

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) structures for the system described by 10

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

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

$$H_d(e^{j\omega}) = \begin{cases} e^{-3j\omega} & -0.75\pi \leq \omega \leq 0.75\pi \\ 0 & 0.75\pi \leq |\omega| \leq \pi \end{cases}$$

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

$$\begin{aligned} 0.8 \leq |H(\omega)| \leq 1 & \quad \text{for } 0 \leq \omega \leq 0.2\pi \\ |H(\omega)| \leq 0.2 & \quad \text{for } 0.6\pi \leq \omega \leq \pi \end{aligned}$$

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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