Roll No. ..... Total No. of Pages : 3

BT6/M05 9080

Digital Signal Processing

Paper : ECT-306

Time : Three Hours] [Maximum Marks : 75

Note :— Solve any **FIVE** questions. Question No. **9** is compulsory. Remaining **FOUR** questions should be solved by selecting only **ONE** question from each of the **FOUR** different sections.

SECTION—I

1. (a) Determine the Z-Transform of the following signal and sketch the corresponding pole-zero pattern

$$x(n) = \frac{1}{2}(n^2 + n)\left(\frac{1}{3}\right)^{n-1} u(n-1). \quad 9$$

(b) A digital filter is characterized by the transfer function

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

Check the stability using Jury-Marden criterion. 6

2. (a) Compute 8-point DFT of the sequence $x(n) = \{1, 2, 3, 4, 5, 6, 7, 8\}$ using the radix – 2 DIT-FFT algorithm. 12

(b) Explain 'In place computation' and 'Bit reversal' in context of FFT algorithm. 3

SECTION—II

3. (a) Obtain Direct form-I, Direct form-II, Cascade and parallel structures for the following system :

$y(n) = -0{\cdot}1\, y(n-1) + 0{\cdot}2\, y(n-2) + 3x(n) + 3{\cdot}6x(n-1) + 0{\cdot}6\, x(n-2)$. 8

(b) Determine the lattice structure for the FIR filter with system function

$$H(z) = 1 + \frac{13}{24} z^{-1} + \frac{5}{8} z^{-2} + \frac{1}{3} z^{-3}. \quad 7$$

4. Consider a causal IIR system with system function :

$$H(z) = \frac{1 + 2z^{-1} + 3z^{-2} + 2z^{-3}}{1 + 0{\cdot}9z^{-1} - 0{\cdot}8z^{-2} + 0{\cdot}5z^{-3}}$$

(i) Determine the equivalent lattice-ladder structure.

(ii) Check if the system is stable. 15

SECTION—III

5. Design a 25 tap causal linear phase low pass FIR filter with cutoff frequency of $\pi/4$, using Hann window. 15

6. Determine the coefficient 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

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

SECTION—IV

7. Design a low pass filter with a passband magnitude characteristic that is constant to within 0·75 dB for frequencies below $w = 0{\cdot}2613\pi$ and stopband attenuation of atleast 20dB for frequencies between $w = 0{\cdot}4018\pi$. and $w = \pi$. Obtain the order of filter and poles of Chebyshev filter using BZT. 15

8. Determine the order and poles of Lowpass Butterworth filter having equiripple low pass characteristics within 1 dB cut off frequency at 2 kHz and minimum attenuation of 40 dB at 6 kHz using impulse invariance technique. 15

Compulsory Question

9. Explain :

(a) Goertzel algorithm

(b) Equivalent structures

(c) Gibb's phenomenon

(d) Bilinear Z-transformation.