Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– VII (New) EXAMINATION – WINTER 2019

Subject Code: 2171003 **Date: 03/12/2019**

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.**

			MARKS
Q.1	**(a)**	Define the following terms in context of signal processing: (1) Period of discrete sinusoid, (2) Correlation of signals, (3) ROC of Z-transform.	**03**
	(b)	The system given below have input x(n) and output y(n). $y(n) = \log\{x(n)\}$ Answer the followings with justification. (1) Is the system linear? (2) Is it time-invariant? (3) Is it stable?	**04**
	(c)	Draw & discuss typical block diagram of Digital Signal Processing (DSP). Explain any one example of DSP used in real-time application.	**07**
Q.2	**(a)**	Explain the following terms in brief: (1) Minimum phase system. (2) Dirichlet's Condition for existence of DTFT.	**03**
	(b)	State the relationship between Z-transform and Fourier transform. Determine the step response of the causal system described by the following LCCDE. $y(n) = y(n-1) + x(n)$ Consider $x(n)$ as input and $y(n)$ as output of the system.	**04**
	(c)	Compute the linear as well as circular convolution of following sequences: $x(n) = \{1, 2, 0, 1\}\ and\ h(n) = \{2, 2, 1, 1\}\ for\ 0 \le n \le 3$ Comment on the results obtained.	**07**
		OR	
	(c)	A liner time-invariant system is characterized by its impulse response $h(n) = \left(\frac{1}{2}\right)^n u(n)$ Determine the spectrum and energy density spectrum of the output signal when the system is excited by the signal. $x(n) = \left(\frac{1}{4}\right)^n u(n)$	**07**
Q.3	**(a)**	Compute the Z-transform of the following sequence. $x(n) = a^{\lvert n\rvert}; 0 < a < 1$	**03**
	(b)	Draw Direct Form-I and Direct Form-II structures for the following system function:	**04**

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

(c) Write down the properties of Z-transforms and prove the followings: **07**
(1) Time-shifting property
(2) Differentiation property

OR

Q.3 **(a)** Compute the DFT of the following four-point sequence using DFT matrix. **03**

$$x(n) = \{0, 1, 2, 3\}$$

(b) Consider the signal **04**

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

with Fourier transform $X(\omega)$. Compute the following quantities, without explicitly computing$X(\omega)$.
(1) $X(0)$ (2) $X(\pi)$ (3) $\int_{-\pi}^{\pi} |X(\omega)|^2 \, d\omega$

(c) List out the properties of DFT and prove the followings: **07**
(1) Symmetry for real sequence
(2) Time reversal

Q.4 **(a)** Enlist atleast three differences between FIR and IIR Filters. **03**

(b) Explain the followings in context of Multirate signal processing: **04**
(1) Decimation (2) Interpolation

(c) Discuss the design of FIR filter using windowing method in brief. **07**

OR

Q.4 **(a)** What do you mean by frequency wrapping? **03**

(b) Explain the followings in context of DSP processor architecture: **04**
(1) MAC (2) Pipelining

(c) Discuss design steps of IIR filter using bilinear transformation. **07**

Q.5 **(a)** Compute the IDFT of the function $X(\omega) = 2\pi \, \delta(\omega)$ **03**

(b) Write a short critical note on adaptive filters and discuss any one application of it. **04**

(c) Discuss in brief: Radix-2 Decimation-in-Time FFT algorithms. **07**

OR

Q.5 **(a)** Determine the partial-fraction expansion of the proper function **03**

$$X(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$$

(b) Write a short critical note on Harward architecture of DSP processor. **04**

(c) Explain in brief: The Goertzel Algorithm. **07**

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