

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
<b>Q.1</b> (a) Define the following terms in context of signal processing: (1) Period of discrete sinusoid, (2) Correlation of signals, (3) ROC of Z-transform.	<b>03</b>
(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?	<b>04</b>
(c) Draw & discuss typical block diagram of Digital Signal Processing (DSP). Explain any one example of DSP used in real-time application.	<b>07</b>
<b>Q.2</b> (a) Explain the following terms in brief: (1) Minimum phase system. (2) Dirichlet's Condition for existence of DTFT.	<b>03</b>
(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.	<b>04</b>
(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 $0 \leq n \leq 3$ Comment on the results obtained.	<b>07</b>
<b>OR</b>	
(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. $x(n) = \left(\frac{1}{4}\right)^n u(n)$	<b>07</b>
<b>Q.3</b> (a) Compute the Z-transform of the following sequence.	<b>03</b>
$x(n) = a^{ n }; 0 < a < 1$	
(b) Draw Direct Form-I and Direct Form-II structures for the following system function:	<b>04</b>

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

- (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 Harvard architecture of DSP processor. **04**

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

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