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Sixth Semester B.E. Degree Examination, June/July 2019
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 DFT of the sequence $x(n) = 1 ;\ \text{for } 0 \le n \le 2$
$\qquad 0 ;\ \text{otherwise}$
For N = 8. Plot the magnitude and phase spectrum x(k). **(10 Marks)**

b. Perform circular convolution of two sequences using DFT and IDFT method.
$x_1(n) = (1, 1, 2, 1),\quad x_2(n) = (1, 2, 3, 4)$.
Also verify the answer by circular convolution method. **(10 Marks)**

2 a. 14-point DFT of 14 real time sequences is x(K). The first 8 samples of x(k) are given by $x(0) = 12$, $x(1) = -1 + j3$, $x(2) = 3 + j4$, $x(3) = 1 - j5$, $x(4) = -2 + j2$, $x(5) = 6 + j3$, $x(6) = -2 - j3$, $x(7) = 10$. Find the remaining sample of x(k).
Also evaluate (i) x(0) (ii) x(7) (iii) $\sum_{n=0}^{7} |x(n)|^2$ **(10 Marks)**

b. Compute y(n) with impulse response $h(n) = \{3, 2, 1\}$ and $x(n) = (2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1)$. Use only 8-point circular convolution in your approach. Compare the result by solving the problem using (i) overlap save method (ii) overlap add method. **(10 Marks)**

3 a. Calculate the number of multiplications needed in the calculation of DFT (Direct evaluation) and with FFT algorithm, with 8, 16, 32, 256, 1024 point sequences. Also find the speed improvement factor. **(10 Marks)**

b. Derive the Decimation In Frequency algorithm (DIF) for a 8-point DFT sequence. Draw neat signal flow graph mentioning all intermediate output results. Consider $x(n) = (1, 2, 3, 4, 5, 6, 7, 8)$. **(10 Marks)**

4 a. Compute JDFT of the sequence x(k)
$x(k) = (7, -0.707 - j0.707, -j, 0.707 - j0.707, 1, 0.707 + j0.707, j, -0.707 + j0.707)$. **(10 Marks)**

b. Compute 4-point DFT of the sequence $x(n) = (1, 0, 1, 0)$ using DIF-FFT algorithm. **(04 Marks)**

c. What is FFT? What are properties of twiddle factor? **(06 Marks)**

PART – B

5 a. For given specifications $\alpha_p = 3$ dB and $\alpha_s = 15$ dB, $\Omega_p = 1000$ rad/sec and $\Omega_s = 500$ rad/sec. Design a high pass butterworth filter. Assume $\Omega_c = 1$ rad/sec. **(10 Marks)**

b. Design a Chebyshev type-1 for the following specification using bilinear transformation method.
$$0.8 \le |H(e^{jw})| \le 1 \quad ; \quad 0 \le w \le 0.2\pi$$
$$|H(e^{jw})| \le 0.2 \quad ; \quad 0.6\pi \le w \le \pi$$
(10 Marks)

6 a. Show the comparison between Analog and digital filter. (06 Marks)
b. List out the design steps for analog butterworth filter. (08 Marks)
c. Distinguish between Butterworth and Chebyshev (Type-I) filter. (06 Marks)

7 a. Obtain direct form-I, direct form-II, cascade and parallel realization for the system
$y(n) = -0.1y(n-1) + 0.2y(n-2) + 3x(n) + 3.6x(n-1) + 0.6x(n-2)$ (10 Marks)
b. Obtain the cascade realization for the following systems :

(i) $$H(z) = \frac{\left(1+\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}\right)\left(1-\frac{3}{2}z^{-1}+z^{-2}\right)}{\left(1+z^{-1}+\frac{1}{4}z^{-2}\right)\left(1+\frac{1}{4}z^{-1}+\frac{1}{2}z^{-2}\right)}$$

(ii) $$H(z) = \frac{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{2}z^{-1}+\frac{1}{4}z^{-2}\right)}{\left(1+\frac{1}{4}z^{-1}\right)\left(1+z^{-1}+\frac{1}{2}z^{-2}\right)\left(1-\frac{1}{4}z^{-1}+\frac{1}{2}z^{-2}\right)}$$ (10 Marks)

8 a. Design an ideal lowpass filter with a frequency response $H_d(e^{jw}) = 1$ for $-\pi/2 \le w \le \pi/2$
$= 0$ for $\pi/2 \le |w| \le \pi$
Find the values of h(n), for N = 11. Find H(z). Plot the magnitude response. (10 Marks)
b. Explain the design of FIR filter using wndows. (10 Marks)

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