BT-6/M05

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

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

$$y(n)=-0.1y(n-1)+0.2y(n-2)+3x(n)+3.6x(n-1)+0.6x(n-2).$$ 8

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

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

4. Consider a causal IIR system with system function :

$$H(z)=\frac{1+2z^{-1}+3z^{-2}+2z^{-3}}{1+0.9z^{-1}+0.8z^{-2}+0.5z^{-3}}$$

(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

$$H_r\left(\frac{2\pi k}{15}\right)=\begin{cases}1, & k=0,1,2,3\\ 0, & k=4,5,6,7\end{cases}$$ 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 $w = 0.2613\pi$ and stopband attenuation of at least 20dB for frequencies between $w = 0.4018\pi$ 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 4
   (b) Equivalent structures 3
   (c) Gibb's phenomenon 4
   (d) Bilinear Z-transformation. 4