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Total Number of Pages: 02

B.Tech/ & IDD(B.Tech and M.Tech)

REL4G001, RCS4G002, REL4G001, RCS4G002,
REE4G001, RIT4G002, REC5C001

4th/6th Semester Regular/Back Examination: 2023-24

DIGITAL SIGNAL PROCESSING

EE, CSE, CSEAI, CSEAIME, CSEDS, CST, CSE, EEE, CSE, IT, BIOTECH

Time: 3 Hour

Max Marks: 100

Q.Code : P166

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) Describe Energy and Power signal with an example.
 - b) What is BIBO in reference to stability of a system ?
 - c) What is zero padding? What are its applications?
 - d) What do you mean by 'twiddle factor' of DFT & show how it is cyclic?
 - e) What is frequency pre-warping effect?
 - f) State the Time Reversal Property in DFT.
 - g) In an N-point FFT, how many complex additions are required?
 - h) What is the reason that FIR filter is always stable?
 - i) State the characteristics of Adaptive Signal Processing.
 - j) What do you mean by mean square error?

Part-II

- Q2** Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)
- a) Express the given signal sequence as time shifted impulse $x(n)=\{1, 3, 4, -7, 8, -15, 18, 20\}$.
 - b) Differentiate between odd and even signal with suitable example and neat diagram.
 - c) Check whether the given systems are linear, shift variant, causal and stable

$$y[n] = x[n] + n x[n+1]$$

- d) Find $X(\infty)$ if $X(z)$ is given by, $X(z) = \frac{z^2}{(z-1)(z-0.3)}$.
- e) Find the inverse z- transform of $X(z) = \frac{1+3z^{-1}}{1+3z^{-1}+2z^{-2}}$ for $|z|>2$.
- f) Compute the convolution of the following signals by means of z-transform.

$$x_1(n) = \begin{cases} \left(\frac{1}{3}\right)^n, & n \geq 0 \\ \left(\frac{1}{2}\right)^n, & n < 0 \end{cases}$$

$$x_2(n) = \left(\frac{1}{2}\right)^n u(n)$$

- g) Perform the circular convolution of the following two sequences $x_1(n) = \{2, 1, 2, 1\}$ and $x_2(n) = \{1, 2, 3, 4\}$ using the time domain formula.
- h) For the analog transfer function $F(s) = \frac{2}{(s+1)(s+2)}$. Determine its digital equivalent using bilinear transformation method taking $T = 1$ sec.

- i) Realize the given system in Direct Form-I

$$y[n] = 0.5y[n-1] - 0.25y[n-2] + x[n] + 0.4x[n-1]$$

- j) Obtain the cascade structures for the system represented by the difference equation:

$$Y(n) = 0.1 y(n-1) + 0.2 y(n-2) + 3x(n) + 3.6 x(n-1) + 0.6 x(n-2)$$

- k) Write short note on Architecture of ADSP series of digital signal processors.
- l) Explain LMS algorithm in terms of gradient descent method.

Part-III

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

- Q3** Describe an LTI system with an example? Show that an LTI system combined with time scaling property may result in a Time-variant system. **(16)**
- Q4** Perform linear convolution of the following sequence by overlap-add and overlap-save method. **(16)**
- $x(n) = \{1, -1, 2, -2, 3, -3, 4, -4\}$, $h(n) = \{-1, 1\}$ and compare the result.
- Q5** Compute the DFT of the sequence $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$ using the decimation in frequency (DIF) algorithm. **(16)**
- Q6** Explain the method of designing a linear-phase FIR filter using windows with supporting mathematical expressions. What are the basic differences between FIR and IIR Filter (at least four)? **(16)**