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BT-6/M-19 **36011**

DIGITAL SIGNAL PROCESSING

ECE-306E (Opt. I)

Time : Three Hours] [Maximum Marks : 100

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit.

Unit I

1. (a) Explain the Schur Cohn Stability Test. 7

(b) Using the method of residue find the inverse Z-transform of :

$$X(z) = \frac{1}{(z-0.25)(z-0.5)}, \text{ ROC} : |z| 0.5 \quad 8$$

(c) Differentiate between minimum phase and maximum phase systems. 5

2. (a) Define DFT and explain its properties. 10

(b) Compute the circular convolution of $x_1(n) = \{1, 1, 2, 2\}$ and $x_2 = \{1, 2, 3, 4\}$ using DFT and IDFT. 10

Unit II

3. (a) Determine the Direct forms I and II realisations for a third order IIR transfer function given as : **10**

$$H(z) = \frac{0.28z^2 + 0.319z + 0.04}{0.5z^3 + 0.3z^2 + 0.17z - 0.2}$$

(b) Explain direct form, cascade form and transposed form structures for FIR filter. **10**

4. (a) For the system given as :

$$H(z) = \frac{2 + 8z^{-1} + 6z^{-2}}{1 + 8z^{-1} + 12z^{-2}}$$

Realize using Ladder structure. **10**

(b) Realise a system defined by the following state space equations :

$$\begin{bmatrix} r_1(n+1) \\ r_2(n+2 \end{bmatrix} = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} r_1(n) \\ r_2(n) \end{bmatrix} + \begin{bmatrix} 4 \\ 6 \end{bmatrix} x(n)$$ **10**

Unit III

5. (a) Compare the frequency domain characteristics of different types of window functions. **10**

(b) A filter is to be designed with the following desired frequency response :

$$H_d\left(e^{j\omega}\right) = \begin{cases} 0, & -\frac{\pi}{4} \le \omega \le \frac{\pi}{4} \\ e^{-2j\omega}, & -\frac{\pi}{4} < |w| < \pi \end{cases}$$

Determine the filter coefficients $h_d(n)$ if the window function is defined as :

$$\omega(n) = \begin{cases} 1, & 0 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}$$

Also determine the frequency response $H\left(e^{j\omega}\right)$ of the designed filter. **10**

6. (a) Explain about the frequency response of linear phase FIR filters with necessary expressions. **10**

(b) Explain Fourier series method FIR filter design. **10**

Unit IV

7. (a) Explain impulse invariant method of IIR filters design. **10**

(b) Convert the analog filter with system function :

$$H(s) = \frac{(s+0.1)}{(s+0.1)^2 + 9}$$

in to a digital IIR filter using bilinear transformation. The digital filter should have a resonant frequency of $\omega_r = \frac{\pi}{4}$. 10

8. (a) Define frequency transformation. Compare analog and digital frequency transformation. 10

(b) Explain the essential characteristics of Elliptic filters. 5

(c) Describe in brief the characteristics of inverse Chebyshev Filter. 5