CBCS SCHEME

USN

18EC52

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.

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. 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 LTI 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 $K_1 = 0.1$, $K_2 = 0.2$ and K_3 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

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

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

$H(z) = 1 + \frac{3}{4}z^{-1} + \frac{17}{8}z^{-2} + \frac{3}{4}z^{-3} + z^{-4}$ 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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