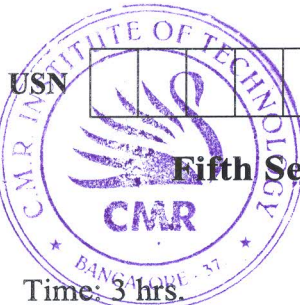


CBCS SCHEME



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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

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

- 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)
 - State and prove the circular time shift and circular frequency shift properties. (06 Marks)
 - If $x(n) = \{1, 2, 0, 3, -2, 4, 7, 5\}$, evaluate the following :
 - $x(0)$
 - $x(4)$
 - $\sum_{n=0}^7 x(k)$.(06 Marks)

Module-2

- Let $x(n)$ be a finite length sequence with $X(K) = \{1, 1-j, 4, 1+j\}$, using properties of DFT, find the DFT of the followings:
 - $x_1(n) = e^{j\frac{\pi}{2}n} x(n)$
 - $x_2(n) = \left\{ \cos \frac{\pi}{2}n \right\} x(n)$ (08 Marks)
 - 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

- State and prove the,
 - Modulation property.
 - Circular time shift property. (08 Marks)
 - Consider a finite duration sequence $x(n) = \{0, 1, 2, 3, 4, 5\}$
 - Find the sequence, $y(n)$ with 6 point DFT is $y(K) = W_2^K X(K)$.
 - Determine the sequence $y(n)$ with 6-point DFT $y(K) = \text{Real}[X(K)]$. (08 Marks)

Module-3

- Given $x(n) = \{1, 0, 1, 0\}$, find $x(2)$ using Goertzel algorithm. (06 Marks)
 - 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:
 $-3 \text{ dB} \leq |H(e^{j\omega})| \leq -1 \text{ dB}$ for $0 \leq \omega \leq 0.5\pi$
 $|H(e^{j\omega})| \leq -10 \text{ dB}$ for $0.7\pi \leq \omega \leq \pi$ (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,
 $H_a(s) = \frac{s+0.1}{(s+0.1)^2 + 9}$ 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)

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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
 $H_d = (w) = \begin{cases} e^{-jw} & \text{for } |w| \leq w_c \\ 0 & \text{otherwise} \end{cases}$
 The length of the filter should be 7 and $w_c = 1$ radian/sample use rectangular window. (06 Marks)
