Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:2171708 Date:03/06/2022

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)**	Explain the following with example: (1) Continuous valued signal (2) Discrete valued signal	**03**
	(b)	State sampling theorem. What is the relation between frequency in discrete time domain and frequency in analog domain?	**04**
	(c)	Sketch the discrete time signal $x(n)=2^{-n}$ for $-2 \le n \le 2$ and obtain: (1) $y_1 = 2x(n) + \delta(n)$ (2) $y_2 = x(n).u(2-n)$	**07**
Q.2	**(a)**	Explain the distinct features of DSP Processor.	**03**
	(b)	Compute the DFT of the four point sequence x(n)=(0 1 2 3)	**04**
	(c)	Perform the circular convolution of the following two sequences graphically: $x_1(n) = \{2,1,2,1\}$ $\uparrow$ $x_2(n) = \{1,2,3,4\}$ $\uparrow$	**07**
		OR	
	(c)	Determine the response of the FIR filter using DFT, with impulse response $h(n) = \{1,2,3\}$ to the input sequence $x(n) = \{1,2,2,1\}$	**07**
Q.3	**(a)**	Determine if the system described by following input-output relation is linear or non-linear: $y(n)=n\,x^2(n)$	**03**
	(b)	Determine the stability and causality of the given system: y(n)=x(2n)	**04**
	(c)	The impulse response of a linear time-invariant system is h(n)={1,1,1}. Determine the response of the system to the input signal using convolution with graphical method for x(n)={1,2,1,2}	**07**
		OR	
Q.3	**(a)**	Determine whether the given sinusoid $x(n)=\cos 0.01\pi n$ is periodic or not. In case it is periodic specify the fundamental period.	**03**
	(b)	What is correlation? Mention types of correlation and its applications.	**04**
	(c)	Determine the homogeneous solution of the system described by $y(n) - 3\,y(n-1) - 4\,y(n-2) = x(n)$	**07**
Q.4	**(a)**	Find the Z-transform and ROC of x(n)=nu(n). where u(n)is unit step sequence.	**03**

(b) Find the inverse Z-transform using partial fraction expansion: **04**

$$X(z) = \frac{1}{(1+z^{-1})(1-z^{-1})^2}$$

(c) Using Z-transform method obtain impulse response of a system described by: **07**

$$y(n) = 2.5y(n-1) + x(n)$$

OR

Q.4 **(a)** Find Z transform and ROC of following signal : **03**

$$x(n) = (-3)^n u(-n-1)$$

(b) Find the inverse z-transform of $X(Z) = \frac{1-\frac{1}{2}Z^{-1}}{1-\frac{1}{4}Z^{-2}}$ $|Z| > 1/2$ using power series expansion method. **04**

(c) A Linear Time Invariant system is characterized by the system function **07**

$$H(z) = \frac{3 + 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$

Specify the ROC of H(z) and determine h(n) for the following conditions:

(a) The system is stable
(b) The system is causal
(c) The system is anti causal.

Q.5 **(a)** Explain the advantages of IIR filter over FIR filter. **03**

(b) Consider the causal Linear Time Invariant system function **04**

$$H(z) = \frac{1 + z^{-1}}{\left(1 - 0.5z^{-1} + \frac{1}{3}z^{-2}\right)(1 + 0.25z^{-1})}$$

Draw Direct form-II structure for IIR filter.

(c) Explain Radix-2 decimation in time algorithm in detail. **07**

OR

Q.5 **(a)** Compare merits and demerits of DSP over ASP. **03**

(b) The transfer function of discrete time causal system is given by **04**

$$H(z) = \frac{1 - z^{-1}}{1 - 0.2z^{-1} - 0.15z^{-2}}$$

Draw cascade realization for IIR filter.

(c) Convert the analog filter with system function **07**

$$H_a(s) = \frac{s + 0.1}{(s + 0.1)^2 + 16}$$

Into a digital IIR filter by means of the bilinear transformation. The digital filter is to have a resonant frequency of $\omega_r = \pi/2$.

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