Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- VIIth SEMESTER–EXAMINATION – MAY/JUNE- 2012

Subject code: 170804 Date: 28/05/2012

Subject Name: Discrete Time Signal Processing

Time: 02:30 pm – 05:00 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)** Define the impulse response h(t) of a continuous-time LTI system. Explain some properties of Continuous-Time LTI Systems. **07**

(b) Defines the convolution of two continuous-time signals x(t) and h(t). The input x(t) and the impulse response h(t) of a continuous time LTI system are given by **07**

$x(t) = u(t) \qquad h(t) = e^{-\alpha t}u(t), \alpha > 0$

Compute the output y(t) using linear convolution theorem.

Q.2 **(a)** For a general discrete-time signal x[n], define the z-transform X(z). Consider the sequence **07**

$x[n] = a^n u[n] \qquad a$ real and $0 < 1 < a$.

Find out it z-transform X(z) and plot its ROC.

(b) What do you mean by the Region of Convergence of z-transform X(z)? What are the Properties of the ROC of X(z). **07**

OR

(b) Find the z-transform of (a) $x[n] = -a^n u[-n-1]$ and plot its ROC. **07**

Q.3 **(a)** Define the discrete Fourier series representation of a periodic sequence x[n] with fundamental period N_0 and explain the properties of Discrete Fourier Series. **07**

(b) Write equations for the Fourier transform X(Ω) of a non-periodic sequence x[n] and its inverse Fourier transform x[n]. What is the condition for the convergence of X(Ω). **07**

OR

Q.3 **(a)** What are the properties of the Fourier transform X(Ω)? Explain any two of them. **07**

(b) Find the inverse Fourier transform x[n] of the rectangular pulse spectrum X(Ω) defined by **07**

$$X(\Omega) = \begin{cases} 1 & |\Omega| \le W \\ 0 & W < |\Omega| \le \pi \end{cases}$$

and Plot x[n] for $W = \pi/4$.

Q.4 **(a)** Verify the time-shifting property of DFT: **07**

$$x[n - n_0] \leftrightarrow e^{-j\Omega n_0}X(\Omega)$$

(b) Consider the sequence x[n] defined by **07**

$$x[n] = \begin{cases} 1 & |n| \leq 2 \\ 0 & \text{otherwise} \end{cases}$$

Sketch x[n] and its Fourier transform X(Ω).

OR

Q.4 **(a)** What is frequency domain sampling? What is the condition for avoiding aliasing for the reconstructed spectrum of the sampled sequence? **07**

Q.4 **(b)** Explain Divide and Conquer Approach to Computation of the DFT. **07**

Q.5 **(a)** A causal discrete-time LTI system is described by **07**

$$y[n] - \frac{3}{4}y[n-1] + \frac{1}{8}y[n-2] = x[n]$$

where x[n] and y[n] are the input and output of the system, respectively. Determine the frequency response H(Ω) of the system.

(b) Consider a causal discrete-time FIR filter described by the impulse response **07**

$$h[n] = \{2, 2, -2, -2\}$$

Sketch the impulse response h[n], frequency response H(Ω), the magnitude response |H(Ω)| and the phase response θ(Ω) of the filter.

OR

Q.5 **(a)** What is Fast Fourier Transform (FFT)? Write its advantages and disadvantages over direct computation of the DFT. **07**

(b) What is IIR filter? Explain techniques of IIR filter design. **07**

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