CBCS SCHEME

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15EC52

Fifth Semester B.E. Degree Examination, June/July 2023
Digital Signal Processing

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define DFT and IDFT of a signal obtain the relationship between of DFT and z – transform. **(06 Marks)**

b. Compute circular convolution using DFT and IDFT for the following sequences, $x_1(n) = \{2, 3, 1, 1\}$ and $x_2(n) = \{1, 3, 5, 3\}$. **(10 Marks)**

OR

2 a. The first five samples of the 8 – point DFT x(k) are given as follows : $x(0) = 0.25$, $x(1) = 0.125 - j0.3018$, $x(4) = x(6) = 0$, $x(5) = 0.125 - j0.0518$. Determine the remaining samples, if the x(n) is real valued sequence. **(04 Marks)**

b. State and prove the circular time shift and circular frequency shift properties. **(06 Marks)**

c. If $x(n) = \{1, 2, 0, 3, -2, 4, 7, 5\}$, evaluate the following :

i) x(0) ii) x(4) iii) $\sum_{n=0}^{7} x(k)$. **(06 Marks)**

Module-2

3 a. Let x(n) be a finite length sequence with $X(K) = \{10, 1-j, 4, 1+j\}$, using properties of DFT, find the DFT of the followings:

(i) $x_1(n) = e^{j\frac{\pi}{2}n} x(n)$

(ii) $x_2(n) = \left\{\cos\frac{\pi}{2}n\right\} x(n)$ **(08 Marks)**

b. Find the response of an LTI system with an impulse response $h(n) = \{3, 2, 1\}$ for the input $x(n) = \{2, -1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1\}$, using overlap add method. Use 8-point circular convolution. **(08 Marks)**

OR

4 a. State and prove the,

(i) Modulation property. (ii) Circular time shift property. **(08 Marks)**

b. Consider a finite duration sequence $x(n) = \{0, 1, 2, 3, 4, 5\}$

(i) Find the sequence, y(n) with 6 point DFT is $y(K) = W_2^K X(K)$.

(ii) Determine the sequence y(n) with 6-point DFT $y(K) = \text{Real}[X(K)]$. **(08 Marks)**

Module-3

5 a. Given $x(n) = \{1, 0, 1, 0\}$, find x(2) using Goertzel algorithm. **(06 Marks)**

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

OR

6 a. What is chirp–z transform? Mention its applications? **(06 Marks)**

b. Find the 4-point circular convolution of x(n) and h(n) give below, using radix–2. DIF–FFT algorithm.

$x(n) = \{1, 1, 1, 1\}$

$h(x) = \{1, 0, 1, 0\}$. **(10 Marks)**

Module-4

7 a. Design a digital low pass Butterworth Filter using bilinear transformation to meet the following specifications:

$-3\,dB \le |H(e^{j\omega})| \le -1\,dB$ for $0 \le \omega \le 0.5\pi$

$|H(e^{j\omega})| \le -10\,dB$ for $0.7\pi \le \omega \le \pi$ **(10 Marks)**

b. Obtain the parallel form of realization of a system difference equation,

$y(n) = 0.75y(n-1) - 0.125y(n-2) + 6x(n) + 7x(n-1) + x(n-2)$ **(06 Marks)**

OR

8 a. Convert the analog filter with system function,

$H_a(s) = \dfrac{s+0.1}{(s+0.1)^2+9}$ into a digital IIR filter by means of the impulse invariance method. **(08 Marks)**

b. Obtain the DF-I and cascade form of realization of the system function,

$$H(z) = \frac{1+\frac{1}{3}z^{-1}}{\left(1-\frac{1}{5}z^{-1}\right)\left(1-\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}\right)}.$$ **(08 Marks)**

Module-5

9 a. Obtain direct form – I, Form – II, Cascade and parallel form of realization for the following System. $y(n) = 0.75\,y(n-1) - 0.125\,y(n-2) + 6x(n) + 7x(n-1) + x(n-2)$. **(12 Marks)**

b. Realize an FIR filter given $h(n) = \left(\frac{1}{2}\right)^n [u(n) - u(n-4)]$ using direct form – I. **(04 Marks)**

OR

10 a. Write equations of any four different windows used in design of FIR filters. **(10 Marks)**

b. Design the symmetric FIR, lowpass filter whose desired frequency response is given as

$$H_d = (w) = \begin{cases} e^{-jwt} \text{ for } |w| \le w_e \\ 0 \text{ otherwise} \end{cases}$$

The length of the filter should be 7 and $w_c = 1$ radian/sample use rectangular window. **(06 Marks)**

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