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CBCS SCHEME

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17EC52

fImportant 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.

VTU-23-02-2022 08:40:30am - SF - SF - SF - SF - SF
23-02-2022 09:05:34am - SF - SF - SF - SF

Fifth Semester B.E. Degree Examination, Feb./Mar.2022
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. Define DFT. Establish the relationship of DFT with z-transform and DTFT. **(05 Marks)**

b. Compute the DFT of the sequences :

i) $x(n) = \cos\frac{2\pi}{N}k_0 n$

ii) $x_2(n) = \delta(n) + 2\delta(n-1) + 3\delta(n-2) + 4\delta(n-3)$. **(10 Marks)**

c. Determine the inverse DFT of the sequence y(k) = [0, 2 – 2j, 0, 2 + 2j]. **(05 Marks)**

OR

2 a. Evaluate the circular convolution of the following two sequences using concentric circle method.

$x_1(n) = [2, 1, 2, 1, 3]$, $x_2[n] = [1, 2, 3, 4]$. **(10 Marks)**

b. The first five points of eight point DFT of a real valued sequence are (0.25, 0.125 – j0.30, 0, 0.125 – j0.05, 0).

Determine :

i) Remaining points ii) x(0) iii) x(4) iv) $\sum_{n=0}^{7} x(n)$ v) $\sum_{n=0}^{7} |x(n)|^2$. **(10 Marks)**

Module-2

3 a. State and prove the following properties of DFT

i) Circular time reversal

ii) Circular frequency shift

iii) Parseval's theorem. **(12 Marks)**

b. If X(k) is the DFT of the sequence x(n). Determine the N point DFT of the sequences

$x_c(n) = x(n)\cos\frac{2\pi k_0 n}{N}$ and

$x_s(n) = x(n)\sin\frac{2\pi k_0 n}{N}$ interms of x(k). **(08 Marks)**

OR

4 a. How many complex multiplications and additions required for computing DFT using direct DFT and FFT algorithm for N = 512. **(06 Marks)**

b. Consider a FIR filter with impulse response h(n) = [3, 2, 1]. If the input sequence x(n) = [2, 1, –1, –2, –3, 5, 6, –1, 2, 0, 2, 1] using overlap save method. Use 8 point circular convolution. **(14 Marks)**

Module-3

5 a. Develop 8 – point DIT – FFT algorithm. **(10 Marks)**

b. Compute DFT of the sequence x(n) = [1, 2, 3, 4, 4, 3, 2, 1] using DIF-FFT algorithm. **(10 Marks)**

OR

6 a. Perform circular convolution of the sequences x(n) = [1, 2, 3, 4] and h(n) = [1, 1, 1, 1,] using DIF FFT algorithm. **(10 Marks)**

b. With relevant equations, explain Goertzel and chirp Z – transform algorithm. **(10 Marks)**

Module-4

7 a. Design an IIR lowpass analog butter worth filter that meets following specification.

$$0.8 \le |H(j\Omega)| \le 1 \quad \text{for} \quad 0 \le \Omega \le 0.2\pi$$
$$|H(j\Omega)| \le 0.2 \quad \text{for} \quad 0.6\pi \le \Omega \le \pi$$
(12 Marks)

b. Let $H(s) = \frac{1}{5^2 + \sqrt{2}s + 1}$ represent the transfer function of low pass filter with a passband of 1 rad/sec. Use frequency transformation to find the transfer function of the following analog filters.

i) A lowpass filter with passband of 10 rad/sec

ii) A high pass filter with cut off frequency of 10 rad/sec. **(08 Marks)**

OR

8 a. Realize the filter described the transfer function :

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

Using cascade and parallel from structure. **(10 Marks)**

b. The system function of an analog filter is given as $H_a(s) = \frac{1}{(s+1)(s+2)}$. Obtain H(z) using impulse invariant and bilinear transform method. take sampling frequency of 5 samples/sec. **(10 Marks)**

Module-5

9 a. Realize FIR filter with impulse response h(n) = [1, 2, 3, 4, 3, 2, 1] using direct form and linear phase structure. **(10 Marks)**

b. Draw direct form I and Lattice structure for the filter given by

$$y(n) = x(n) + \frac{2}{5}x(n-1) + \frac{3}{4}x(n-2) + \frac{1}{3}x(n-3).$$
(10 Marks)

OR

10 a. Name any four types of windows used in the design of FIR filters. Write the analytical equations and draw the magnitude response characteristics of each window. **(08 Marks)**

b. Determine the filter coefficients $h_d(n)$ for the desired frequency response of a lowpass filter given by

$$H_d(e^{j\omega}) = \begin{cases} e^{-j2\omega} & \text{for} \quad \frac{-\pi}{4} \le \omega \le \frac{\pi}{4} \\ 0 & \text{for} \quad \frac{\pi}{4} \le |\omega| \le \pi \end{cases}$$

Also determine h(n) and frequency response $H(e^{j\omega})$ using Hamming window. **(12 Marks)**

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