

QP Code : MV-19989

(3 Hours)

[ Total Marks : 100

- N.B. (1) Question No. 1 is compulsory.  
 (2) Out of remaining questions attempt any four questions.  
 (3) In all five questions to be attempted.  
 (4) Figures to the right indicate full marks.

1. (a) Obtain a digital filter transfer function  $H(\omega)$  by applying Impulse invariance transformation on the analog TF. 5

$$H_a(s) = \frac{s}{s^2 + 3s + 2}. \text{ Use } f_s = 1 \text{ K samples/sec.}$$

- (b) Consider a filter with TF : 5  
 $H(z) = (z^{-1} - a) / (1 - a z^{-1})$   
 Identify the type of filter and justify it.
- (c) Find the number of complex multiplications and complex additions required to find DFT for 32 point sequence. Compare them with the number of computations required if FFT algorithm is used. 5
- (d) Consider the sequence  $x(n) = \delta(n) + 2\delta(n - 2) + \delta(n - 3)$ . 5  
 Find DFT of  $x(n)$ .

2. (a) A sequence is given as  $x(n) = \{1 + 2j, 1 + 3j, 2 + 4j, 2 + 2j\}$  6  
 (i) Find  $X(k)$  using DIT-FFT algorithm.  
 (ii) Using the results in (i) and not otherwise find DFT of  $p(n)$  and  $q(n)$  where

$$p(n) = \{1, 1, 2, 2\}$$

$$q(n) = \{2, 3, 4, 2\}$$

- (b)  $X(K) = \{36, -4 + j9.656, -4 + j4, -4 + j1.656, -4, -4 - j1.656, -4 - j4, -4 - j9.656\}$  10  
 Find  $x(n)$  using IFFT algorithm (use DIT IFFT).  
 (c) Explain the properties of symmetricity and periodicity of phase factor. 4

3. (a) By means of FFT-IFFT method (DIT algo) compute Circular convolution of 8  
 $x(n) = \{2, 1, 2, 1\}$      $h(n) = \{1, 2, 3, 4\}$
- (b) An 8 point sequence  $x(n) = \{1, 2, 3, 4, 5, 6, 7, 8\}$   
 (i) Find  $X(K)$  using DIF FFT algorithm. 5  
 (ii) Let  $x_1(n) = \{5, 6, 7, 8, 1, 2, 3, 4\}$  Using appropriate DFT property and answer of previous part, determine  $X_1(K)$ . 5  
 (iii) Again use DFT property and find  $X_2(K)$  where  $x_2(n) = x(n) + x_1(n)$ . 2

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4. (a) Draw the Lattice filter realization for the all pole filter 10

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

- (b) Obtain DF-I, DF-II, cascade (first order sections) and parallel (first order sections) 10  
structures for the system described by

$$y(n) = -0.1 y(n-1) + 0.72 y(n-2) + 0.7 x(n) - 0.252 x(n-1).$$

5. (a) Design a FIR low pass digital filter using Hamming window for  $N = 7$  10

$$H_d(e^{j\omega}) = e^{-3j\omega} \quad -0.75\pi \leq \omega \leq 0.75\pi$$

$$= 0 \quad 0.75\pi \leq |\omega| \leq \pi$$

- (b) A LPF has following specifications :— 10

$$0.8 \leq |H(\omega)| \leq 1 \quad \text{for } 0 \leq \omega \leq 0.2\pi$$

$$|H(\omega)| \leq 0.2 \quad \text{for } 0.6\pi \leq \omega \leq \pi$$

Find filter order and analog cut off frequency if

- (i) Bilinear transformation is used for designing  
(ii) Impulse invariance is used for designing.

6. (a) Explain up sampling by an integer factor with neat diagram and waveforms. 10

- (b) Explain the need of a low pass filter with a decimator and mathematically prove 10  
that  $\omega_y = \omega_x D$ .

7. Write notes on any four of the following :— 20

- (a) Frequency sampling realization of FIR filters  
(b) Goertzel algorithm  
(c) Set top box for digital TV reception  
(d) Adaptive echo cancellation  
(e) Filter banks.
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