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Paper Code : EC602 DIGITAL SIGNAL PROCESSING

UPID : 006032

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) Which of the following is the difference equation of the FIR filter of length M, input $x(n)$ and output $y(n)$?

a) $y(n) = \sum_{k=0}^{M+1} b_k x(n+k)$

b) $y(n) = \sum_{k=0}^{M+1} b_k x(n-k)$

c) $y(n) = \sum_{k=0}^{M-1} b_k x(n-k)$

d) None of the mentioned

(II) What are the type of digital signal processor?

(III) The system described by the input-output equation $y(n) = nx(n) + bx^3(n)$ is a _____

(IV) Which is the commutative property of the LTI System in case of discrete time system?

a) $x[n] + h[n] = h[n] + x[n]$

b) $x[n] + h[n] = h[n] * x[n]$

c) $x[n] * h[n] = h[n] * x[n]$

d) $x[t] * h[t] = h[n] * x[n]$

(V) If $X(z)$ is the z-transform of the signal $x(n)$, then what is the z-transform of the signal $x(-n)$?

(VI) The convolution using convolution sum formula is called _____

(VII) The z-transform of a sequence $x(n)$ which is given as $X(z) = \sum_{k=-\infty}^{\infty} x(n)z^{-n}$ is known as _____

(VIII) The Convolution property of DFT says that $\text{DFT}\{x(n)*h(n)\}$

(IX) The Cooley-Tukey algorithm of FFT is a _____

(X) What is the magnitude response $|W(\omega)|$ of a rectangular window function?

(XI) $x(n)*\delta(n-k) = ?$

(XII) A continuous time LTI system has memory only when _____

Group-B (Short Answer Type Question)

Answer any three of the following :

[5 x 3 = 15]

2. Perform circular convolution of the two sequences. [5]

$$X_1(n) = \{2, 1, 2, 1\} \text{ and } X_2(n) = \{1, 2, 3, 4\}$$



3. Prove that $Z[a^n] = \frac{z}{z-a}$ is $|z| > |a|$. [5]

4. Determine the system is Linear or Non Linear:- $y(n) = x^2(n)$ [5]

5. State the difference between linear and circular convolution. [5]

6. State the difference between Overlap add method and Overlap save method [5]

Group-C (Long Answer Type Question)

Answer any three of the following :

[15 x 3 = 45]

7. Perform the Linear convolution of the following sequences by Overlap add method [15]

$$X(n) = \{1, 2, 3, -1, -2, -3, 4, 5, 6\} \text{ and } h(n) = \{2, 1, -1\}$$

8. (a) Write down the properties of ROC in z transform [7]

(b) The transfer function of a system is given by $H(z) = 1/(1-0.5z^{-1}) + 1/(1-2z^{-1})$. Determine the stability and causality of the system for a) ROC : $|z| > 2$ b) ROC: $|z| < 0.5$. [8]

9. Perform the Linear convolution of the following sequences by overlap save method. [15]

$$X(n) = \{1, 2, 3, -1, -2, -3, 4, 5, 6\} \text{ and } h(n) = \{2, 1, -1\}$$

10. (a) Determine the inverse z transform of $X(z) = \log(1+az^{-1}); |z| > |a|$ [7]

(b) [8]

Find $Z^{-1} \left[\frac{z^2}{(z-1)(z-3)} \right]$.

11. (a) What are the difference between hamming and blackman window [5]

(b) Design Butterworth filter using impulse invariant method for the following [10]

specification

$$0.8 \leq |H(e^{j\omega})| \leq 1, \quad 0 \leq \omega \leq 0.2\pi$$

$$|H(e^{j\omega})| \leq 0.2, \quad 0.6\pi \leq \omega \leq \pi$$

*** END OF PAPER ***