Question Paper

Exam Date & Time: 18-Jun-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

Sixth Semester B.TECH End Sem Makeup Exam June 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) Design high pass Butterworth IIR filter using bilinear transform in Z domain having the following specifications: (5)

A) i) Passband gain of 0.707 at 0.65π rad/sample,

ii) Stopband gain of 0.2 at 0.45π rad/sample,

iii) Sampling time of 0.5 s.

[CO3, PO1-5, PO12, BL4]

B) Evaluate if the system $y(n) = sin\,(x^2(n))$ is (3)

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

[CO1, PO1-5, PO12, BL2]

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

[CO2, PO1-5, PO12, BL2]

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

A)

$$H(z) = \frac{Y(z)}{X(z)} = \frac{0.4411 - 0.8822\,z^{-1} + 0.4411z^{-2}}{1 - 0.5407\,z^{-1} + 0.2237\,z^{-2}}$$

[CO3, PO1-5, PO12, BL3]

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

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

[CO1, PO1-5, PO12, BL2]

C) Partition the given sequence $x(n) = \{1, -1, 2, -2, 3, -3, 4, -4\}$ into sections for (2)

performing linear convolution with $h(n) = \{-1,\ 1\}$ using overlap save method 1. 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 frequencies in multiple of $\pi/8$ in $[0, 2\pi]$. What is the type of filter? (5)

A)

$$h(n) = \{0, -0.0556, -0.0143, 0.25, -0.0143, -0.0556, 0\}$$

[CO4, PO1-5, PO12, BL4]

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

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

[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)

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

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, BL3]

C) Compute the poles of a low pass Butterworth IIR filter having order N=4 and sketch them in Z plane. (2)

[CO3, PO1-5, PO12, BL2]

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 seven samples of Hamming window sequence. (5)

A)

[CO4, PO1-5, PO12, BL2]

B) Analyse and synthesize working of digital vocoder. Explain with block diagrams. (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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