CBCS SCHEME

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18EC52

Fifth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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. Compute N-point DFT of the following signals :
i) $x(n) = a^n$, $0 \le n \le N-1$
ii) $x(n) = 1$, $0 \le n \le N-1$. **(10 Marks)**

b. Determine 4-point circular convolution of the sequences.
$x_1(n) = \{2, 1, 2, 1\}$ and $x_2(n) = \{1, 2, 3, 4\}$ using graphical method. **(05 Marks)**

c. Compute the DFT of the sequence defined by $x(n) = (-1)^n$ for i) N = 3 ii) N = 4. **(05 Marks)**

OR

2 a. Illustrate the following properties of DFT :
i) Linearly
ii) Circular time shift **(10 Marks)**

b. Compute the IDFT of 4-point sequence :
$X(K) = \{4, -j2, 0, J2\}$ using DFT. **(10 Marks)**

Module-2

3 a. Develop radix – 2 decimation – in – time FFT algorithm and write signal flow graph for N = 8. **(10 Marks)**

b. i) Compute the 4-point DFT of the sequence $x(n) = \{1, 0, 1, 0\}$ using DIT FFT radix – 2 algorithm.
ii) Find x(n) for X(K) found in part(i) by DIF FFT algorithm. **(10 Marks)**

OR

4 a. Find the o/p y(n) of a filter whose impulse response is $h(n) = \{3, 2, 1, 1\}$ and input $x(n) = \{1, 2, 3, 3, 2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1\}$ using overlap – add method assuming the length of block is 7. **(10 Marks)**

b. Explain overlap-save method to find the output of the filter. **(10 Marks)**

Module-3

5 a. Explain any three window functions to design FIR filters. **(10 Marks)**

b. A lowpass filter is to be designed with the following desired frequency response

$$H_d(e^{jw}) = H_d(w) = \begin{cases} e^{-j2w}, & |w| < \frac{\pi}{4} \\ 0, & \frac{\pi}{4} |w| < \pi \end{cases}$$

Determine the filter coefficients $h_d(n)$ and h(n) if w(n) is a rectangular window defined as follows :

$$w_R(n) \begin{cases} 1, & 0 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}$$

Also, find the frequency response, H(w) of the resulting FIR filter. **(10 Marks)**

OR

6 a. Realize the FIR filter whose impulse response is given by

$$h(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2) + \frac{1}{4}\delta(n-3) + \delta(n-4).$$ **(10 Marks)**

b. Consider a three stage FIR Lattice structure having the co-efficient $K_1 = -0.65$, $k_2 = -0.34$ and $k_3 = 0.8$. Realize this filter in direct form. **(10 Marks)**

Module-4

7 a. Compare IIR filter with FIR filter. **(10 Marks)**

b. Derive an expression for the order of analog Butterworth prototype low pass filter. **(10 Marks)**

OR

8 a. Design an Buterworth filter for which gain $K_p = 0.5$, $K_s = 0.1$ and passband frequency is 2 rad/sec, stopband frequency is 10 rad/sec. **(10 Marks)**

b. Draw the block diagrams of direct form – I realizations for a digital IIR filter described by the system function :

$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{\left(z - \frac{1}{4}\right)\left(z^2 - z + \frac{1}{2}\right)}.$$ **(10 Marks)**

Module-5

9 a. Discuss briefly the following DSP hardware units :
i) MAC unit ii) Shifter iii) Address generators. **(10 Marks)**

b. Convert the following decimal numbers into Q – 15 representation :
i) 0.560123 ii) 0.160123. **(10 Marks)**

OR

10 a. Explain briefly the basic architecture of TMS320C54X family processor. **(10 Marks)**

b. Discuss the following IEEE floating – point formats
i) Single precision format
ii) Double precision format. **(10 Marks)**

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