CBCS SCHEME

USN | | | | | | | | | | | **15EE63**

Sixth Semester B.E. Degree Examination, July/August 2022
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. Find the 4 point DFT of $x(n) = \{1, -2, 3, 2\}$. Sketch the magnitude and phase spectra. **(06 Marks)**

b. State and prove the following properties of DFT.
i) Linearity ii) Time reversals of the sequences. **(06 Marks)**

c. The DFT of a real signal is $\{1, A, -1, B, 0, -j2, C, -1+j\}$. Find A, B and C. **(04 Marks)**

OR

2 a. Find IDFT of $X(K) = \{4, 2, 0, 4\}$ using DFT. **(06 Marks)**

b. State and prove Parsevals theorem. **(04 Marks)**

c. If the DFT $\{x(n)\} = \{4, -j2, 0, j2\}$, using the properties of DFT.
find i) DFT $x^2(n)$ ii) Signal energy. **(06 Marks)**

Module-2

3 a. Develop the DIT-FFT algorithm for N = 8. Draw the complete signal flow graph. **(08 Marks)**

b. Compute the 4 point DFT of the sequence $x(n) = \{2, 1, 4, 3\}$ by invoking decimation in frequency FFT algorithm. **(08 Marks)**

OR

4 a. Compute 4 point DFT and $x(n) = \text{Sin}\left(\frac{\pi}{2}n\right) 0 \le n \le 3$ using DIF-FFT algorithm. **(04 Marks)**

b. For an LTI system, the input $x(n) = \{2, 2, 2\}$ and the impulse response $h(n) = \{-2, -2\}$. Determine the response of the systems by radix – 2 DIT-FFT. **(12 Marks)**

Module-3

5 a. Obtain H(z) form $H_a(s)$ when T = 0.5Sec and $H_a(s) = \frac{4}{(s+3)(s+4)}$. **(04Marks)**

b. Given that $|H_a(j\Omega)|^2 = \frac{1}{1+64(\Omega)^6}$, determine analog filter functions $H_a(s)$. **(06 Marks)**

c. Determine the order and poles of analog Chebysheve type 1 filter to meet the following specifications
Passband : $|H(j\Omega)|_{dB} \ge -2dB \quad 0 \le \Omega \le 500\pi$
Stopband : $|H(j\Omega)|_{dB} \le -75dB \quad \Omega \ge 5000\pi$
(06 Marks)

OR

6 a. For the analog transfer functions $H_a(s) = \frac{2}{(s+1)(s+3)}$, determine H(z) if T = 0.5Sec, using impulse invariant method. **(04 Marks)**

b. Design a Butterworth digital filter using bilinear transformation. The specification of desired low passfilter are :

$$0.9 \le |H(w)| \le 1 ; \quad 0 \le w \le \frac{\pi}{2}$$

$$|H(w)| \le 0.2 \quad \frac{3\pi}{4} \le w \le \pi$$

Take T = 1Sec. **(12 Marks)**

Module-4

7 a. Design A Chebyshev IIR digital filter to satisfy the following constraints.

$$0.707 \le |H(w)| \le 1 ; \quad 0 \le w \le 0.2\pi$$

$$|H(w)| \le 0.1 \quad 0.5\pi \le w \le \pi$$

Use bilinear transformations. **(12 Marks)**

b. Obtain the Cascade realization of the system

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

OR

8 a. Find the Chebyshev filter order for the following specification

$$\sqrt{0.6} \le |H(w)| \le 1 \quad 0 \le w \le \pi/2$$

$$|H(w)| \le 0.2 \quad \frac{3\pi}{2} \le w \le \pi$$

With T = 1Sec. Use impulse invariant transformations. **(05 Marks)**

b. Give the necessary expressions for transforming lowpass filter to high pass, bandpass and bandstop filters in the digital domain. **(05 Marks)**

c. Realize the IIR filter $H(z) = \frac{3z^2 + 5z + 4}{z^2 + 6z + 8}$. Using Ladder structure. **(06 Marks)**

Module-5

9 a. Design a filter with

$$H_d(e^{jw}) = \begin{cases} e^{-j3w} ; & \frac{-\pi}{4} \le w \le \frac{\pi}{4} \\ 0 ; & \frac{\pi}{4} \le |w| \le \pi \end{cases}$$

Use hamming window. **(12 Marks)**

b. Realize the following system with minimum number of multipliers.

$$H(z) = \frac{1}{3} + \frac{1}{5}z^{-1} + \frac{2}{3}z^{-2} + \frac{1}{5}z^{-3} + \frac{1}{3}z^{-4}$$ **(04 Marks)**

OR

10 a. Design a linear phase FIR filter of length M = 15 which has symmetric unit impulse response and frequency response that satisfy the conditions

$$H\left(\frac{2\pi}{15}K\right) = 1 \quad K = 0, 1, 2, 3$$

$$= 0.4 \quad K = 4$$

$$= 0 \quad K = 5, 6, 7$$

(10 Marks)

b. Draw the direct form structure of the FIR systems given below

i) $H(z) = 1 + \frac{1}{5}z^{-1} + \frac{3}{4}z^{-2} + \frac{1}{3}z^{-3} + \frac{1}{7}z^{-4} + \frac{1}{6}z^{-5}$

ii) $H(z) = (1 - z^{-1})(1 + 2z^{-1} - 3z^{-2})$ **(06 Marks)**