

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-VII • EXAMINATION – WINTER • 2014

Subject Code: 170804**Date: 27-11-2014****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) Prove that LTI system is stable if its impulse response is absolutely summable. Determine the range of values of parameter 'a' for which the LTI system with impulse response $h(n) = a^n u(n)$ is stable. **07**

(b) Determine impulse response and step response of a causal and stable LTI system described by second-order difference equation **07**

$$y(n) - \frac{1}{12}y(n-1) - \frac{1}{12}y(n-2) = x(n)$$

Q.2 (a) Explain following properties of Z transform. **07**

(i) Time shifting (ii) Differentiation

(b) Using long division determine the inverse z-transform of the following: **07**

$$X(z) = \frac{1}{1 - \frac{3}{2}z^{-1} + \frac{1}{2}z^{-2}} \quad \text{when ROC: } |z| > 1$$

OR

(b) Using partial-fraction expansion find the inverse z-transform of the following: **07**

$$X(z) = \frac{1 - \frac{1}{2}z^{-1}}{1 - \frac{1}{4}z^{-2}} \quad |z| > \frac{1}{2}$$

Q.3 (a) Determine z-transform and ROC of the following sequences **07**

(i) $x(n) = [3(2^n) - 4(3^n)]u(n)$

(ii) $x(n) = (-1)^n 2^{-n} u(n)$

(b) Determine DTFT of the sequences given by **07**

(i) $x(n) = u(n) - u(n-6)$

(ii) $x(n) = a^n u(n)$

OR

Q.3 (a) Explain following properties of discrete time Fourier transform. **07**

(i) Convolution (ii) frequency differentiation

(b) Perform the circular convolution of two sequences. **07**

$x_1(n) = \{1, 1, 2, 2\}$ $x_2(n) = \{1, 2, 3, 4\}$

Q.4 (a) Derive the DFT of the sample data sequence $x(n) = \{1, 1, 2, 2, 3, 3\}$. **07**

(b) Explain decimation-in-time Radix-2 FFT algorithm. **07**

OR

Q.4 (a) Determine IDFT of $X(k) = \{1, 2, 3, 4\}$ **07**

(b) Explain Divide and Conquer Approach to Computation of the DFT. **07**

- Q.5 (a)** What are different specifications required to design a low pass IIR digital filter? **07**
Compare IIR digital filter design using the Butterworth and Chebyshev approximations.
- (b)** Explain Frequency Sampling method for FIR digital filter design. **07**
- OR**
- Q.5 (a)** Describe the design of discrete-time IIR filters using bilinear transformation method. **07**
- (b)** Compare the commonly used windowing techniques for FIR filter design. **07**
