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10MT74

Seventh Semester B.E. Degree Examination, Jan./Feb. 2021
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain the relationship between Z-transform and DFT. **(05 Marks)**

b. Find the Z-transform of the sequence x(n) = {1, 0, 2, 0}. Using Z-transform result find DFT. **(05 Marks)**

c. Compute 8-point DFT of a sequence $x(n) = (-1)^{n+1}$ $0 \le n \le 7$. Also plot the magnitude of DFT. **(10 Marks)**

2 a. State and prove circular convolution property of DFT. **(10 Marks)**

b. Compute the output of a linear filter given the impulse response h(n) = {1, 1, 1} and an input to be a long sequence x(n) = {1, 2, 0, -3, 4, 2, -1, 1, -2, 3, 2, 1, -3} using overlap Add method, 8- point circular convolution. **(10 Marks)**

3 a. State and prove the properties of phase Factor. **(06 Marks)**

b. Calculate the number of complex multiplications and complex additions required for the direct computation of DFT and FFT algorithms for N = 16, 128. **(04 Marks)**

c. If $x_1(n) = \{1, 2, 0, 1\}$ and $x_2(n) = \{1, 3, 3, 1\}$ obtain $x_1(n)$ Ⓝ $x_2(n)$ by using DIT-FFT algorithm. **(10 Marks)**

4 a. Derive the expression and draw the signal flow graph for 8- point DFT using decimation in time. **(10 Marks)**

b. First five point of the eight point DFT of a real valued sequence is given by X(0) = 0, X(1) = 2 + J2, X(2) = –J4, X(3) = 2 – J2, X(4) = 0. Determine the remaining points and also find the original sequence x(n) using Decimation in Frequency FFT algorithm. **(10 Marks)**

PART – B

5 a. Design Butterworth filter for the following specification

$$0.8 \le H_a(s) \le 1 \quad \text{for } 0 \le F \le 1000\text{Hz}$$
$$H_a(s) \ge 0.2 \quad \text{for } F \ge 5000\text{Hz}$$
(10 Marks)

b. Let $H(s) = \dfrac{1}{s^2 + s + 1}$ represents the transfer function of a lowpass filter with passband of 1 rad/sec. Use freqeunce transformation to find the transfer function of the following analog filters.

i) A law pass filter with passband of 10r/s
ii) A high pass filter with cut-off frequency 10r/s
iii) A bandpas filter with cut-off frequencies 10r/s and 20r/s. **(10 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

6 a. The desired frequency response of the lowpass filter is given by

$$H_d(e^{J\omega}) = H_d(\omega) = \begin{cases} e^{-J3\omega}, & |\omega| < \frac{3\pi}{4} \\ 0, & \frac{3\pi}{4} < |\omega| < \pi \end{cases}$$

Determine the frequency response of the FIR filter if the Hamming window is used with $N = 7$. **(10 Marks)**

b. Design a lowpass FIR filter using frequency sampling techniques having cutoff frequency of $\frac{\pi}{2}$ rad/s. The filter should have linear phase and length of 17. **(10 Marks)**

7 a. Design a digital lowpass Butterworth filter using bilinear transformation method to meet the following specification take T = 2sec.
Passband ripple ≤1.25dB. Passband edge = 200Hz
Stopband attenuation ≥ 15dB. Stopband edge = 400Hz
Sampling frequency 2KHz. **(10 Marks)**

b. Derive the transformation of IIR filter using Impulse invariance and verify whether it satisfies the sufficient and necessary conditions of mapping. **(10 Marks)**

8 a. Obtain the cascade, Direct form I, and II for the given difference equation
$y(n) = \frac{3}{4}y(n-1) - \frac{1}{8}y(n-2) + x(n) + \frac{1}{3}x(n-1)$. **(10 Marks)**

b. A FIR filter is given by $y(n) = x(n) = + \frac{2}{5}x(n-1) + \frac{3}{4}x(n-2) + \frac{1}{3}x(n-3)$.
Draw the lattice structure. **(10 Marks)**

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