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 : $10 \times 1 = 10$

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 = infinite

d) both $Z = 0$ and Z = infinite.

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) 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) $\Sigma |h(n)| \leq \infty$ for all values of n

b) $\Sigma |h(n)| \geq \infty$ for all values of n

c) $\Sigma |g(n)| \leq \infty$ 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 :

$0{\cdot}9 < H(j\Omega) < 1$ for $0 < \Omega < 0{\cdot}2$ pi & $H(j\Omega) < 0{\cdot}2$ for $0{\cdot}4$ 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

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

$$G(s) = (s + 0{\cdot}1) / (s + 0{\cdot}1)^2 + 16$$

into a digital filter using bilinear transformation. The digital filter should have a resonant frequency of $w_r = \Pi/4$ 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.