BT–6/J07

Digital Signal Processing

Paper : ECT-306

Option : II

Time : Three Hours] [Maximum Marks : 75

Note : Attempt **FIVE** questions in all, selecting **ONE** question from each section. Q. No. 9 is compulsory.

SECTION—I

1. (a) A digital filter is characgterised by the transfer function :

$$H(z)=\frac{1+2z^{-1}+3z^{-2}+2z^{-3}}{1+0\cdot9z^{-1}-0\cdot8z^{-2}+0\cdot5z^{-3}}$$

check the stability of the filter using Jury-Marden stability criteria. 7

(b) Determine the causal signal x(n) if its z-transform, X(z) is given by :

$$X(z)=\frac{1-az^{-1}}{z^{-1}-a}$$

8

2. (a) Determine 8-point DFT of the sequence x(n) = {0, 1, 2, 2, 3, 4, 5, 6} using Radix-2, DIT-FFT algorithm. 12

(b) Explain bit-reversal in context of FFT algorithms. 3

SECTION—II

3. (a) A FIR filter is given by the difference equation :

$$y(n)=2x(n)+\frac{4}{5}x(n-1)+\frac{3}{2}x(n-2)+\frac{2}{3}x(n-3)$$

determine its lattice form. 9

(b) Obtain Direct form-I, Direct form-II and cascade form structures for the following system :

$$H(z)=\frac{2(1-z^{-1})(1+\sqrt{2}z^{-1}+z^{-2})}{(1+0\cdot5z^{-1})(1-0\cdot9z^{-1}+0\cdot81z^{-2})}$$

6

4. (a) Sketch the lattice-ladder structure for the system :

$$H(z)=\frac{1-0\cdot8z^{-1}+0\cdot15z^{-2}}{1+0\cdot1z^{-1}-0\cdot72z^{-2}}$$

and also check the stability. 9

(b) Explain Frequency Sampling Structure. 6

SECTION—III

5. (a) Show that FIR filters are always stable filters. 3
   (b) Design a linear phase low pass FIR filter with 10 coefficients, whose cut-off frequency is 200 Hz. Assume sampling frequency = 2 kHz. 12

6. Determine the coefficients {h(n)} of a linear-pase FIR filter of length M = 15, which has a symmetric unit sample 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. Determine the system function H(z) of the lowest order Chebyshev digital filter that meets the following specifications :
   (i) 1/2 dB ripple in passband, $0 \le |\omega| \le 0{\cdot}24\pi$
   (ii) At least 40 dB attenuation in the stopband $0{\cdot}35\pi \le |\omega| \le \pi$.
   Use the Bilinear transformation. 15

8. Explain design of IIR filters in frequency domain. 15

Compulsory question

9. (i) Alternation theorem 3
   (ii) Impulse Invarient technique 4
   (iii) All-pass filters 3
   (iv) Transposed form structures. 5