

Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH (EEE)/SEM-7/EEE-703/2011-12

2011

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 any *ten* the following :

10 × 1 = 10

i) Laplace transform of $\delta (n)$ is equal to

- | | |
|------|--------------------------|
| a) 0 | b) ∞ |
| c) 1 | d) cannot be determined. |

ii) $X (n) = e^{2n} u (n)$, the signal is

- a) energy signal
- b) power signal
- c) energy signal but not power signal
- d) neither energy nor power signal.



iii) Advantage of digital signal processing over analog signal processing is

- a) greater accuracy
- b) flexibility in configuration
- c) digital realization is cheaper
- d) all of these.

iv) The system $y(n) = x(n) + n \cdot x(n-1)$ is

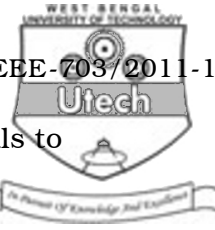
- a) non-causal and time-invariant
- b) causal and time-variant
- c) causal and time-invariant
- d) non-causal and time invariant.

v) The Z-transform of $u(-n)$ is

- a) $1 / (1 - Z^{-1})$
- b) $N / (1 - Z)$
- c) $1 / (1 - Z)$
- d) $1 / (Z - 1)$.

vi) $X(n) = 2^n u(n) - 3^n u(-n-1)$, ROC of $X(z)$ is

- a) $|z| < 2$
- b) $|z| < 3$
- c) $2 < |z| < 3$
- d) $2 > |z| > 3$.



- vii) $X(z) = 3z / (z - 1)(z + 1)$, $x(\alpha)$ equals to
- a) 0
 - b) $3/2$
 - c) 1
 - d) cannot be determined.
- viii) A discrete-time signal is periodic if its frequency is
- a) irrational number
 - b) prime number
 - c) rational number
 - d) complex number.
- ix) The ROC of the Z-transform of a causal sequence is
- a) the interior of a circle
 - b) the exterior of a circle
 - c) a rectangle
 - d) an annular region.
- x) For rectangular window used for designing FIR filters, the peak amplitude of side lobe is
- a) - 41 dB
 - b) - 3 dB
 - c) 0 dB
 - d) - 13 dB.
- xi) A digital filter is said to be IIR
- a) if present output depends on previous output only
 - b) if system function $H(z)$ has one more non-zero denominator coefficients
 - c) if all the poles lie outside the unit circle
 - d) if system function has only zeros.



xii) Digital IIR filters designed using bilinear transformation are free from

- a) zero-input limit cycles due to round-off errors in multiplication
- b) limit cycles due to overflow errors addition
- c) aliasing of characteristic
- d) dead-band effect.

GROUP – B

(Short Answer Type Questions)

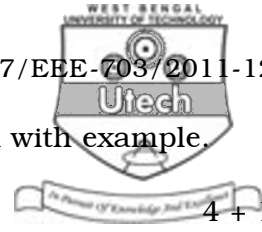
Answer any *three* of the following. $3 \times 5 = 15$

- 2. If a discrete-time LTI system is BIBO stable, show that the ROC of its system function $H (z)$ must contain the unit circle, *i.e.*, $|z| = 1$.
- 3. a) What are the two basic differences between the Fourier transform of a discrete-time signal with Fourier transform of continuous time signal ?
b) Find the Fourier transform of a sequence

$$x (n) = 1 \text{ for } - 2 \leq n \leq 2$$

$$= 0, \text{ otherwise.}$$

2 + 3



4. a) Define energy signal and power signal with example. 4 + 1
 b) Give an example of a Periodic signal. 4 + 1
5. a) Explain the time shifting property of the z-transform.
 b) What are the properties of Region of convergence ? 1 + 4
6. a) Define discrete Fourier series.
 b) Distinguish between linear and circular convolution of two sequences. 1 + 4

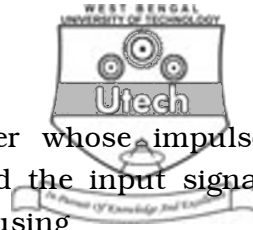
GROUP – C

(Long Answer Type Questions)

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

7. a) Find the circular convolution of two finite duration sequences
 $X_1(n) = \{ 3, -2, -1, 3, -4 \}$ and $X_2(n) = \{ 1, 3, 4 \}$
 using
 i) graphical method and
 ii) matrix method.
- b) If $x(n) = \{ 1, 3, 2 \}$ and $y(n) = \{ 1, 2 \}$, find the linear convolution $x(n) * y(n)$ using DFT based approach.

9 + 6



8. a) Find the output $y (n)$ of a filter whose impulse response is $h (n) = \{ 1, 1, 1 \}$ and the input signal $x (n) = \{ 3, - 1, 0, 1, 3, 2, 0, 1, 2, 1 \}$ using
- overlap-save method
 - overlap-add method.
- b) Determine the 8-point DFT of the sequence $x (n) = \{ 1, 1, 1, 1, 1, 1, 0, 0 \}$.
- c) Compute DFT of a sequence $(- 1)^n$ for $N = 4$.
- d) State and prove time shifting property of DFT.

6 + 4 + 2 + 3

9. a) What is signal flow graph ?
- b) What do you mean by the transposition theorem and transposed structure ?
- c) Determine the direct form II and transposed direct form II for the given system :

$$Y (n) = \frac{1}{2} y (n - 1) - \frac{1}{4} y (n - 2) + x (n) + x (n - 1).$$

3 + 4 + 8

10. a) Design a Butterworth filter using the bilinear transformation for the specifications :

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

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

- b) Consider the transfer function of an analog filter is

$$H (s) = \frac{s + 2}{s^2 + 13s + 42} .$$

Now design the digital filter using impulse invariance method. Consider the sampling interval $T = 0,1s$.

8 + 7



11. a) Explain the scaling property of the Z-transform.
- b) $X(n) = 2^n u(n-2)$. Determine its Z-transform and ROC.
- c) Use partial fraction method to find the inverse Z-transform of the following transfer function :

$$H(z) = \frac{(z^2 + z)}{(z-1)(z-3)}$$

ROC : $|z| > 3$.

4 + 4 + 7

