CBCS SCHEME

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18EE63

Sixth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Digital Signal Processing

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Find the DFT of the sequence $x(n) = \{1, 2, 2, 1\}$. **(05 Marks)**

b. Compute the N-point DFT of the sequence. $x(n) = a^n$ for $0 \le n \le N-1$. Also calculate if $x(n) = (0.5)^n u(n)$ for $0 \le n \le 3$. **(07 Marks)**

c. State and prove the following properties of DFT.
i) Periodicity ii) Circular frequency shift property. **(08 Marks)**

OR

2 a. Find the circular convolution of the sequences using DFT and IDFT method.
$x_1(n) = \{2, 1, 2, 1\}$ and $x_2(n) = \{1, 2, 3, 4\}$. **(08 Marks)**

b. Compare circular convolution and Linear convolution. **(03 Marks)**

c. Find the output y(n) of a filter where impulse response is $h(n) = \{1, 1, 1\}$ and the input signal to the filter is $x(n) = \{3, -1, 0, 1, 3, 2, 0, 1, 2, 1\}$ use overlap save method. Assume block length N = 6. **(09 Marks)**

Module-2

3 a. Define FFT. What are the advantages of FFT over DFT? **(05 Marks)**

b. Derive the algorithm for Radix – 2 DIT – FFT algorithm for N = 8. Also draw the signal flow graph for N = 8. **(10 Marks)**

c. Find the IDFT of the sequence
$x(k) = \{10, -2 + j2, -2, -2 - j2\}$ by using DIT-FFT algorithm. **(05 Marks)**

OR

4 a. Determine the DFT of the given data sequence by using DIF - FFT algorithm.
$x(n) = \{2, 1, 4, 6, 5, 8, 3, 9\}$. **(10 Marks)**

b. Given the sequence $x_1(n)$ and $x_2(n)$ as below, compute the circular convolution $x_1(n) \otimes_N x_2(n)$ for N = 4 use DIT – FFT algorithm. $x_1(n) = \{2, 1, 1, 2\}$ and $x_2(n) = \{1, -1, -1, 1\}$. **(10 Marks)**

Module-3

5 a. Design a Butterworth low pass filter to meet the following specifications.
i) Pass band gain = – 1dB
ii) Pass edge frequency = 4 rad/sec
iii) Stop band attenuation greater then or equal to 20 dB
iv) Stop band edge frequency = 8 rad/sec. **(10 Marks)**

b. Explain the steps to be followed for designing a low pass Chebyshev filter. **(05 Marks)**

c. What are the differences between IIR and FIR filter? **(05 Marks)**

OR

6 a. Design and Realize a digital low pas filter using Bilinear transformation method. Use the following specification.

i) Monotonic stop band and pass band

ii) –3 dB cut-off at 0.5 π radius

iii) – 15 dB attenuation at 0.75 π radians. Assume T = 1 Sec **(12 Marks)**

b. Design a Chebyshev analog low pass filter that has a –3 dB cut off frequency and 100 rad/sec and a stop band attenuation of 25 dB or greater for all radian frequencies past 250 rad/sec. **(08 Marks)**

Module-4

7 a. The transfer function of an analog filter given as $H_a(s) = \frac{1}{(s+1)(s+2)}$. Obtain H(z) using impulse invariant transformation method. Take sampling frequency of 5 samples/sec. **(10 Marks)**

b. Explain the designing of IIR filter using Bilinear Transformation technique. Also explain the mapping procedure from S-plane to Z-plane. **(10 Marks)**

OR

8 a. Find H(z) for the given analog system transfer function $H_a(S) = \frac{S+1}{S^2+5S+6}$. **(08 Marks)**

b. What are the differences between Butterworth filter and Chebyshev filter? **(04 Marks)**

c. Obtain the direct form – I and direct form – II realization for the system described by the difference equation. $y(n) - \frac{1}{2}y(n-1) - \frac{1}{3}y(n-2) + \frac{1}{4}y(n-3) = x(n) + \frac{1}{5}x(n-1) + \frac{1}{6}x(n-2)$ **(08 Marks)**

Module-5

9 a. Explain the design procedure of FIR filters using windows. **(08 Marks)**

b. Design the symmetric FIR low pass filter whose desired frequency response is given as,

$$H_d(\omega) = \begin{cases} e^{-j\omega\tau} & \text{for } |\omega| \le \omega_C \\ 0 & \text{Otherwise} \end{cases}.$$

The length of the filter should be 7 and $\omega_C = 1$ rad/samples. Use Rectangular window. **(12 Marks)**

OR

10 a. Define the following windows along with their impulse response :

(i) Rectangular window.
(ii) Hamming window.
(iii) Hanning window.
(iv) Blackmann window. **(08 Marks)**

b. The desired response of a low-pass filter is,

$$H_d(e^{j\omega}) = \begin{cases} e^{-j3\omega} & \frac{-3\pi}{4} \le \omega \le \frac{3\pi}{4} \\ 0 & \frac{3\pi}{4} < |\omega| \le \pi \end{cases}.$$

Determine $H(e^{j\omega})$ for M = 7 using a hamming window. **(12 Marks)**

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