



Name :

Roll No. :

Invigilator's Signature :

**CS/M.Tech(ECE-VLSI)/SEM-2/MVLSI-202/2011
2011**

DIGITAL SIGNAL PROCESSING AND APPLICATIONS

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.*

Answer Question 1 and any *four* from the rest.

5 × 14 = 70

1. Answer any *seven* of the following :

7 × 2

State *True* / *False* and justify.

- i) Given a system with $h(n) = a^n u(n)$, a is constant, then system is IIR.
- ii) The mapping from analog to digital domain in impulse invariant method is one to many.
- iii) FIR filter is recursive and linear.
- iv) System function of digital filter is expressed as $H(z) = \sum_k b_k z^{-k}$ represents FIR filter.

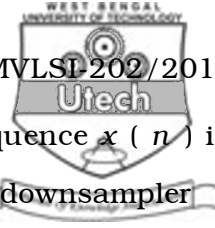


- v) Stability criteria for a discrete time LTI system is
 $\sum |h(n)| < \alpha$.
- vi) A digital filter has $h(n) = \{-3, -2, 0, 2, 3\}$ has symmetric linear phase.
- vii) A DTLTI system has an impulse response
 $h(n) = \{1, 2, 1, 1, -1\}$. Its output is
 $y(n) = \{1, 5, 6, 4, 3, 2, 9, 3, 2\}$ for an excitation of
 $x(n)$. The length of $x(n)$ is 13.
- viii) A discrete time system is represent by $y(n) = x(n^2)$ is linear and causal.
2. a) State and prove the convolution property of Z-transform. State and prove stability theorem of Z-transform.
- b) Discuss the stability and find $h(n)$.

$$H(z) = 1/[1 - (1/2)z^{-1}][1 + (1/2)z^{-1}][1 - (1/4)z^{-1}]$$

3 + 4 + 7

3. a) Find the total response of the system described by difference equation
 $y(n) + 2y(n-1) + y(n-2) = x(n) + x(n-1)$ for
 I/P $x(n) = (1/2)^n u(n)$ with initial condition
 $y(-1) = y(-2) = 1$.
- b) A discrete LTI system has $h(n) = a^n u(n)$. Is it causal ? Under what condition will it be BIBO stable ? Also find $y(n)$ if $x(n) = u(n)$.
- 7 + 7



4. a) The frequency response of an input sequence $x(n)$ is shown. If the signal is passed through a downsampler ($M = 2$), find the frequency response of O/P. Under what condition will the output be free from aliasing?

- b) Show that upsampler and downsampler are time variant systems. 7 + 7

5. a) Design a digital Butterworth filter using the following specification using Bilinear transformation.

$$0.8 < H(e^{j\omega}) < 1 \text{ for } 0 < \omega < 0.2\pi$$

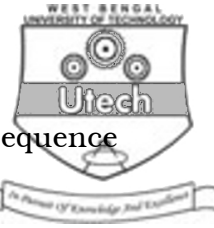
$$H(e^{j\omega}) < 0.2 \text{ for } 0.6\pi < \omega < \pi$$

- b) Discuss the disadvantages of impulse invariant method and Bilinear transformation.
- c) Realize the system with difference equation in cascade form :

$$y(n) = (3/4)y(n-1) - (1/8)y(n-2) + x(n) + (1/3)x(n-1)$$

5 + 4 + 5

6. a) Compare Fixed point & Floating point representations.
- b) Explain effect on Finite Word Length on Direct Form-I and Direct Form-II structures. 7 + 7



7. a) Find the IDFT using DIF method of the sequence
 $X(k) = \{ 10, -(-2 - 2j), 2, (-2 + 2j) \}$.
- b) Determine the section convolution whose impulse response is $h(n) = \{ 1, 1, 1 \}$ and input signal is $X(n) = \{ 3, -1, 0, 1, 3, 2, 0, 1, 2, 1 \}$ using Overlap-Save method.

5 + 9

8. Design an ideal LPF whose desire frequency response

$$H_d(e^{j\omega}) = \begin{cases} 1, & \pi/3 \geq \omega \geq -\pi/3 \\ 0 & \text{otherwise} \end{cases}$$

Using Hanning window

- a) determine the impulse response for $N = 9$
- b) determine $H(Z)$.

14

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