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Following Paper ID and Roll No. to be filled in your Answer Book.

PAPER ID : 23456 Roll No. | | | | | | | | | | |

B. Tech. Examination 2021-22

(Even Semester)

DIGITAL SIGNAL PROCESSING

Time : Three Hours] *[Maximum Marks : 60*

Note :– Attempt all questions.

SECTION – A

1. Attempt all parts of the following : 8×1=8

   (a) Write down the expression for one sided z transform.

   (b) Explain linearly property of Z transform.

   (c) What do you meanby periodictiy of the DFT?

   (d) Define causal systems.

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(e) What is the minimum sampling rate required to avoid aliasing for the signal

$$x(t) = 2 \cos 100 \pi t$$

(f) Write down the condition for a real valued sequence X (n) to be an even sequence.

(g) Determine if the systems described by :

$$y(n) = n\, x(n)$$

is linear or non-linear.

(h) Write down the statement of initial value theorem.

SECTION – B

2. Attempt any two parts of the following : $2 \times 6 = 12$

(a) Determine the z transform of the following finite duration signals :

(i) $x(n) = \left\{ 3 \quad 1 \quad 2 \quad \underset{\uparrow}{5} \quad 7 \quad 0 \quad 1 \right\}$

(ii) $x(n) = \left\{ 2 \quad 4 \quad \underset{\uparrow}{5} \quad 7 \quad 0 \quad 1 \quad 2 \right\}$

(iii) $x(n) = \{0, 0, 1, 2, 5, 4, 0, 1\}$

(b) Explain in detail the chirp-z algorithm.

(c) Determine the unit sample response of the ideal low pass filter. Also prove that it is not realizable.

(d) Show that the convolution in time domain is the same as product in frequency domain.

SECTION – C

Note :– Attempt all questions. Attempt any two parts from each questions. $5 \times 8 = 40$

3. (a) Determine the inverse z transform of :

$$x(z) = \frac{z}{3z^2 - 4z + 1}$$

if the ROC are :

(i) $|z| > 1$

(ii) $|z| < \frac{1}{3}$

(b) Determine the DFT of the following sequence :

$$x(n) = \begin{cases} \frac{1}{4}, & \text{for } 0 \le n \le 2 \\ 0, & \text{otherwise} \end{cases}$$

(c) Perform the circular convolution of the following two sequences :

$$x_1(n) = \left\{ \begin{matrix} 2 & 1 & 2 & 1 \\ \uparrow & & & \end{matrix} \right\}$$

$$x_2(n) = \left\{ \begin{matrix} 1 & 2 & 3 & 4 \\ \uparrow & & & \end{matrix} \right\}$$

4. (a) Determine DFT (8-point) for a continuous time signal $x(t) = \sin(2\pi ft)$ with $f = 50$ Hz.

(b) Establish the relationship between DFT and z transform.

(c) Obtain direct form I and II realizations for a third order HR transfer function :

$$H(z) = \frac{0.28\,z^2 + 0.319\,z + 0.04}{0.5\,z^3 + 0.3\,z^2 + 0.17\,z - 0.2}$$

5. (a) Explain Goertzel algorithm for efficient DFT computation.

(b) Develop cascade and parallel realization structures for the following :

$$H(z) = \frac{z/6 + 5/24 + \left(5/24\right)z^{-1} + \frac{1}{24}z^{-2}}{1 - \frac{1}{2}z^{-1} + \frac{1}{4}z^{-2}}$$

(c) A low pass filter has the desired response as given below :

$$H_d\left(e^{jiQ}\right) = \begin{cases} e^{-jzw}, & 0 \le w < \frac{\pi}{2} \\ 0, & \frac{\pi}{2} \le w \le \pi \end{cases}$$

Determine the filter coefficients h (n) for M = 7, using Type-I frequency sampling technique.

6. (a) An analog filter has the following system function. Convert this filter into a digital filter using backward difference for the derivative :

$$H(s) = \frac{1}{(s+0.1)^2 + 9}$$

(b) Explain the design of IIR filter by the bilinear transformation method. What are the advantages and disadvantages of this method?

(c) Explain the design of Hilbert transform. What are the applications of Hilbert transform?

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