## CBCS SCHEME

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### Fifth Semester B.E. Degree Examination, July/August 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.   Compute N-point DFT of a sequence
         $$x(n) = \frac{1}{2} + \frac{1}{2}\cos\left(\frac{2\pi}{N}\left(n - \frac{N}{2}\right)\right).$$                                    **(10 Marks)**
    b.   Compute circular convolution using DFT and IDFT for the following sequences
         $x_1 = (1, 2, 3, 1)$ and $x_2(n) = \{4, 3, 2, 2\}$.                                 **(10 Marks)**

**OR**

2   a.   Obtain the relationship between DFT and Z-transform.                              **(10 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.                      **(10 Marks)**

#### Module-2

3   a.   Find the response of an LII system with an impulse response h(n) = {3, 2, 1} for the input
         x(n) = {2, -1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1} using overlap add method use 8-point circular
         convolution.                                                                       **(10 Marks)**
    b.   Develop the radix-2 decimation in frequency FFT algorithm for N = 8 and draw the signal
         flow graph.                                                                        **(10 Marks)**

**OR**

4   a.   Find the output y(n) of a filter whose impulse response h(n) = {1, 2} and the input signal to
         the filter is x(n) = {1, 4, 3, 2, 7, 4, -7, -7, -1, 3, 4, 3} using overlap save method. Use only
         5 point circular convolution approach.                                            **(10 Marks)**
    b.   Using DIT-FFT algorithm, compute the DFT of a sequence x(n) = (1, 1, 1, 1, 0, 0, 0, 0).
                                                                                           **(10 Marks)**

#### Module-3

5   a.   Let the coefficients a three stage FIR lattice structure be K₁ = 0.1, K₂ = 0.2 and K₃ = 0.3.
         Find the coefficients of the direct form – I FIR filter and draw its block diagram.  **(10 Marks)**
    b.   A linear time-invariant system is described by the following input-output relation.
         $2y(n) - y(n-2) - 4y(n-3) = 3x(n-2)$. Realize the system in the following forms:
         i)     Direct form – I realization.
         ii)    Direct form – II realization.                                               **(10 Marks)**

**OR**

6  a.  The desired frequency response of a lowpass filter is given by

$$H_d(e^{jw}) = H_d(w) = \begin{cases} e^{-j3w}, & |w| < \dfrac{3\pi}{4} \\ 0, & \dfrac{3\pi}{4} < |w| < \pi \end{cases}$$

Determine the frequency response of the FIR filter it Hamming window is used with N = 7.
(10 Marks)

   b.  Find the lattice-ladder structure for the filter given by the following difference equation:

$$y(n) + \frac{3}{4}(n-1) + \frac{1}{4}y(n-2) = x(n) + 2x(n-1).$$
(10 Marks)

## Module-4

7  a.  Obtain a parallel realization for the system for the system described by

$$H(Z) = \frac{(1+z^{-1})(1+2z^{-1})}{\left(1+\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)\left(1+\frac{1}{8}z^{-1}\right)}.$$
(10 Marks)

   b.  Obtain the cascade realization of system
   $H(z) = [2z^{-1} - z^{-2}] . [z^{-1} - z^{-2}].$
(10 Marks)

**OR**

8  a.  Design a Butterworth analog high pass filter that will meet the following specifications:
   i)    Maximum passband attenuation = 2dB
   ii)   Passband edge frequency = 200rad/sec
   iii)  Minimum stopband attenuation = 20dB
   iv)   Stopband edge frequency = 100rad/sec.
(12 Marks)

   b.  Realize the FIR filter whose transfer function is given by

$$H(z) = 1 + \frac{3}{4}z^{-1} + \frac{17}{8}z^{-2} + \frac{3}{4}z^{-3} + z^{-4} \text{ using direct form} - I.$$
(08 Marks)

## Module-5

9  a.  Explain the digital signal processors based on the Harvard architecture.  (10 Marks)
   b.  Find the signed Q-15 representation for the decimal number 0.560123.  (10 Marks)

**OR**

10  a.  Explain with neat block diagram floating point DS processor (TMS320C3X).  (10 Marks)
    b.  Explain fixed-point digital signal processors (architecture of the TMS320C54X family).
(10 Marks)

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