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Sixth Semester B.E. Degree Examination, Aug./Sept. 2020
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Assume missing data if any.***

PART – A

1 a. Obtain 8 point DFT of sequence $x(n) = \{1, 1, 1, 1, 0, 0, 0, 0\}$ and hence plot magnitude and phase spectra. **(10 Marks)**

b. State and prove symmetry property for the DFT of a complex sequence. **(04 Marks)**

c. Find the N point DFT of a sequence $x(n) = \cos\left(\frac{2\pi nk_0}{N}\right)$, where n = 0, 1, 2, ...N-1. **(06 Marks)**

2 a. Find the circular convolution of sequences $x(n) = \{1, -1, 2, 3\}$ and $h(n) = \{0, 1, 2, 3\}$. **(04 Marks)**

b. Using overlap-ADD fast convolution technique obtain the output y(n) for the input sequence $x(n) = \{3, 0, -2, 0, 2, 1, 0, -2, -1, 0\}$ which is passed through a filter with impulse response $h(n) = \{2, 2, 1\}$. **(10 Marks)**

c. Explain OVERLAP_SAVE fast convolution technique. **(06 Marks)**

3 a. Obtain 8 point DFT of a sequence $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$ using decimation in time fast Fourier transform technique. **(10 Marks)**

b. What are the number of complex multiplications and complex additions involved in radix-2 decimation in time fast fourier transform using modified butterfly. Explain with a neat flow diagram for N = 8. **(10 Marks)**

4 a. Develop a fast fourier transform algorithm using decomposition in time for N = 9. **(10 Marks)**

b. An 8 point DFT of a sequence is given by,
$X(K) = \{0, 2 - j4.8284, 0, 2 - j0.8284, 0, 2 + j0.8284, 0, 2 + j4.8284\}$.
Obtain the sequence x(n) using Inverse decimation in frequency radix-2 fast Fourier algorithm. **(10 Marks)**

PART – B

5 a. Explain Analog-Analog transformation used to design Low pass, High pass, Band pass, Band reject filters from a normalized low pass analog filter. **(08 Marks)**

b. Design a low pass Chebyshev filter to satisfy the following specifications:
(i) Acceptable pass band ripple of 2 dB.
(ii) Cut off frequency of 40 rad/sec.
(iii) Stop band attenuation of 20 dB or more at 52 rad/sec. **(12 Marks)**

6 a. Design an IIR digital low pass filter using BILINEAR transformation to satisfy the following condition:
(i) Low pass filter with -1 dB cutoff at 100π rad/sec.
(ii) Stop band attenuation of 30 dB or greater at 1000π rad/sec.
(iii) Monotonic pass band and stop band.
(iv) Sampling rate of 2000 samples/sec. **(10 Marks)**

b. Design using impulse invariant transformation, an IIR digital low pass filter to satisfy the following specifications:
(i) -3.01 dB attenuation at a cut off frequency of 2 rad.
(ii) Stop band attenuation of 15 dB or greater at 4.8284 rad.
(iii) Monotonic pass band and stop band. **(10 Marks)**

7 a. Give the time domain and frequency domain representation of,
(i) Rectangular window.
(ii) Bartlett window.
(iii) Blackmann window. **(08 Marks)**

b. Using a rectangular window, design a symmetric FIR low pass filter whose desired frequency response is given by,

$$H_d(\omega) = \begin{cases} e^{-i\omega\tau} & \text{for } |\omega| \le \omega_C \\ 0 & \text{Otherwise} \end{cases}.$$

The length of the filter should be 7 and $\omega_C = 1$ radians/sample. **(12 Marks)**

8 a. Give the linear phase realization of the impulse response of an FIR filter using ladder structure.

$$h(n) = \delta(n) - \frac{1}{4}\delta(n-1) + \frac{1}{2}\delta(n-2) + \frac{1}{2}\delta(n-3) - \frac{1}{4}\delta(n-4) + \delta(n-5).$$ **(06 Marks)**

b. Give the direct form – I and form – II realization of an IIR filter represented by a transfer function $H(z) = \dfrac{7z^2 - 5.25z + 1.375}{z^2 - 0.75z + 0.125}$. **(08 Marks)**

c. Realize $H(z) = \dfrac{\left(1 + \frac{1}{5}z^{-1}\right)}{\left(1 - \frac{1}{2}z^{-1} + \frac{1}{3}z^{-2}\right)\left(1 + \frac{1}{4}z^{-2}\right)}$ in cascade form. **(06 Marks)**

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