CBCS SCHEME

USN [| | | | | | | | |]

18EE63

Sixth Semester B.E. Degree Examination, June/July 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. Prove the following properties of DFT:
i) Frequency shift
ii) Linear property. **(05 Marks)**

b. Find IDFT of the sequence.
X (k) = { 5, 0, 1-j, 0, 1, 0, 1+j, 0 } **(07 Marks)**

c. Let X(k) be a 14 point DFT of length real sequence of x (n). The fist 8 samples of X (k) are given by X (0) = 12, X (1) = -1+j3, X (2) = 3 + j4, X (3) = 1 – j5, X (4) = -2 + j2, X (5)= 6 + 3j, X (6) = -2 -3j, X (7) = 10.
Find the remaining sample of X (k). Also evaluate i) X (0) ii) X (7) **(08 Marks)**

OR

2 a. Obtain the linear convolved output y (n) = x (n) ∗ h (n) using circular convolution. Given that x (n) = [1, 1, 0, -1, -1] and h (n) = [1, 2, 3, 2, 1] **(08 Marks)**

b. Find the Output of LT1 system whose impulse response h(n) = [1, 1, 1] and i/p signal x (n) = [3, -1, 0, 1, 3, 2, 0, 1, 2 . . . .] using overlap add method. Use block length N = 5. **(12 Marks)**

Module-2

3 a. Find the DFT of the sequence x (n) = 2^n using DIT – FFT algorithm. Where x (n) = 2^n for $0 \le n \le 7$. **(10 Marks)**

b. What are FFT algorithms? Find the number of computations required to find the DFT of an
i) Direct method
ii) DITFFT Algorithm. If N = 16, N = 256, N= 1024 **(06 Marks)**

c. Explain the difference between DIT and DIF algorithm. **(04 Marks)**

OR

4 a. The DFT x (k) of sequence is given by x(k) = [0, $2\sqrt{2}$ (1 – j), 0, 0,0, 0, 0 $2\sqrt{2}$ (1 + j)] Determine the corresponding time sequence x (n) and write the SFG using ID1F – FCT algorithm. **(10 Marks)**

b. Find the 4 point circular convolution of x(n) = { 4, 3, 2, 1 } with h (n) = { 1 , 2, 3, 4 } using Radix – 2 decimation in time FFT Algorithm. **(10 Marks)**

Module-3

5 a. Given that $|H_a(i\Omega)|^2 = \dfrac{1}{1+64\Omega^6}$
Determine the analog filter system function $H_a(s)$. **(10 Marks)**

b. Determine H(z) using impulse invariance technique for the analog s/m function $H_a(s) = \dfrac{1}{(s+0.5)(s^2+0.55+2)}$ **(10 Marks)**

OR

6 a. Design a second order band pass Chebyshev filter with the passband of 200Hz to 300Hz and $\Delta p = 0.5$dB. **(10 Marks)**

b. Determine H(z) of lowest order Butterworth filter that will meet the following specifications.

i) 1dB ripple in passband; $0 \le w \le 0.15\pi$ rad

ii) Atleast 20db attenuation in stop band $\}$: $0.45\pi \le w \le \pi$ rod

Use bilinear Transformation for T = 1 sec. **(10 Marks)**

Module-4

7 a. Design a digital Chebyshev – I filter that satisfies the following constraints.

$0.800 \le |H(jw)| \le 1 \quad 0 \le w \le 0.27\pi$

$|H(jw)| \le 0.2 \quad 0.6\pi \le w \le \pi$

Use impulse invariant transformation. **(12 Marks)**

b. Write the comparison between Butterworth and Chebyshev filter. **(08 Marks)**

OR

8 a. Design a digital Chebyshev – I filter using bilinear transformation to meet the following specifications.

i) 3db ripple in passband ; $0 \le |w| \le 0.3\pi$

ii) 20db attenuation in the stop band ; $0.6\pi \le |w| \le \pi$ **(10 Marks)**

b. Obtain cascade and parallel realizations for the system function given by

$$H(z) = \frac{1 + \frac{1}{4}z^{-1}}{(1 + \frac{1}{2}z^{-1})\,(1 + \frac{1}{2}z^{-1} + \frac{1}{4}z^{-2})}$$ **(10 Marks)**

Module-5

9 a. Design the symmetrical FIR Lowpass filters whose desired freq. response in given as

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

The length of the filter should be 7 and w_c = 1rad | sample. Use Hanning window. **(12 Marks)**

b. Realize a linear phase FIR having

$h(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2) + \frac{1}{4}\delta(n-3) + \delta(n-4)$ **(08 Marks)**

OR

10 a. Design a low pass filter (FIR) using frequency sampling technique having cut – off freq. of $\pi/2$ rod | sample. The filter should have linear phase and length 17. **(12 Marks)**

b. Realize a FIR filter with impulse response h (n) is given by

$H(n) = \left(\frac{1}{2}\right)^n [u(n) - u(n-4)]$ **(08 Marks)**

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