CBCS SCHEME

USN

18EE63

Sixth Semester B.E. Degree Examination, June/July 2024
Digital Signal Processing

Time: 3 hrs. Max. Marks: 100

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

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-1

1 a. Calculate 8-point DFT of $x(n) = \cos\left(\frac{n\pi}{4}\right)$. Draw magnitude and phase of x(k). **(10 Marks)**

b. Derive the DFT properties for Periodicity and linearity property. **(10 Marks)**

OR

2 a. Compute circular convolution of discrete sequence
$x_1(n) = \{1, 3, 5, 3\}$ $x_2(n) = \{2, 3, 1, 1\}$ by i) Circular method ii) Matrix method. **(10 Marks)**

b. Find the output y(n) of a filter whose 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}. Using overlap save method. **(10 Marks)**

Module-2

3 a. Develop an 8-point DIF-FFT algorithm starting from DFT. State clearly all the step. Explain how it reduces the number of computation. **(10 Marks)**

b. Find DFT of x(n) = {1, 1, 1, 1, 0, 0, 0, 0} using DIT – FFT algorithm show all the intermediate result in signal flow graph. **(10 Marks)**

OR

4 a. The DFT x(k) of sequence is given as x(k) = {0, 2, + 2j, –j4, 2 –j2, 0, 2 + 2j, j4, 2 –j2} using using IDIF – FFT. Determine x(n). **(10 Marks)**

b. Develop an 8-point IDIT-FFT algorithm starting from DFT. Draw the complete signal flow graph to find x(n). **(10 Marks)**

Module-3

5 a. Design an analog Butterfly filter has a gain – 2dB and 20r/s and attenuation in excess of 10dB beyond 30r/s. **(10 Marks)**

b. Determine the transfer function if Chebyshev filter for the following specification :
i) Maximum passband repple is 1dB
ii) Stop and band attenuation is 40dB for $\Omega \geq 4$r/s. **(10 Marks)**

OR

6 a. For the constraints $0.8 \leq |H(e^{jw})| \leq |$ for $0 \leq w \leq 0.2\pi$, $|H(e^{jw})| \leq 0.2$ for $0.6\pi \leq w \leq \pi$. Design a Butterworth digital filter using bilinear transformation. Assume T = 1 Second. **(10 Marks)**

b. Using Impulse invariant technique find the transfer function of digital filter H(z) for analog Transform function

$$H(s) = \frac{b}{(s+a)^2 + b^2}.$$ **(10 Marks)**

Module-4

7 a. Design a Chebyshev filter with T = 1 second using Bilinear transformation for the following specification.
   i) $0.8 \le |H(e^{jw})| \le 1$ for $0 \le w \le 0.2\pi$
   ii) $|H(e^{jw})| \le 0.1$ for $0.5\pi \le w \le \pi$ **(10 Marks)**

b. Realise the system for direct Form – I and direct form – II.

$$H(z) = \frac{0.7 - 0.25z^{-1} - z^{-2}}{1 + 0.1z^{-1} - 0.72z^{-2}}.$$ **(10 Marks)**

OR

8 a. Obtain the parallel form and cascade form for given system.
$y(n) = 0.75\, y(n-1) - 0.125y(n-2) + 6\, x(n) + 7x(n-1) + x(n-2)$ **(10 Marks)**

b. Design a maximally flat digital LPF to meet following specification.
$0.8 \le |H(e^{jw})| \le 1$ for $0 \le w \le \pi/4$
$|H(e^{jw})| \le 0.18$ for $0.75\pi \le w \le \pi$
Using impulse invariant transformation. Assume T = 1 Sec. **(10 Marks)**

Module-5

9 a. For a given FIR filter $y(n) = x(n) + 2/5\, x(n-1) + 3/4x(n-2) +$. Draw direct form – I and Lattice structure. **(10 Marks)**

b. Design the symmetric FIR lowpass filter whose desired frequency response is given as

$$H_d(w) = \begin{cases} e^{-jwz} & \text{for } |w| \le w_c \\ 0 & \text{otherwise} \end{cases}$$

The length of the filter should be 7 and $w_c = 1$ radius/sample use rectangular window. **(10 Marks)**

OR

10 a. Determine the filter coefficient $h_d(n)$ for the desired frequency response of a low pass filter given by

$$H_d(e^{jw}) = \begin{cases} e^{-j2w} & \text{for } -\frac{\pi}{4} \le w \le \frac{\pi}{4} \\ 0 & \text{for } \frac{\pi}{4} \le |w| \le \pi \end{cases}$$

If we define the new filter coefficient by $h(n) = h_d(n) \cdot w(n)$ where

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

Determine h(n) and also the necessary response $|H(e^{jw})|$ and compare with $|H_d(e^{jw})|$ determine $H(e^{jw})|$ Determine $H(e^{jw})$ using Hamming window. **(10 Marks)**

b. Determine form structures of casecade first order section also as a cascade 1^{st} and 2^{nd} order section form FIR lattice filter for $H(z) = |(1 + 0.6z^{-1})^5$. **(10 Marks)**

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