



Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech/EEE(N)/SEM-5/EEE-503/2012-13

2012

DIGITAL SIGNAL PROCESSING

Time Allotted : 3 Hours

Full Marks : 70

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. Choose the correct alternatives for the following :

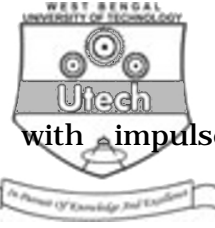
10 × 1 = 10

i) The Z transform of $u (n - 1)$ is

- a) $Z / (Z - 1)$
- b) $1 / Z (Z - 1)$
- c) $Z / (Z + 1)$
- d) none of these.

ii) The Z transform of $\delta (n - 1)$ is

- a) Z
- b) $1 // Z$
- c) $1 / (Z - 1)$
- d) none of these.



iii) The transfer function of a system with impulse response $h(n) = u(n) - u(n-1)$ is

- a) 2
- b) $2/(Z-1)$
- c) 1
- d) $Z/(Z-1)(Z+1)$.

iv) If $x(n)$ is a finite-duration, two-sided sequence, ROC of its Z-transform is entire Z-plane except

- a) $Z = 0$
- b) $Z = 1$
- c) $Z = \infty$
- d) both $Z = 0$ and $Z = \infty$.

v) If $x(n)$ is a sequence of L samples and $h(n)$ of M samples, the convolution of $x(n)$ and $h(n)$ contains

- a) $\text{Max}(L, M)$ samples
- b) $L + M - 1$ samples
- c) $L + M - 2$ samples
- d) $L + M$ samples.



vi) Two non-interacting DTLTI systems in cascade have impulse responses $g(n)$ and $h(n)$, the impulse response of the combination is

- a) $g(n)h(n)$
- b) $g(n) * h(n)$
- c) $g(n) + h(n)$
- d) none of these.

vii) A DTLTI system with impulse response $g(n)$ is BIBO stable if

- a) $\sum |h(n)| \leq \infty$ for all values of n
- b) $\sum |h(n)| \geq \infty$ for all values of n
- c) $\sum |g(n)| \leq \infty$ for all values of n
- d) none of these.

viii) The zero padding indicates

- a) zero appending in $x(k)$ sequence
- b) the values of $X(K) = 0$
- c) dummy sample added with $X(K)$ values
- d) none of these.



ix) If the Z transform of $x(n)$ is $X(Z)$ then the correct one is

- a) Z transform of $x(-n)$ is $X(1/Z)$
- b) Z transform of $x(-n)$ is $X(1/Z^2)$
- c) Z transform of $x(-n)$ is $X(1/Z)$
- d) Z transform of $x(-n)$ is $X(Z)$.

x) A system is described by $y(n) = x(n) + x(n-1)$ the system is

- a) time invariant and linear
- b) time variant and linear
- c) time invariant and nonlinear
- d) time variant and nonlinear.

GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. A DTLTI with impulse response $h(n) = \{ 1, 1, 1 \}$ is excited by a sequence $x(n) = \{ 4, 3, 2, 1 \}$. Determine the output $y(n)$ of the system.

3. Find the DFT of a sequence $x(n) = \{ 1, 1, 1, 0 \}$.



4. The output $y(n)$ and the input $x(n)$ of a discrete-time system are related by the equation $y(n) = e^{x(n)}$. Determine whether the system is linear, time-invariant and stable.

5. Design a digital Butterworth filter using following specifications using Impulse Invariant method :

$$0.9 < H(j\Omega) < 1 \text{ for } 0 < \Omega < 0.2\pi \text{ \& } H(j\Omega) < 0.2 \text{ for } 0.4\pi < \Omega < \pi.$$

GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

6. a) What is ROC ? State its properties. 2

b) Find the system function and impulse response of the system described by

$$y(n) = x(n) + 2x(n-1) - 4x(n-2) + x(n-3)$$

5

c) Find the inverse Z-transform of

$$X(z) = z(z^2 - 4z + 5) / (z - 3)(z - 2)(z - 1) \quad 2 < z < 3.$$

5

d) Prove that an LTI system is BIBO stable if the ROC system function includes the unit circle. 3



7. a) Distinguish between FIR and IIR filters. 2
- b) What is warping effect ? How can you remove this effect ? 3
- c) Convert the analog filter with the system function

$$G(s) = (s + 0.1) / (s + 0.1)^2 + 16$$

into a digital filter using bilinear transformation. The digital filter should have a resonant frequency of $\omega_r = \pi/4$ rad. 10

8. a) Find the DFT of the sequence { 1, 1, 1, 1, 2, 2, 2, 2 } using radix-2 Decimation-in-Time FFT. Sketch the magnitude and phase plot. 10
- b) What is the need for FFT ? 3
- c) What is bit reversal ? 2
9. a) Obtain the mapping formula for the approximation of derivatives method using backward difference. 6
- b) Find the linear convolution using circular convolution for the two sequences 9

$$x(n) = \{ 1, 2, -1, 2, 3, -2, -3, -1, 1, 1, 2, -1 \}$$

$$h(n) = \{ 1, 2 \}$$



10. Write short notes on any *three* of the following : 3 × 5

- a) Gibbs phenomenon
- b) CCS6713 architecture
- c) Finite word length effects in DSP
- d) Fast convolution method.

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