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10EE64

Sixth Semester B.E. Degree Examination, July/August 2022
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Find the 8 point DFT of sequence $x(n) = \{1, 1, 1, 1, 1, 1, 0, 0\}$
Sketch its magnitude and phase spectra **(10 Marks)**

b. Compute the N-point DFT of a sequence
$x(n) = a^n \quad 0 \le n \le N-1$ **(05 Marks)**

c. Compute the circular convolution of sequences $x_1(n) = \{1, 1, 2, 1\}$ and $x_2(n) = \{1, 2, 3, 4\}$ using circular arrays. **(05 Marks)**

2 a. Let $x(n) = \{2, 1, 1, 0, 3, 2, 0, 3, 4, 6\}$ with a 10-point DFT X(k). Evaluate the following without explicitly computing the DFT:

(i) X(0) (ii) X(5) (iii) $\sum_{k=0}^{9} X(k)$ (iv) $\sum_{k=0}^{9} |X(k)|^2$ **(08 Marks)**

b. State and prove the property of circular convolution. **(04 Marks)**

c. Find the output y(n) of a filter whose impulse response is $h(n) = \{1, 1, 1\}$ and input signal $x(n) = \{3, -1, 0, 1, 3, 2, 0, 1, 2, 1\}$ using overlap save method. Use 5-point circular convolution. **(08 Marks)**

3 a. Find the 8-point DFT of the sequence $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$ using radix-2 DIT FFT algorithm. **(10 Marks)**

b. Given $X(k) = \{7, -0.707-j0.707, -j, 0.707+j0.707, 1, 0.707+j0.707, j, -0.707+ j0.707\}$, find x(n) using DIF FFT algorithm. **(10 Marks)**

4 a. If $x_1(n) = \{1, 2, 0, 1\}$ and $x_2(n) = \{1, 3, 3, 1\}$ obtain $x_1(n)$ Ⓝ $x_2(n)$ by DIF FFT algorithm. **(10 Marks)**

b. Develop DIT – FFT algorithm for N = 9. Draw the signal flow graph. **(10 Marks)**

PART – B

5 a. Transform the analog filter

$$H_a(s) = \frac{1}{s^2 + \sqrt{2}s + 1}$$

into digital filter H(z) using impulse invariant transformation. Take T = 1 sec. **(08 Marks)**

b. Design a digital Butterworth filter using bilinear transformation for the following specifications. Assume T = 1 sec.

$0.8 \le |H(e^{jw})| \le 1 \quad 0 \le w \le 0.2\pi$

$|H(e^{jw})| \le 0.2 \quad 0.6\pi \le w \le \pi$ **(12 Marks)**

6 a. Design an analog Chebyshev filter with a maximum passband attenuation of 2.5 dB at $\Omega_p = 20$ rad/sec and the stopband attenuation of 30 dB at $\Omega_s = 50$ rad/sec. **(10 Marks)**

b. Explain frequency transformation method to transform analog normalized low pass filter into analog low pass, high pass, band pass and band reject filters. **(10 Marks)**

7 a. Design a FIR filter with the following desired frequency response.

$$H_d(w) = e^{-j3w} \qquad -\frac{\pi}{4} \le w \le \frac{\pi}{4}$$
$$= 0 \qquad \frac{\pi}{4} \le |w| \le \pi$$

Use Hanning window with N = 7. **(10 Marks)**

b. Determine the filter coefficients h(n) obtained by sampling $H_d(\omega)$ given by :

$$H_d(\omega) = \begin{cases} e^{-j3\omega}, & 0 < \omega \le \frac{\pi}{2} \\ 0, & \frac{\pi}{2} < \omega < \pi \end{cases}$$

Also obtain frequency response taking N = 7. **(10 Marks)**

8 a. Draw the direct form I realization for the following third order IIR transfer function

$$H(z) = \frac{0.28z^2 + 0.319z + 0.04}{0.5z^3 + 0.3z^2 + 0.17z - 0.2}$$ **(05 Marks)**

b. Obtain cascade and parallel structure for the following system

$$H(z) = \frac{0.7 - 0.252z^{-2}}{(1 + 0.9z^{-1})(1 - 0.8z^{-1})}$$ **(10 Marks)**

c. Realize a linear phase FIR filter with the following impulse response

$$h(n) = \delta(n) + \frac{1}{2}\delta(n-1) - \frac{1}{4}\delta(n-2) + \frac{1}{2}\delta(n-3) + \delta(n-4)$$ **(05 Marks)**

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