b) Test the causality of the given systems. **04**

    i. $y(n) = x(n^2)$

    ii. $y(n) = nx(n)$

(c) Determine the z-transform and ROC of discreate time signal given by, **07**

$$x(n) = 0.5^n u(n) + 0.8^n u(-n-1).$$

OR

Q.5 (a) What is up sampling and down sampling? Give one application of that. **03**

(b) Determine whether following signals are periodic or not. If periodic find the fundamental period. **04**

    i. $x(n) = e^{j7\pi n}$

    ii. $x(n) = \cos\left(\dfrac{n}{8} - \pi\right)$

(c) Find the inverse Fourier transform of the frequency response of first order system $H(e^{j\omega}) = (1 - ae^{-j\varpi})^{-1}$ **07**

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