Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. VIIth Semester–Examination – Nov- 2011

Subject code: 170804
Subject Name: DiscreteTime Signal Processing

Date:26/11/2011 **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)** Define the following properties of a system: (i) Stability (ii) Causality (iii) Linearity (iv) Time invariant, and (v) System with and without memory. **07**

(b) Compute the impulse response of the system described by the difference equation: y[n] – 1.5 y[n-1] = 0.5x[n]. {consider initial rest condition and x[n] = δ[n] } **07**

Q.2 **(a)** Compute the Z-Transform of the following sequences and determine the corresponding region of convergence: $x(n) = (0.5)^n u(n)$ and plot its ROC. **07**

(b) Using the power series expansion technique, find the inverse *z*-transform of the following *X*(*z*): **07**

$$X(z) = \frac{1}{1 - az^{-1}}, \qquad |z| > |a|$$

OR

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

$$X(z) = \frac{z}{2z^2 - 3z + 1} \qquad |z| < \frac{1}{2}$$

Q.3 **(a)** Explain the following properties of the Fourier Transform: (i) Linearity (ii) Frequency differentiation (iii) Multiplication in time (iv) Time shifting **07**

(b) Find the Fourier transform of the rectangular pulse sequence: $x[n] = u[n] - u[n - N]$ **07**

OR

Q.3 **(a)** How DFT is used in linear filtering? By means of the DFT and IDFT, determine the response of the FIR filter with impulse response; h(n) = (**1**, 2,3) to the input sequence x(n) = (**1**,2,2,1). **07**

(b) 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 (a) Determine the frequency response $H(\Omega)$ of the system and (b) Find the impulse response $h[n]$ of the system.

Q.4 **(a)** Compare the computational complexity of direct computation of DFT over FFT. Write different methods of FFT algorithm. **07**

(b) Explain Radix- 2 FFT Algorithm. Why it is called decimation-in-time algorithm. **07**

OR

Q.4 **(a)** Using linear transformation method compute the DFT of the four-point sequence, x(n) = (**0** 1 2 3). **07**

(b) What is the difference between linear convolution and circular convolution? Perform the circular convolution on the two sequences $x_1(n)$ = (1, 2, 1) and $x_2(n)$ = (1, 2, 3). **07**

Q.5 **(a)** What do you understand by FIR digital filter? Explain in brief FIR digital filter design using windowing techniques. **07**

(b) What are different specifications required to design a low pass IIR digital filter? Compare IIR digital filter design using the Butterworth and Chebyshev approximations. **07**

OR

Q.5 **(a)** Write transfer function for FIR digital filter. Why FIR digital filters can have an exact linear phase? Explain. **07**

(b) Explain Impulse Invariance and bilinear transformation techniques of IIR filter design. **07**

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