Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (OLD) EXAMINATION – WINTER 2018

Subject Code: 171003 **Date: 26/11/2018**

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.**

Q.1 **(a)** A discrete-time signal x(n) is defined as **07**

$$x(n) = \begin{cases} 1+\frac{n}{3} & -3 \le n \le 1 \\ 1 & 0 \le n \le 3 \\ 0 & elsewhere \end{cases}$$

a) Determine its value and Sketch the signal.

b) Sketch the signal if

I. First fold $x(n)$and then delay the resulting signal by four samples

II. First delay $x(n)$ by four samples and then fold the resulting signal

c) Compare above results. Is folding and Delay Operation is commutative operation?

d) Can you express the signal $x(n)$ in terms of $\delta(n)$ and $u(n)$?

(b) For each of following system determine whether system is stable, causal, Linear, Time invariant or not. **07**

1. $y(n) = \sum_{k=-\infty}^{n+1} x(k)$
2. $y(n) = x(n^2)$
3. $y(n) = log x(n)$

Q.2 **(a)** Prove that convergence of absolute sum of the impulse response is a sufficient condition for BIBO (bounded input bounded output) stability of LTI system. **07**

(b) Obtain a linear convolution of following two discrete-time signals: **07**

$$x(n) = \sum_{k=0}^{2} \delta(n-k)$$

$$h(n) = 2^n[u(n) - u(n-3)]$$

OR

(b) Enlist Properties of linear convolution. **07**

Obtain linear Convolution for $x(n) = \{1,1,\underset{\uparrow}{0},1,1\}$ and $h(n) = \{1,-2,-3,\underset{\uparrow}{4}\}$

Q.3 **(a)** What is ROC? Explain the properties of ROC in Z-Transform. **07**

(b) Find magnitude Response and Phase Response of system described by differential equation **07**

$$y(n) - \frac{1}{2}y(n-1) = x(n) - \frac{1}{4}x(n-1)$$

OR

Q.3 **(a)** What is canonic and non-canonic structure? Obtain Direct form-I and Direct form-II realization of the following transfer function. **07**

$$H(z) = \frac{3 + 3.6z^{-1} + 0.6z^{-2}}{1 + 0.1z^{-1} - 0.2z^{-2}}$$

(b) Prove differentiation property of Z-transform and obtain the Z-transform of nu(n) using the same. **07**

Q.4 **(a)** The system function of the analog filter is given as **07**

$$H_a = \frac{s + 0.1}{(s + 0.1)^2 + 9}$$

Obtain the system function of the IIR digital filter by using impulse invariance method.

(b) State and Prove following Properties in terms of DFT. **07**

1. Time Reversal
2. Periodicity

OR

Q.4 **(a)** Compare FIR and IIR filters. **07**

(b) Determine the response of FIR filter using DFT if **07**

$x(n) = \{\underset{\uparrow}{1},2\}$ and $h(n) = \{2,\underset{\uparrow}{2}\}$

Q.5 **(a)** Explain Decimation in Time FFT algorithm. **07**

(b) Derive the DFT of the sample data sequence $x(n) = \{1,1,2,2,3,3\}$ determine the corresponding amplitude and phase spectrum. **07**

OR

Q.5 **(a)** Explain multiplier-Accumulator (MAC) hardware in DSP processors. **07**

(b) Discuss the applications of digital signal processing with suitable examples. **07**

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