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Paper Code : OE-601A/OE-EE601A Digital Signal Processing

UPID : 006623

Time Allotted : 3 Hours *Full Marks :70*

The Figures in the margin indicate full marks.
Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer *any ten* of the following : [1 x 10 = 10]

(I) Define region of convergence in z-transform.

(II) In the Radix-2 FFT algorithm, how many stages are required for a signal of length N?

(III) Which filters exhibit oscillation in transition region?

(IV) The mathematical technique commonly used to estimate the parameters of an ARMA (AutoRegressive Moving Average) model is_____

(V) What is the condition to be satisfied for a discrete-time signal to be even?

(VI) The inverse z-transform converts a function in the z-domain to a function in the_____.

(VII) If there is m elements in $x(n)$ and Nelements in $h(n)$, how many elements will be there in $x(n) * h(n)$?

(VIII) Cascading a factor of I interpolator and a factor of D decimator results in a sampling rate conversion by a factor of _____

(IX) The power spectrum of a time series represents_____

(X) The signals that are discrete in time and quantized in amplitude are called_____ signals.

(XI) The Nyquist sampling frequency is _____times of the frequency of original signal.

(XII) Write down the formula to determine N-point IDFT of the sequence $X(k)$.

Group-B (Short Answer Type Question)

Answer *any three* of the following : [5 x 3 = 15]

2. Calculate Discrete Fourier Transform (DFT) of the sequence {1,2,3,4}. [5]

3. Compare FIR and IIR filters. [5]

4. Define strict-sense stationary (SS) and wide-sense stationary (WSS) process. [5]

5. Determine whether the following system is linear, stable, causal and time-invariant using appropriate tests: [5]
$y(n) = nx(n) + x(n+2) + y(n-2)$

6. A function [5]
$X(z) = \frac{1}{z^2 + 2z + 5}$ has a ROC that excludes the unit circle.

Find $x(1)$, the value of the inverse z-transform at n=1, using the residue theorem.

Group-C (Long Answer Type Question)

Answer *any three* of the following : [15 x 3 = 45]

7. (a) Explain time scaling property of discrete time signal with examples. [5]

(b) Determine whether the following discrete-time signal are periodic or not. If periodic, determine the fundamental period. [5]
$x(n) = \sin(0.02\pi n)$

(c) Define Static and Dynamic systems. [5]

8. (a) Using power series expansion method, determine the inverse z- transform of $X(z) = \ln(1 + z^{-1})$; ROC [5]

(b) Find the inverse z-transform of $X(z) = \frac{z^2}{(z-2)(z-3)}$ using convolution property of z-transform. [5]

(c) Find the inverse z-transform of $X(z) = \frac{z^{-1}}{3 - 4z^{-1} + z^{-2}}$; ROC: $|z| > 1$ [5]

9. Perform the linear convolution of the following sequences using [15]
(a) overlap-add method, (b) overlap-save method.
x(n) = {1,-2, 2,-1, 3,-4, 4,-3} and h(n) = {1, -1}

10. (a) Consider a discrete-time linear time invariant system described by the [5]
difference equation $y(n)-\frac{3}{4}y(n-1)+\frac{1}{8}y(n-2)=x(n)+\frac{1}{3}x(n-1)$. where, $y(n)$ is the output and $x(n)$is the input. Assuming that the system is relaxed initially, obtain the unit sample response of the system.

(b) An LTI system is described by the equation [10]
$y(n)=x(n)+0.81x(n-1)-0.81x(n-2)-0.45y(n-2)$ Determine the transfer function of the system,sketch the poles and zeros on the z-plane and assess the stability.

11. (a) Discuss the frequency sampling method of FIR filter design. [8]

(b) Describe Kaiser Window method in filter design. [7]

*** END OF PAPER ***