

Discrete Time Signal Processing.

Nov. 1 Pr. 153
Con. 5115-06.

(REVISED COURSE)

YM-5929

(3 Hours)

[Total Marks : 100

- N.B. (1) Question No. 1 is compulsory.
(2) Attempt any four questions out of remaining six.
(3) Assume suitable data if necessary.

1. (a) Frequency Response of FIR filter is—
 $H(e^{j\omega}) = e^{-j3\omega} (2 + 1.8 \cos 3\omega + 1.2 \cos 2\omega + 0.5 \cos \omega)$
 Find—
 (i) Impulse Response. 4
 (ii) Identify filter type based on passband. 2
 (b) $x_1(n) = \{ 1, 2, 3, 4 \}$ and $x_2(n) = \{ 5, 6, 7, 8 \}$ 6
 Find $x_1(k)$ and $x_2(k)$ of above sequence by computing DFT only once.
 (c) Find number of Real additions and Real multiplications required to find DFT for 32-point signal. 4
 Compare them with number of computations required if FFT algorithm is used.
 (d) One of the zeros of antisymmetric FIR filter is at $0.5 \angle 60^\circ$. Show locations of other zeros. What is minimum order of this filter? 4

2. (a) An FIR Filter is described by difference equation— 10
 $y(n) = x(n) + x(n-10)$
 (i) Compute and sketch its magnitude and phase response.
 (ii) Determine response to the input—

$$x(n) = 10 + 5 \cos \left(\frac{2\pi}{5} n + \frac{\pi}{2} \right) - \infty < n < \infty$$

- (b) The desired frequency response of LPF is — 10

$$H_d(e^{j\omega}) = e^{-3j\omega} \quad \text{for} \quad \frac{-3\pi}{4} \leq \omega \leq \frac{3\pi}{4}$$

$$= 0 \quad \frac{3\pi}{4} < |\omega| < \pi$$

Determine $H(e^{j\omega})$ for $M = 7$ using Hamming Window.

3. (a) $x(n) = \{ 1, 2, 3, 1 \}$. Find DFT $X(k)$ using $X(k)$ obtained above and not otherwise, find DFT of following sequences 3
 (i) $x_1(n) = \{ 1, 0, 2, 0, 3, 0, 1, 0 \}$ 3
 (ii) $x_2(n) = \{ 1, 2, 3, 1, 1, 2, 3, 1 \}$ 4
 (b) Develop DIT FFT algorithm for decomposing DFT for $N = 6$ and draw the flow graph. 10

4. (a) DT system has transfer function.

$$H(z) = \frac{1}{1 - 0.8z^{-1} + 0.12z^{-2}}$$

A four bit processor is used in which MSB represent sign bit and remaining 3 bits store quantized coefficients.

- (i) What is the effect of quantization on pole location if direct form II is used for realization. 4
 (ii) If Cascade form is used for realization, then what is the change in pole values, after quantization. 4
 (iii) In which case (direct/Cascade form) shift from actual pole locations due to quantization is less. 2

- (b) Find output of the system using circular convolution if input $x(n)$ and impulse response $h(n)$ are given by. Use DFT/IDFT method— 10

$$x(n) = n + 1 \quad ; \quad 0 \leq n \leq 3$$

$$= 0 \quad ; \quad \text{elsewhere}$$

$$h(n) = 2 \delta(n) + 3 \delta(n-1) + \delta(n-2)$$

5. (a) A digital Low pass filter is required to meet following specifications. 10

| | | |
|-----------------------|---|--------------|
| Passband Ripple | : | ≤ 1 dB |
| Passband Edge | : | 4 KHz |
| Stop band Attenuation | : | ≥ 40 dB |
| Stop band Edge | : | 6 KHz |
| Sample Rate | : | 24 KHz |

- (i) Determine order of Butterworth filter which meets above specifications.
 (ii) Determine cut of frequency of filter.

- (b) Using Trapezoidal rule of integration, 10

show that — $s = \frac{2}{T} \frac{1-z^{-1}}{1+z^{-1}}$ and $\Omega = \frac{2}{T} \tan \frac{\omega T}{2}$

6. (a) Consider a causal, LTI system—

$$H(z) = \frac{1 - \frac{1}{2}z^{-1}}{\left(1 - z^{-1} + \frac{3}{16}z^{-1}\right)\left(1 + \frac{1}{4}z^{-1}\right)}$$

Realize the system in each of the following forms.

- | | |
|--|---|
| (i) Direct form I | 4 |
| (ii) Direct form II | 4 |
| (iii) Cascade form | 4 |
| (iv) Parallel form | 4 |
| (b) Explain energy compaction capability of Discrete Cosine Transform. | 8 |
| 7. (a) Explain any one method of Linear filtering if input data sequence is long. | 8 |
| (b) Explain Architecture of TMS 32 C 5X series of processors with the help of block diagram. | 4 |
| (c) Compare DSP processors with general purpose processor. | |