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Total Number of Pages: 02

Course: IDD (B.Tech and M.Tech)  
Sub\_Code: REC5C001

5<sup>th</sup> 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)

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

- Determine the Z-transform of the signal  $x(n) = 2\delta(n) + 2^n u(n-1)$
- Find the 4-pt radix-2 DIF-FFT of  $x(n) = 3^n, 1 < n < 6$
- Design the direct form structure of the FIR system described by  $G(z) = 3 + \frac{3}{4}z^{-1} + \frac{1}{4}z^{-2} + \frac{6}{7}z^{-3} + \frac{1}{7}z^{-4} + \frac{3}{5}z^{-5}$ .
- Compute the cross correlation between  $x(n) = \{1, -1, 1\}$  and  $y(n) = \{1, 1, 3\}$
- Find the N-point DFT of  $a^n$  for  $0 < a < 1$ .
- List and derive any three properties of Z-Transform.
- 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)

- Adaptive noise cancellation
- Windows Method for Filter design
- Adaptive filtering
- 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 (16)  
the equation and then draw the block diagram of:

- Direct-form-I
- Direct form-II
- Cascade Direct Form-I