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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.

Module-1

- 1 a. Compute N-point DFT of a sequence

$$x(n) = \frac{1}{2} + \frac{1}{2} \cos\left(\frac{2\pi}{N}\left(n - \frac{N}{2}\right)\right). \quad (10 \text{ Marks})$$

- 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.

$$2y(n) - y(n-2) - 4y(n-3) = 3x(n-2). \text{ Realize the system in the following forms:}$$

i) Direct form – I realization.

ii) Direct form – II realization. (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. The desired frequency response of a lowpass filter is given by

$$H_d(e^{j\omega}) = H_d(\omega) = \begin{cases} e^{-j3\omega}, & |\omega| < \frac{3\pi}{4} \\ 0, & \frac{3\pi}{4} < |\omega| < \pi \end{cases}$$

Determine the frequency response of the FIR filter if Hamming window is used with $N = 7$.

(10 Marks)

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

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

(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

$$H(z) = [2z^{-1} - z^{-2}] \cdot [z^{-1} - z^{-2}].$$

(10 Marks)

OR

- 8 a. Design a Butterworth analog high pass filter that will meet the following specifications:

- Maximum passband attenuation = 2dB
- Passband edge frequency = 200rad/sec
- Minimum stopband attenuation = 20dB
- 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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