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Total Number of Pages: 02

Course: IDD (B.Tech and M.Tech)
Sub_Code: REC5C001

5th Semester Regular/Back Examination: 2024-25

SUBJECT: Digital Signal Processing

BRANCH(S): AEIE, ECE, ELECTRONICS & C.E, ETC, EIE, ECE

Time: 3 Hours

Max Marks: 100

Q.Code: R228

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 Answer the following questions: (2 x 10)

- a) Define a LTI system.
- b) What is the ROC in Z-transform of an impulsive signal?
- c) What is the order of complexity of the discrete Fourier transform?
- d) How do you define BIBO stability for an LTI system?
- e) Define the nonlinearity relation between the analog and digital frequency in bilinear transform method.
- f) Define the discrete cosine transform.
- g) How do you define circular convolution?
- h) What are the different methods to find the inverse Z-Transform?
- i) Define the homogeneity and additivity property of DFT.
- j) What are the methods to design IIR filters?

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- a) Determine the Z-transform of the signal $x(n) = 2\delta(n) + 2^n u(n-1)$
- b) Find the 4-pt radix-2 DIF-FFT of $x(n) = 3^n$, $1 < n < 6$
- c) Design the direct form structure of the FIR system described by $G(z) = 3 + \frac{3}{4}z^{-1} + \frac{1}{4}z^{-2} + \frac{6}{7}z^{-3} + \frac{1}{7}z^{-4} + \frac{3}{5}z^{-5}$.
- d) Compute the cross correlation between $x(n) = \{1, -1, 1\}$ and $y(n) = \{1, 1, 3\}$
- e) Find the N-point DFT of a^n for $0 < a < 1$.
- f) List and derive any three properties of Z-Transform.
- g) Check if the system described below is LTI or not?

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

h) Design the direct form – II filter with transfer function $H(z) = \frac{1+2z^{-1}}{1-4z^{-1}-2z^{-2}}$.

i) Using partial fraction method, find the inverse z-Transform of the following transfer function, $H(z) = \frac{z^{-1}-2}{16z^{-2}+12z^{-1}+2}$.

j) Use the overlap add method, to find the long-division convolution between $x(n) = \{2, -1, 1, 1, 2, -1, 0, 1, 2, 1, 0, 1, 2, 1, 2, 0, 1, 1, -1\}$ and $h(n) = \{1, -2, 1, -2\}$

k) Differentiate between linear convolution and correlation with the help of suitable example.

l) Compute the convolution of $x(n) = \{1, -2, 1\}$ and $y(n) = \{2, -2, 1\}$ using Z-Transform/inverse Z-transform method.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 a) $X(k) = \{36, -4 + j9.7, -4 + j4, -4 + j1.7, -4, -4 - j1.7, -4 - j4, -4 - j9.7\}$ find $x(n)$ (8x2) using DIF-FFT Algorithm.

b) Let $x_1(n) = x_2(n) = \begin{cases} 5 & 0 \leq n \leq N-1 \\ 0 & \text{otherwise} \end{cases}$
 Find the circular convolution between $x_1(n)$, $x_2(n)$.

Q4 Write Short Notes (Any Two) (8x2)

- a) Adaptive noise cancellation
- b) Windows Method for Filter design
- c) Adaptive filtering
- d) Discrete Cosine Transform

Q5 a) Apply bilinear transform to $H(s) = \frac{21}{(s+19)(s+13)}$ with $T = 0.25$ sec and find $H(z)$. (8x2)

b) Convert the analog IIR filter into the digital IIR using impulse invariant method for given transfer function $H(S) = \frac{(S+7)}{(S+7)^2+49}$

Q6 The output of an impulse response is given by $H(z) = \frac{16z(z^2-8)}{15z^3-5z^2+3z-5}$, write the equation and then draw the block diagram of:

- a) Direct-form-I
- b) Direct form-II
- c) Cascade Direct Form-I