Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (CSE)/SEM-8/CS-801C/2010

2010

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 Fourier Transform of a discrete and aperiodic sequence is

      a) continuous and periodic

      b) discontinuous and periodic

      c) continuous and aperiodic

      d) discontinuous and aperiodic.

   ii) If $X\left(e^{j\omega}\right)$ is the Fourier Transform of $x(n)$, what is the Fourier Transform of $nx(n)$?

      a) $j\frac{d}{dw}X\left(e^{w}\right)$ b) $j\frac{d}{dw}X\left(e^{jw}\right)$

      c) $\frac{d}{dw}X\left(e^{jw}\right)$ d) $\frac{d}{dw}X\left(e^{\omega}\right)$.

iii) ROC of a causal signal is the ..... of a circle of some radius *r*.

a) Interior

b) Interior and exterior

c) Exterior

d) None of these.

iv) Which of the following is not a method of evaluating inverse z-transform ?

a) Long division method

b) Short division method

c) Residue method

d) Convolution method.

v) Z-transform of a digital step function is

a) $1/\left(1-z^{-1}\right)$

b) $1/(z-1)$

c) $z/(z-1)$

d) $z/\left(1-z^{-1}\right)$.

vi) If $X(k)$ is DFT of a sequence $x(n)$ then DFT of real part of $x(n)$ is

a) $\frac{1}{2}\left[x(k)+X^*(N-k)\right]$

b) $\left[x(k)\div X^*(N-k)\right]$

c) $\left[x(k)\div X(N-k)\right]$

d) $\left[X^*(k)\div X(N-k)\right]$.

vii) DFT of $x(n) = \delta(n)$ is

a) 2

b) 1

c) 0

d) 3.

viii) Which of the following is not an application of FFT algorithm ?

a) Linear filtering

b) Correlation

c) Spectrum Analysis

d) Aliasing.

ix) The bilinear transform equation between s-plane and z-plane is

a) $s = 2\left[1 - z^{-1}\right] / T\left[1 + z^{-1}\right]$

b) $s = \left[1 - z^{-1}\right] / T\left[1 + z^{-1}\right]$

c) $s = 2\left[1 - z^{-1}\right] / \left[1 + z^{-1}\right]$

d) $s = \left[1 - z^{-1}\right] / \left[1 + z^{-1}\right]$.

x) What is the reason that FIR filter is always stable ?

a) Because all its zeros are at the origin

b) Because all its poles are at the origin

c) Because all its poles and zeros are at the origin

d) None of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Find the DFT of a sequence $x(n)$ = { 1, 2, 3, 4, 4, 3, 2, 1 } using DIT algorithm.

3. Find the Fourier transform of the following :

   a) $(1/2)^{n-1}u(n-1)$

   b) $\delta(n-1)-\delta(n\div 1)$ 3 + 2

4. Find the relationship between *s*-plane and *z*-plane.

5. Find the discrete convolution of the sequence $u(n)*u(n-3)$.

6. Design an analog Butterworth filter that has a –2 dB pass band attenuation at a frequency of 20 rad/sec and an at least –10 dB stop band attenuation at 30 rad/sec. 5

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Find the convolution of the signals

   $x(n) = 1;\ n = -2, 0, 1$

   $2;\ n = -1$

   $0;$ elsewhere

   $h(n) = \delta(n) - \delta(n-1) + \delta(n-2) - \delta(n-3)$

   b) Consider a causal and stable LTI system whose input $x(n)$ and output $y(n)$ are related through the second order difference equation.

   $y(n)-\frac{1}{6}y(n-1)-\frac{1}{6}y(n-2)=x(n)$. Determine the impulse response $h(n)$ for the system.

   c) What are causal and non-causal systems ? 6 + 7 + 2

8. a) What is aliasing effect ?

b) Find the inverse z-transform of $X(z) = \log\left(1 - 0 \cdot 5z^{-1}\right)\ z > 0 \cdot 5$ using differentiation property.

c) Find the inverse z-transform of $X(z) = \left(1 - 3z^{-1}\right) / \left(1 - 3z^{-1} + 2z^{-2}\right)\ \ | z | > 2.$ 3 + 5 + 7

9. a) Find the DFT of a sequence $x(n)$ = { 1, 1, 0, 0 } and find the IDFT of $Y(k)$ – { 1, 0, 1, 0 }.

b) Find the circular convolution of two finite duration sequences $x_1(n) = \{1,\ -1,\ -2,\ 3,\ -1\}$, $x_2(n) = \{1,\ 2,\ 3\}$

(5 + 6) + 4

10. a) Find the output $y(n)$ of a filter whose impulse response is $h(n)$ = { 1, 1, 1 } and input signal

$x(n)$ = { 3, –1, 0, 1, 3, 2, 0, 1, 2, 1 } using

i) overlap-save method

ii) overlap-add method.

b) What is warping effect ? (6 + 5) + 4

11. a) Apply bilinear transformation to $H(s) = 2/(s + 1)(s + 2)$ with $T = 1$ sec and find $H(z)$.

b) Design an ideal lowpass filter with a frequency response

$$H_d\left(e^{j\omega}\right) - 1 \text{ for } -\pi/2 \le \omega \le \pi/2$$

Find the values of $h(n)$ for $N = 11$. Find $H(z)$. Plot the magnitude response. 5 + 10