CBCS SCHEME

USN | | | | | | | | | | **15EC52**

Fifth Semester B.E. Degree Examination, Jan./Feb. 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. Compute N-point DFT of a sequence $x(n)=\frac{1}{2}+\frac{1}{2}\cos\left(\frac{2\pi}{N}\left(n-\frac{N}{2}\right)\right)$. **(08 Marks)**

b. Compute 4-point circular convolution of the sequences using time domain and frequency domain.
$x(n)=\{\underset{\uparrow}{2},1,2,1\}$ and $h(n)=\{\underset{\uparrow}{1},2,3,4\}$ **(08 Marks)**

OR

2 a. Obtain the relationship between DFT and z-transform. **(08 Marks)**

b. Let x(n) be a real sequence of length N and its N-point DFT is X(K), show that
(i) $X(N-K)=X^*(K)$
(ii) $X(0)$ is real.
(iii) If N is even, then $X\left(\frac{N}{2}\right)$ is real. **(08 Marks)**

Module-2

3 a. Explain the disadvantages of direct computation of DFT and advantage of FFT. **(04 Marks)**

b. Find the output y(n) of a filter whose impulse response h(n) = {3, 2, 1} and input x(n) = {2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1}. Using overlap and save method. Use 8 point circular convolution in your approach. **(10 Marks)**

c. State and prove symmetric property of twiddle factor W_N. **(02 Marks)**

OR

4 a. Find the number of complex multiplications and additions required to computer 128 point DFT using i) Direct method ii) FFT iii) What is the speed improvement factor iv) Number of real register needed v) Number of trigonometric functions needed. **(06 Marks)**

b. A long sequence x(n) is filtered with a filter with impulse response h(n) to produce 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 and add method. Use only 5 point circular convolution in your approach. **(10 Marks)**

Module-3

5 a. Given x(n) = {1, 0, 1, 0}, find x(2) using Goertzel algorithm. **(06 Marks)**

b. Find the 8-point DFT of the sequence x(n) = {1, 2, 3, 4, 4, 3, 2, 1} using DIT – FFT radix – 2 algorithm. **(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.

OR

6 a. What is chirp–z transform? Mention its applications? **(06 Marks)**

b. Find the 4-point circular convolution of x(n) and h(n) give below, using radix–2. DIF–FFT algorithm.

$x(n) = \{1, 1, 1, 1\}$

$h(x) = \{1, 0, 1, 0\}$. **(10 Marks)**

Module-4

7 a. Compare Butterworth and Chebyshev filters. **(04 Marks)**

b. Design an analog lowpass Butterworth filter for the following specifications:

$0.8 \le |H_a(s)| \le 1, 0 \le \Omega \le 0.2\pi, |H_a(s)| \le 0.2, 0.6\pi \le \Omega \le \pi$. **(08 Marks)**

c. Explain Analog to Analog transformation. **(04 Marks)**

OR

8 a. Design a digital lowpass filter using BLT to satisfy the following chart:

i) Monotonic pass and stop band

ii) -3dB cut – off of 0.5π rad

iii) Magnitude down atleast 15dB at 0.75π rad. **(08 Marks)**

b. Find H(z) for the given T.F $H(s) = \frac{s+a}{(s+a)^2 + b^2}$ using Impulse Invariant Transformation (IIT) technique. **(08 Marks)**

Module-5

9 a. A linear time – invariant digital IIR filter is specified by the following transfer function :

$$H(z) = \frac{(z-1)(z-2)(z+1)z}{\left[z-\left(\frac{1}{2}+\frac{1}{2}j\right)\right]\left[z-\left(\frac{1}{2}-j\frac{1}{2}\right)\right]\left[z-j\frac{1}{4}\right]\left[z+j\frac{1}{4}\right]}$$

Realize the system in the following forms : i) direct form – I ii) Direct form –II. **(12 Marks)**

b. Obtain a cascade realization for the system function given below :

$$H(z) = \frac{\left(1+z^{-1}\right)^3}{\left(1-\frac{1}{4}z^{-1}\right)\left(1-z^{-1}+\frac{1}{2}z^{-2}\right)}.$$ **(04 Marks)**

OR

10 a. Explain the following terms :

i) Rectangular window

ii) Bartlett window

iii) Hamming window. **(08 Marks)**

b. A filter is to be designed with the following desired frequency response :

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

Find the frequency response of the FIR filter designed using rectangular window defined below :

$$\omega_R(n) = \begin{cases} 1, & 0 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}.$$ **(08 Marks)**

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