Reg. No. :

Question Paper Code : 80532

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Fifth Semester

Electronics and Communication Engineering

EC 8553 – DISCRETE-TIME SIGNAL PROCESSING

(Common to : Biomedical Engineering/Computer and Communication Engineering/Electronics and Telecommunication Engineering/Medical Electronics)

(Regulations 2017)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Perform circular convolution of the following two sequences : $x(n) = \{1, 0, 1, 1\}$ and $h(n) = \{1, 1, 1\}$.

2. Calculate the number of additions and multiplications involved in Direct DFT and FFT Technique for a length $N = 128$.

3. Determine $H(z)$ using Impulse Invariant Technique for the following analog system function given by $H(S) = \frac{10}{S^2 + 7S + 10}$ for $T = 0.2$ Sec.

4. The first five points of the 8-point DFT of a real-valued sequence are 5, 1-j3, 0, 3-j4 and 3+j4. Find the remaining DFT co-efficients.

5. Give the conditions for impulse response of the FIR filter to have linear phase?

6. Define warping effect.

7. What do you mean by product round off error?

8. State the need of scaling is required in representing number?

9. List the classifications of digital signal processors.

10. Brief on the concept of pipelining.

PART B — (5 × 13 = 65 marks)

11. (a) Compute DFT of the given sequence using DIT FFT algorithm. (N = 8)

$x(n) = \cos\frac{n\pi}{2}$.

Or

(b) Develop radix-2 decimation in frequency FFT algorithm for evaluating the DFT for N = 16 and fully label it.

12. (a) Design a digital Butterworth filter for the following specifications using bilinear transformation :

$0.9 \le |H(j\omega)| \le 1$ for $0 \le \omega \le \frac{\pi}{2}$

$|H(j\omega)| \le 0.2$ for $\frac{3\pi}{4} \le \omega \le \pi$.

Or

(b) Design an analog Chebyshev low pass filter for the following specifications.

$\alpha_p = 3$ dB, $\alpha_s = 16$ dB, $f_p = 1$ kHz, $f_s = 2$ kHz.

13. (a) Design a Bandpass FIR Filter for $N = 7$, $\omega_{c_1} = 0.3$ radian, $\omega_{c_2} = 0.65$ radian using Hamming window. Compare it with Hanning window.

Or

(b) Use frequency sampling method to design a FIR lowpass filter with $\omega_c = \pi/4$, for $N = 15$. Plot the magnitude response.

14. (a) A signal set $x(n) = \{0.234, 0.789, 0.912, 0.133\}$ is convolved with an impulse response set $h(n) = \{0.7661, 0.9213, 0.2371, 0.5531\}$. If signal samples and coefficients are rounded off to the leading two higher order digits after decimal points. Assuming circular convolution, determine the round off error.

Or

(b) (i) Discuss the quantization noise with reference to the transfer characteristics of a quantizer. (6)

(ii) Derive the expression for quantization noise if the word length is B bits. (7)

15. (a) (i) Explain MAC operation and why it is implemented in programmable DSPs. (8)

(ii) How pipelining increases the throughput efficiency. (5)

Or

(b) Explain the functions of TMS320C50 Processor with neat diagram.

PART C — (1 × 15 = 15 marks)

16. (a) Use the bilinear transformation to design a discrete time Chebyshev HPF with an equiripple passband

$0 \le \left|H\left(e^{j\omega}\right)\right| \le 0.1, \qquad 0 \le \omega \le 0.1\pi$

$0.9 \le \left|H\left(e^{j\omega}\right)\right| \le 1.0, \qquad 0.3\pi \le \omega \le \pi$

Realize it with minimum no. of delay elements.

Or

(b) (i) Realize the Direct form structure for the FIR filter described by (8)

$H(z) = 1 + 2z^{-1} + 6z^{-2} + 4z^{-3} + 5z^{-4} + 8z^{-5}$

(ii) Realize the Linear phase structure for the FIR filter described by (7)

$$H(z) = \frac{1}{2} + \frac{1}{3}z^{-1} + z^{-2} + \frac{1}{4}z^{-3} + z^{-4} + \frac{1}{3}z^{-5} + \frac{1}{2}z^{-6}.$$

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