CBCS SCHEME

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18EE63

Sixth Semester B.E. Degree Examination, Feb./Mar. 2022
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. Prove the following properties of DFT.
i) Linearity ii) circular item shift. **(06 Marks)**

b. Compute N-point DFT of $x(n) = a^n$ for $0 \le n \le N-1$. **(04 Marks)**

c. Compute 6-point DFT of the sequence x(n) = {4, 3, 2 ,1, 0, 0}. Also plot magnitude and phase spectrum. **(10 Marks)**

OR

2 a. Compute the circular convolution using DFT and IDFT for the following sequences $x_1(n) = \{2, 1, 2, 1\}$ and $x_2(n) = \{1, 2, 3, 4\}$. **(10 Marks)**

b. A long sequence x(n) is filtered through a filter with impulse response h(n) to yield to output y(n). If x(n) = {1, 4, 3, 0, 7, 4, –7, –7, –1, 3, 4, 3} and h(n) = {1, 2}. Compute y(n) using overlap add technique. Use only a 5-point circular convolution in your approach. **(10 Marks)**

Module-2

3 a. Develop an 8-point DIT – FFT algorithm starting from the equation of DFT and also draw signal flow graph. **(10 Marks)**

b. Obtain 8-point DFT of the following sequence using radix – 2 DIF-FFT algorithm. x(n) = {2, 1, 2, 1}. **(10 Marks)**

OR

4 a. First five points of the 8-point DFT of a real valued sequence is given by X(0) = 0, X(1) = 2 + j2, X(2) = –j4, X(3) = 2 – j2, X(4) = 0. Determine the remaining points. Hence find the original sequence x(n) using DIF–FFT algorithm. **(14 Marks)**

b. Tabulate the number of complex multiplications and complex additions required for the direct computation of DFT and FFT algorithm for N = 8, 16, 32. **(06 Marks)**

Module-3

5 a. Design an analog bandpass filter to meet the following frequency domain specifications :
i) a – 3.0103dB upper and lower cut-off frequency of 50Hz and 20KHz
ii) a stopband attenuation of atleast 20dB and 20Hz and 45KHz
iii) a monotic frequency response. **(10 Marks)**

b. Design a Chebyshev analog lowpass filter that has a –3dB cut-off frequency of 100rad/sec and a stopband attenuation of 25dB or greater for all radian frequencies past 250 rad/sec. **(10 Marks)**

OR

6 a. Determine the system function H(z) of the lowest order Chebyshev filter that meets the following specifications :
i) 3dB ripple in the passband $0 \le |\omega| \le 0.3\pi$
ii) Atleast 20dB attenuation in the stopband $0.6\pi \le |\omega| \le \pi$
Use the bilinear transformation. **(10 Marks)**

b. Transform the analog filter $H_a(s) = \frac{(s+1)}{s^2+5s+6}$ into H(z) using impulse invariant transformation take T = 0.1sec. **(10 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.

Module-4

7 a. A Chebyshev – I filter of order N = 3 and unit band width is known to have a pole at s = –1

i) Find the two other poles of the filter and parameter ε

ii) The analog filter is mapped to the z-domain using the bilinear transformation with T = 2. Find the transfer function H(z) of the digital filter. **(10 Marks)**

b. Design a digital Chebyshev-I filter that satisfies the following constraints :

$$0.8 \le |H(\omega)| \le 1 \qquad 0 \le \omega \le 0.2\pi$$
$$|H(\omega)| \le 0.2 \qquad 0.6 \le \omega \le \pi$$

Use impulse invariant transformation. **(10 Marks)**

OR

8 Obtain the direct form-I, direct form-II, cascade and parallel form realization for the following system :

$y(n) = 0.75y(n-1) - 0.125y(n-2) + 6x(n) + 7x(n-1) + x(n-2).$ **(20 Marks)**

Module-5

9 a. A low pass filter is to be designed with the following desired frequency response

$$H_d(e^{j\omega}) = H_d(\omega) = \begin{cases} e^{-j2\omega}, & |\omega| < \pi/4 \\ 0, & \pi/4 < |\omega| < \pi \end{cases}$$

Determine the filter co-efficient $h_d(n)$ and h(n) if $\omega(n)$ is a rectangular window defined as

$$\omega_R(n) = \begin{cases} 1, & 0 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}$$

Also find the frequency response $H(\omega)$ of the resulting filter. **(10 Marks)**

b. Use the window method with a hamming window to design a 7-tap differentiator. The magnitude response of an ideal differentiator is shown in Fig.Q9(b). Compute and plot the magnitude response of the resulting FIR differentiator.

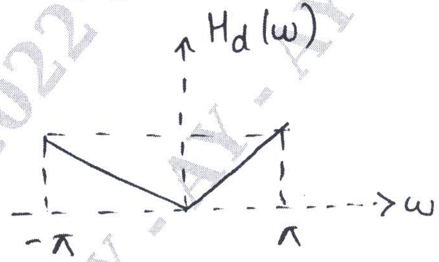

Fig.Q9(b) **(10 Marks)**

OR

10 a. Determine the impulse response h(n) of a filter having desired frequency response :

$$H_d(e^{j\omega}) = \begin{cases} e^{-j(N-1)\omega/2} & \text{for } 0 \le |\omega| \le \pi/2 \\ 0, & \text{for } \pi/2 \le |\omega| \le \pi \end{cases}$$

N = 7. Use frequency sampling approach. **(12 Marks)**

b. Obtain direct form and cascade form realization of the system function :

$$H(z) = 1 + \frac{5}{2}z^{-1} + 2z^{-2} + 2z^{-3}.$$ **(08 Marks)**

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