

BT-6/J07

Digital Signal Processing (2005-06)

Paper : II ECE-306 E

Option : II

Time : Three Hours]

[Maximum Marks : 100

Note : Attempt any FIVE questions.

1. (a) Compute the unit step response of the system with impulse response

$$h(n) = \begin{cases} 3^n, & n < 0 \\ \left(\frac{2}{5}\right)^n, & n \geq 0 \end{cases} \quad 10$$

- (b) Determine the z-transform of $x(n) = a^{|n|} \sin \omega_0 n$, $|a| < 1$.
Also sketch its pole-zero pattern. 10

2. (a) Explain the properties of DFT. 8

- (b) Determine the 8-point DFT of the sequence

$$x(n) = \{0, 1, 2, 3, 4, 3, 2, 1\}$$

using DIF-FFT algorithm. 12

3. (a) Obtain Direct form-I, Direct-II, Cascade and Parallel form structure for the following system

$$H(z) = \frac{2(1 - z^{-1})(1 + \sqrt{2}z^{-1} + z^{-2})}{(1 + 0.5z^{-1})(1 - 0.9z^{-1} + 0.81z^{-2})} \quad 10$$

- (b) Sketch lattice ladder structure for the system

$$H(z) = \frac{1 - 0.8z^{-1} + 0.15z^{-2}}{1 + 0.1z^{-1} - 0.72z^{-2}} \quad 10$$

4. (a) Consider an FIR lattice filter with coefficients $K_1 = 0.65, K_2 = -0.34$ and $K_3 = 0.8$.

- (i) Find its impulse response by tracing a unit impulse input through the lattice structure.

- (ii) Draw the equivalent Direct form structure. 12

- (b) Explain Direct form, Cascade and transposed form structures for FIR filters. 8

5. (a) Show that FIR filters are always stable. 3

- (b) Determine the coefficients $\{h(n)\}$ of a linear phase FIR filter of length $M = 15$, which has a symmetric unit sample response and a frequency response that satisfies the condition

$$H_r\left(\frac{2\pi K}{15}\right) = \begin{cases} 1, & K = 0, 1, 2, 3 \\ 0, & K = 4, 5, 6, 7 \end{cases}$$

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6. (a) Explain design of optimum equiripple FIR filters. 14
(b) Explain windowing technique. 6
7. Determine the system function $H(z)$ or lowest order Chebyshev digital filter that meets the following specifications :
(i) $\frac{1}{2}$ - dB ripple in passband, $0 \leq |\omega| \leq 0.24\pi$
(ii) At least 50 dB attenuation in the stopband $0.35\pi \leq |\omega| \leq \pi$.
Use Bilinear transformation. 20
8. Write short notes on any TWO of the following :
(a) Goertzel algorithm
(b) Applications of FFT algorithm
(c) Overlap add and overlap save method. 20

