Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**B. E. - SEMESTER – VII • EXAMINATION – WINTER 2012**

**Subject code: 170804 Date: 27/12/2012**

**Subject Name: Discrete Time Signal Processing**

**Time: 10.30 am - 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)** Explain the following properties of a system: **07**
(i) Time Invariant (ii) Causality (iii) Stability (iv) Linearity.

**(b)** For the system described by the sequence y(n) = x(2n), determine for the following conditions: **07**
(i) Time Invariant (ii) Causality (iii) Stability (iv) Linearity.

**Q.2** **(a)** If $x(n) = b^{|n|}$, find its Z transform X(z) and indicate its ROC. **07**

**(b)** Explain the properties of region of convergence (ROC) of Z- transform. **07**

**OR**

**(b)** Using power series expansion method find the inverse Z- transform of $X(z) = 1/(1 - az^{-1})$ , $|z| > |a|$. **07**

**Q.3** **(a)** Explain the following properties of discrete time Fourier transform: **07**
(i) Time and Frequency Shifting (ii) Differentiation and Integration
(iii) Parseval's Relations (iv) Time and Frequency Scaling.

**(b)** Compute the DFT of the following finite length sequences considered **07**
to be of length N: (i) $x(n) = \delta(n)$ (ii) $x(n) = \delta(n-n_0)$ , $0 < n_0 < N$

$x(n) = a^n$ , $0 \le n \le N-1$

**OR**

**Q.3** **(a)** Explain multiplication of two DFTs and circular convolution. **07**

**(b)** Perform the circular convolution of the two sequences: **07**
$x_1(n) = (1,2,1,2)$ and $x_2(n) = (1,2,2,3)$.

**Q.4** **(a)** Explain the frequency analysis of a signal $x(n) = \cos(\omega_0 n)$ using DFT. **07**

**(b)** What are the complexities of direct computation of the DFT, Explain with example? How these complexities are minimized if we use divide and conquer approach for the computation of DFTs. **07**

**OR**

**Q.4** **(a)** Differentiate between decimation- in- time FFT and decimation- in-frequency FFT algorithm. **07**

**(b)** A finite duration sequence of length L is given as **07**

$$x(n) = \begin{cases} 1, & 0 \le n \le L-1 \\ 0, & otherwise \end{cases}$$

Determine Discrete Fourier Transform (DFT) of this sequence and plot its magnitude and phase spectrum.

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| **Q.5** | **(a)** | Explain the basic systems for discrete- time filtering of continuous–time signals. How specifications for a discrete-time filter is determined. Explain with suitable graph for a low pass filter. | **07** |
| | **(b)** | Describe the design of discrete-time IIR filters using bilinear transformation method. | **07** |

**OR**

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|---|---|---|---|
| **Q.5** | **(a)** | Explain the design of low pass FIR filter using Kaiser window method. | **07** |
| | **(b)** | Compare the commonly used windowing techniques for FIR filter design. | **07** |

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