CBCS SCHEME

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15EE63

Sixth Semester B.E. Degree Examination, June/July 2023
Digital Signal Processing

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Find the 4-point DFT of a sequence :

$$x(n) = \begin{cases} 1 & \text{for} \quad 0 \le n \le 2 \\ 0 & \text{otherwise} \end{cases}$$

Hence verify the result by taking IDFT using linear transformation. **(08 Marks)**

b. State and prove the following properties of DFT :

i) Linearity

ii) Circular Time shift. **(08 Marks)**

OR

2 a. Using overlap save method, compute y(n) of FIR filter with impulse response h(n) = {1, 1, 1} and input x(n) = {1, 2, 0, –3, 4, 2, –1, 1, –2, 3, 2, 1, –3}. **(08 Marks)**

b. The first 5 points of the 8 point DFT of a real valued sequence are : {0.25, 0.125 – j0.3018, 0, 0.125 – j0.518, 0}. Determine remaining 3 points of the DFT. Estimate the value of x(0). **(04 Marks)**

c. Compare linear and circular convolution. **(04 Marks)**

Module-2

3 a. What is FFT? Determine the number of multiplications and additions required for direct computation of DFT versus the FFT algorithm for N = 128. **(04 Marks)**

b. Given the sequences $x_1(n)$ = {1, 2, 3, 4} and $x_2(n)$ = {4, 3, 2, 1}. Compute the circular convolution for N = 4 by using DIT – FFT algorithm. **(12 Marks)**

OR

4 a. Find the DFT of x(n) = {2, 1, 2, 1, 1, 2, 1, 2} using the DIF – FFT algorithm. **(08 Marks)**

b. Develop a decimation in time algorithm for evaluating the DFT for N = 6. **(08 Marks)**

Module-3

5 a. For the given specifications K_P = 3dB ; K_g = 15dB; Ω_P = 1000rad/sec; Ω_S = 500rad/sec. Design analog Butterworth high pass filter. **(08 Marks)**

b. The system function of an analog filer is given as $H_a(s) = \dfrac{1}{(s+1)(s+2)}$, obtain H(z) using impulse invariant method. Take sampling frequency of 5 samples/sec. **(08 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

6 a. Design a Chebyshev filter to meet the following specifications :
i) pass band ripple : ≤ 2db
ii) pass band edge : 1rad/sec
iii) stop band attenuation : ≥ 20db
iv) stop band edge : 1.3rad/sec. **(10 Marks)**

b. Convert the analog filter into a digital filter into a digital filter whose system function is $H(s) = \dfrac{2}{(s+1)(s+3)}$ using bilinear transformation with $T = 0.1$sec. **(06 Marks)**

Module-4

7 a. Design the digital filter using Chebyshev approximation and bilinear transformation to meet the following specifications :
Pass band ripple = 1dB for $0 \leq \omega \leq 0.15\pi$
Stop band attenuation $\geq$ 20dB for $0.45\pi \leq \omega \leq \pi$. **(12 Marks)**

b. Realize the following system function in cascade form :

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

(04 Marks)

OR

8 Obtain the direct form – I, direct form – II, cascade and parallel for the following system:
$y(n) = 0.75y(n-1) - 0.125y(n-2) + 6x(n) + 7x(n-1) + x(n-2)$. **(16 Marks)**

Module-5

9 a. What are the advantages and disadvantages with the design of FIR filters using window function? **(06 Marks)**

b. Design a FIR low pass filter with the frequency response, using rectangular window :

$$hd(\omega) = \begin{cases} e^{\frac{-j\omega_C (N-1)}{2}} & -\frac{\pi}{2} \leq \omega \leq \frac{\pi}{2} \\ 0 & \text{elsewhere} \end{cases}.$$

(10 Marks)

OR

10 a. Distinguish between FIR and IIR filters. **(04 Marks)**

b. Realize the FIR linear phase filter, with the impulse response,

$$h(n) = \delta(n) - \frac{1}{2}\delta(n-1) + \frac{1}{4}\delta(n-2) + \frac{1}{4}\delta(n-3) - \frac{1}{2}\delta(n-4) + \delta(n-5).$$

(06 Marks)

c. Explain why windows are necessary in FIR filter design. What are the different windows in practice? **(06 Marks)**

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