

**B. Tech Degree VI Semester Examination, April 2009****CS/EI/EE 601 DIGITAL SIGNAL PROCESSING**  
(2002 Scheme)

Time : 3 Hours

Maximum Marks : 100

- I. (a) Determine the zero-input response of the linear time invariant discrete time system described by the difference equation  

$$y(k+2) - 0.6y(k+1) - 0.16y(k) = 5x(k+2), \text{ with}$$

$$y(-1) = 0, y(-2) = \frac{25}{4}, y(k) \text{ denote the o/p and } x(k) \text{ denote the input.} \quad (10)$$

- (b) Use z - transform to perform the convolution of the following two sequences.

$$h(n) = \begin{cases} \left(\frac{1}{2}\right)^n & 0 \leq n \leq 2 \\ 0 & \text{else} \end{cases}$$

$$x(n) = \delta(n) + \delta(n-1) + 4\delta(n-2). \quad (10)$$

**OR**

- II. (a) Consider a system whose output  $y(n)$  is related to the input  $x(n)$  by

$$y(n) = \sum_{k=-\alpha}^{\alpha} x(k)x(n+k). \text{ Determine whether the system is}$$

- (i) Linear (ii) Shift invariant  
 (iii) Stable (iv) Causal (10)

- (b) Prove (i) Commutative property (10)  
 (ii) Distributive property of convolution. (10)

- III. (a) Discuss the circular shift property of DFT. (5)

- (b)  $G(k)$  and  $H(k)$  are 6 point DFT of the sequences  $g(n)$  and  $h(n)$  respectively.

The DFT of  $G(k)$  is given as

$$G(k) = \{1 + j, -2.1 + j3.2, -1.2 - j2.4, 0, 0.9 + j3.1, -0.3 + j1.1\}$$

The sequences  $g(n)$  and  $h(n)$  are related by the circular time shift as

$$h(n) = g[\langle n - n \rangle_N]. \text{ Determine } H(k) \text{ without computing DFT.} \quad (15)$$

**OR**

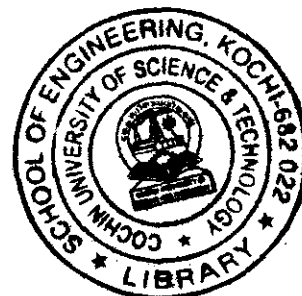
- IV. (a) Discuss the Linearity and Conjugate Symmetry property of DFT. (5)

- (b) First five points of the eight point DFT of a real valued sequence is given by

$$X[0] = 0, X[1] = 2 + j2, X[2] = -j4, X[3] = 2 - j2, X[4] = 0.$$

Determine the remaining points. Hence find the original sequence  $x(n)$  using DIFFFT algorithm. Also draw the butterfly diagram. (15)

(Turn Over)



- V. (a) Obtain the direct form and cascade form realization of the transfer function for an FIR system given by  $H(z) = \left(1 - \frac{1}{4}z^{-1} + \frac{3}{8}z^{-2}\right) \left(1 - \frac{1}{8}z^{-1} - \frac{1}{2}z^{-2}\right)$ . (10)
- (b) What is Gibb's Phenomenon? What is the principle of designing FIR filter using windows? Write the equation for any four window function. (10)
- OR**
- VI. (a) Discuss the Fourier series method of designing FIR Filters. (5)
- (b) Design an FIR HPF with the frequency response
- $$H_d(e^{j\omega}) = 1 \quad \text{for } \frac{-\pi}{4} \leq \omega \leq \pi$$
- $$= 0 \quad \text{for } |\omega| \leq \pi/4$$
- Using Hanning Window. Take  $N = 11$ . (15)
- VII. (a) Obtain the direct form I and II for the second order IIR Filter given by  $y(n) = 2b \cos \omega_0 y(n-1) - b^2 y(n-2) + x(n) - b \cos \omega_0 x(n-1)$ . (10)
- (b) For the analog Transfer function  $H(s) = \frac{2}{(s+1)(s+2)}$ , determine  $H(z)$  using impulse invariance method. Assume  $T = 1$  second. (10)
- OR**
- VIII. (a) Explain bilinear transformation. (5)
- (b) Design a digital butter worth IIR filter satisfying the specification.
- $$0.707 \leq |H(e^{j\omega})| \leq 1 \quad \text{for } 0 \leq \omega \leq \pi/2$$
- $$|H(e^{j\omega})| \leq 0.2 \quad \text{for } \frac{3\pi}{2} \leq \omega \leq \pi$$
- with  $T = 1$  sec. Using bilinear transformation and realize the filter in direct form II. (15)
- IX. (a) Explain fixed point arithmetic and floating point arithmetic. (10)
- (b) Discuss the coefficient quantization effects in direct form realization of IIR filter. (10)
- OR**
- X. (a) List the features of DSP processor. (5)
- (b) Explain the architecture of a typical DSP processor with a neat diagram. (15)

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