

GUJARAT TECHNOLOGICAL UNIVERSITY
ME Semester –II Examination Dec. - 2011

Subject code: 1720702

Date: 12/12/2011

Subject Name: Digital 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) Explain the term linearity, causality, stability, time invariance with respect to discrete time systems. Give example of each with explanation. **07**

(b) Determine the impulse response of system described by the second order difference equation **07**
 $y(n) - 4y(n-1) + 4y(n-2) = x(n) - x(n-1)$.

Q.2 (a) Define and explain the terms (i) cross correlation and (ii) autocorrelation of discrete sequences. Also obtain cross correlation of the following sequences **07**

$$x_1(n) = \{ \dots, 0, 0, 2, -1, 3, 7, 1, 2, -3, 0, 0, \dots \}$$

↑

$$\text{and } x_2(n) = \{ \dots, 0, 0, 1, -1, 2, -2, 4, 1, -2, 5, 0, 0, \dots \}$$

↑

(b) Define z-transform. Explain and prove the following properties of Z-transform. (1) Time shifting (2) Time reversal. **07**

OR

(b) Determine Z-transform and ROC of following signals. **07**

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

(b) $x(n) = (1/2)^n u(n)$.

Q.3 (a) Determine inverse Z-transform by partial fraction expansion method. **07**

$$X(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$$

If (a) ROC: $|z| > 1$ (b) ROC: $|z| < 0.5$ (c) ROC: $0.5 < |z| < 1$

(b) A linear time-invariant system is characterized by the system function **07**

$$H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$

Specify the ROC of $H(z)$ and determine $h(n)$ for following conditions:

- (a) The system is stable .
- (b) The system is causal.
- (c) The system is anticausal.

OR

- Q.3** (a) Explain lattice ladder structure for FIR filters. **07**
(b) Determine the direct form II realization for each of the following LTI systems. **07**
(a) $2y(n) + y(n - 1) - 4y(n - 3) = x(n) + 3x(n - 5)$
(b) $y(n) = x(n) - x(n - 1) + 2x(n - 2) - 3x(n - 4)$

- Q.4** (a) Describe fully Radix-2 DIF FFT algorithm. Write necessary equations and draw the flow diagram for $N = 8$ **07**
(b) By means of the DFT and IDFT, determine the response of the FIR filter with impulse response $h(n) = \{1, 2, 3\}$ **07**
To the input sequence $x(n) = \{1, 2, 2, 1\}$ $\uparrow$

OR

- Q.4** (a) Explain the differences between FIR and IIR Filters and mention their advantages and disadvantages. **07**
(b) Convert the analog filter with the system function **07**

$$H(s) = \frac{s + 0.1}{(s + 0.1)^2 + 16}$$

Into a digital filter by means of the bilinear transformation.
The digital filter is to have a resonant frequency of $\omega_r = \pi/2$.

- Q.5** (a) Perform the circular convolution of following two sequences: $x_1(n) = \{2, 1, 2, 1\}$ & $x_2(n) = \{1, 2, 3, 4\}$ **07**
 $\uparrow \qquad \qquad \qquad \uparrow$
(b) Explain Comb filter. **07**

OR

- Q.5** (a) Explain architecture of general purpose digital signal processor. **07**
(b) Explain the application of DSP in voice processing. **07**
