WEST BENGAL UNIVERSITY OF TECHNOLOGY

EC-602

DIGITAL SIGNAL PROCESSING

Time Allotted: 3 Hours | Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable

GROUP A
(Multiple Choice Type Questions)

1. Answer any *ten* questions. $10 \times 1 = 10$

(i) The system $y(n) = e^{x(n)}$ is

(A) linear time invariant (B) non linear time invariant
(C) linear time variant (D) none of these

(ii) Why 16 point DFT is preferable than 4 point DFT?

(A) Resolution of spectrum is poor for 4 point DFT than 16 point DFT
(B) Resolution of spectrum is high but not reliable in 4 point DFT
(C) Calculation of 4 point DFT is more complex
(D) None of these

(iii) If $x(n) = \{1, 0, 0, 1\}$, the DFT value $x(0)$ is,

(A) 2 (B) $1 + j$
(C) 0 (D) $1 - j$

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(iv) Overlap save method is used to find

(A) circular convolution (B) linear convolution
(C) both (A) & (B) (D) none of these

(v) The direct evaluation of DFT requires

(A) N^2 multiplication N^2 additions
(B) N^2 multiplication $N(N-1)$ additions
(C) $N(N-1)$ multiplication N^2 additions
(D) $N(N-1)$ multiplication $N(N-1)$ additions

(vi) The value of the twiddle factor W_8^4 is given by

(A) 1 (B) $-j$
(C) $\frac{1}{\sqrt{2}} - \frac{j}{\sqrt{2}}$ (D) -1

(vii) $X(n) = \left(\frac{1}{3}\right)^n u(n)$ is

(A) energy signal (B) power signal
(C) both (A) & (B) (D) none of these

(viii) Zero padding of a signal

(A) reduces aliasing (B) increases frequency
(C) increases time resolution (D) has no effect

(ix) A signal is a power signal if

(A) $E < \infty, P = 0$ (B) $P < \infty, E = 0$
(C) $P < \infty, E < \infty$ (D) $P = \infty, E = 0$

(x) The convolution of $u(n)$ with $u(n-4)$ at $n = 5$ is

(A) 5 (B) 2 (C) 1 (D) 0

(xi) For an analog signal $x(t) = 3\cos(50\pi t) + 10\sin(300\pi t)$, the Nyquist sampling rate is

(A) 150 Hz (B) 300 Hz
(C) 25 Hz (D) 50 Hz

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(xii) An LTI system having system function H(z) is said to be stable if,

(A) all the poles of H(z) are located on the origin of the unit circle in z-plane
(B) all the poles of H(z) are located outside the unit circle in z-plane
(C) all the poles of H(z) are located on the unit circle in z-plane
(D) all the poles of H(z) are located inside the unit circle in z-plane

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. 3×5 = 15

2. What is the input sequence $x(n)$ that will generate the output sequence $y(n) = \{1, 5, 10, 11, 8, 4, 1\}$ for a system with impulse response $h(n) = \{1, 2, 1\}$ 5

3. Determine the Z-Transform of the following sequence and find ROC 5
$x(n) = (n+2)(1/2)^n u(n)$.

4. How do you take care warping effect for designing an IIR filter using Bilinear Transform? 5

5. Find the inverse Z-Transform of 5
$X(z) = z^2/(z^2 - 3z + 2)$, ROC: $|z| > 2$

6. What is convolution sum? Find the convolution sum of the Sequences 1+4
$x(n) = \{2, -1, 3, -2\}$ and $h(n) = \{2, -1, 3, -2, 3\}$

7. Define BIBO stability criteria 2+3
Verify the stability of the system having impulse response $h(n) = (1/2)^n u(n)$.

8. For the Sequence $x(n) = \{1, 1, 0, 0, -1, -1, 0, 0\}$ find the 8-point DFT. 5

GROUP C
(Long Answer Type Questions)

Answer any *three* questions. 3×15 = 45

9. (a) Determine the linear convolution and circular convolution of two sequences $x(n) = \{3, 2, 1, 2\}$ & $h(n) = \{1, 2, 1, 2\}$ by graphical method. 5+5
(b) If a discrete-time LTI system is BIBO stable, show that the ROC of its system function H(z) must contain the unit circle. 5

10.(a) Determine the sectional convolution whose impulse response is $h(n) = \{1, 11\}$ and input signal is $X(n) = \{3, -1, 0, 1, 3, 2, 0, 1, 2, 1\}$using overlap save method. 7
(b) Design a symmetric linear phase FIR lowpass filter using rectangular window by taking 7 samples of window sequence and with a cut off frequency, $\omega_c = 0.2\pi$ rad/sample. 8

11.(a) Compute the 8-point DFT of the following sequence: 10+2+3
$x(n) = \{0.5, 0.5, 0.5, 0.5, 0, 0, 0, 0\}$
Use in-place radix-2 decimation in time FFT algorithm.
(b) What is a butterfly regarding FFT?
(c) What are the difference and similarities between DIT and DIF algorithms?

12.(a) For the analog transfer function $H(s) = \frac{2}{s^2 + 3s + 2}$, determine H(z) using impulse invariant transformation if (i) **T = 1second** and (ii) **T = 0.1 second.** 5
(b) Determine the inverse Z-transform of $X(z) = \frac{1}{1 - 0.8z^{-1} + 0.12z^{-2}}$, if (i) ROC is , $|z| > 0.6$ and (ii) ROC is, $0.2 < |z| < 0.6$ 5+5

13. Write short notes on any *three* of the following: 3×5
(a) Causal and non-causal system
(b) Gibbs phenomenon
(c) Window method for designing FIR Filter
(d) TMS 320C 5416 architecture
(e) Recursive and Non-recursive system.