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21EC42

Fourth Semester B.E. Degree Examination, June/July 2024
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. Prove that the sampling of Fourier transform of a sequence x(n) results in N point DFT. Using which both the sequence and the transform can be reconstructed. **(10 Marks)**

b. Compute the 8 point DFT of the sequence $x(n) = \{1, 1, 1, 1, 0, 0, 0, 0\}$. Also write a Matlab code to compute N point DFT of a sequence. **(10 Marks)**

OR

2 a. Compute the circular convolution of the given sequences using DFT and IDFT method $x_1(n) = \{2, 3, 1, 1\}$ and $x_2(n) = \{1, 3, 5, 3\}$. **(10 Marks)**

b. Compute the N point DFT of $x(n) = \begin{cases} \frac{1}{3}; & 0 \le n \le 2 \\ 0; & \text{otherwise} \end{cases}$ **(06 Marks)**

c. If $x(n) = \{1, 2, 0, 3, -2, 4, 7, 5\}$. Evaluate i) X(0) ii) X(4) iii) $\sum_{K=0}^{7} X(K)$. **(04 Marks)**

Module-2

3 a. Determine the response of a LTI system with $h(n) = \{1, -1, 2\}$ for an input. $x(n) = \{1, 0, 1, -2, 1, 2, 3, -1, 0, 2\}$ using overlap add method. Use 6 point circular convolution in your approach. **(10 Marks)**

b. Develop the 8 point DIF_FFT algorithm. Mention the property of phase factor exploited. **(10 Marks)**

OR

4 a. Determine 8 point DFT of $x(n) = \{1, 0, -1, 2, 1, 1, 0, 2\}$ using of radix-2 DIT-FFT algorithm. Clearly show all intermediate results. **(10 Marks)**

b. State and prove circular time shift property. Also write the matlab code for the same. **(10 Marks)**

Module-3

5 a. Design a filter with

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

Use Hamming window with M = 7. Obtain the system transfer function equation. **(10 Marks)**

b. Consider a FIR filter with system function: $H(z) = 1 + 2.82z^{-1} + 3.4048z^{-2} + 1.74z^{-3}$. Sketch the direct form-I and lattice realization of the filter. **(10 Marks)**

OR

6 a. Write a Matlab code to design a high pass FIR filter, using hanning window. The expected output with necessary calculations to be shown. **(10 Marks)**

b. Mention the two desirable characteristics of window function. Compare Rectangular, Hamming, Hanning and Bartlett window functions. **(06 Marks)**

c. Given $H(z) = (1+0.6z^{-1})^3$. Realize as a cascade of 1st and 2nd order section. **(04 Marks)**

Module-4

7 a. Compare analog and digital filters. **(04 Marks)**

b. Given $H(z) = \dfrac{8z^3 - 4z^2 + 11z - 2}{\left(z - \frac{1}{4}\right)\left(z^2 - z + \frac{1}{2}\right)}$. Realize in DF-I and DF-II. **(06 Marks)**

c. Obtain the expression for order and cut-off frequency of Low Pass Butterworth filter. **(10 Marks)**

OR

8 a. Design a digital low pass filter using BLT method to satisfy the following characteristics:

i) Monotonic stopband and pass band

ii) -3db cut off frequency of 0.5π rad

iii) Magnitude down atleast 15dB at 0.75π rad. **(10 Marks)**

b. Mention two conditions of transforming the filter from s plane to z plane. Explain how is it achieved in bilinear transformation with mapping diagram. **(06 Marks)**

c. Write a matlab code to design an analog LP Butterworth filter. **(04 Marks)**

Module-5

9 a. Explain :

i) General Microprocessor based on Von Neumann architecture

ii) Digital signal processors based on Harvard architecture. **(12 Marks)**

b. Convert the following:

i) Q15 signed number 0.100011110110010 to decimal number.

ii) Decimal number -0.160123 to signed Q-15 representation. **(08 Marks)**

OR

10 a. Explain IEEE floating point formats. **(10 Marks)**

b. Explain the basic architecture of TMS320C54X processor. **(10 Marks)**

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