Question Paper

Exam Date & Time: 02-May-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

SIXTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, April-May 2024

DIGITAL SIGNAL PROCESSING [ICE 3251]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates:
Missing data may be suitably assumed.

1) A) Design high pass Butterworth IIR filter using bilinear transform in Z domain having the following specifications: (5)

i) Cutoff frequency of 1000 Hz,

ii) Stopband gain of -10dB at 350 Hz,

iii) Sampling frequency of 5000 Hz.

[CO3, PO1-5, PO12, BL4]

B) Evaluate if the system $y(n) = n\,x(n)$ is (3)

i) memoryless, ii) time invariant, iii) linear? Justify your answer.

[CO1, PO1-5, PO12, BL2]

C) Compute 4 point DFT of sequence $x(n) = \{1, 3, 1, 3\}$ using linear transformation i.e. DFT matrix multiplication method. (2)

[CO2, PO1-5, PO12, BL2]

2) A) Realize the IIR filter transfer function using direct form I and II. (5)

$$H(z) = \frac{Y(z)}{X(z)} = \frac{0.1708 + 0.3415\,z^{-1} + 0.1708\,z^{-2}}{1 - 0.5407\,z^{-1} + 0.2237\,z^{-2}}$$

[CO3, PO1-5, PO12, BL3]

B) Evaluate the cross correlation of the given sequences using any two methods. (3)

$x_1(n) = \{1, 4, 3, 2\}$ and $x_2(n) = \{1, 2, 1, 2\}$.

[CO1, PO1-5, PO12, BL2]

C) (2)

Partition the given sequence $x(n) = \{1, -1, 2, -2, 3, -3, 4, -4\}$ into sections for performing linear convolution with $h(n) = \{-1,\ 1\}$ using overlap save method 2. Explain in brief.

[CO2, PO1-5, PO12, BL3]

3) Evaluate and sketch the frequency response of the FIR filter having impulse response as $h(n)$ by taking digital (5)

A) frequencies in multiple of $\pi/8$ in $[0, 2\pi]$. What is the type of filter?

$$h(n) = \{-0.0081, 0.0469, -0.1441, 0.2, -0.1441, 0.0469, -0.0081\}$$

[CO4, PO1-5, PO12, BL4]

B) Compute $x(n)$ for $n = 0, 1, 2, 3, 4$ using any one method having Z transform as (3)

$$X(z) = \frac{2 + 5z^{-1}}{1 + 4z^{-1} + 3z^{-2}}$$

[CO1, PO1-5, PO12, BL3]

C) Illustrate difference between type 1 and type 2 low pass Chebyshev filter. (2)

[CO3, PO1-5, PO12, BL2]

4) Compute coefficients of a linear phase symmetric FIR filter of length N=7 and frequency response as follows: (5)

A)
$$H\left(\frac{2\pi k}{7}\right) = \begin{cases} 0 & k = 0 \\ 0.4 \; for & k = 1 \\ 1 & k = 2, 3 \end{cases}$$

Realize the filter.

[CO4, PO1-5, PO12, BL4]

B) Compute 4 point FFT of $x(n) = \{1, \; -1, \; -2, \; 2\}$ using both DIT-FFT and DIF-FFT algorithms. (3)

[CO2, PO1-5, PO12, BL2]

C) Compute the poles of a low pass Butterworth IIR filter having order N=3 and sketch them in Z plane. (2)

[CO3, PO1-5, PO12, BL3]

5) Compute transfer function of a linear phase FIR band pass filter to pass frequencies in the range 0.4π to 0.65π rad/sample by taking 7 samples of Hanning window sequence. (5)

A)

[CO4, PO1-5, PO12, BL2]

B) Apply speech recognition technique to convert speech into a text in any language. Explain with a block diagram and give one example. (3)

[CO5, PO1-7, PO12, BL2]

C) Compute and sketch rectangular window and Bartlett / triangular window sequence. (2)

[CO4, PO1-5, PO12, BL2]

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