

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech (CSE)(N)/SEM-5/CS-504C/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 linear convolution of  $x(n)$  and  $h(n)$  results in which of the following numbers of samples of  $y(n)$  where  $L$  and  $M$  are the lengths of  $x(n)$  and  $h(n)$  respectively ?
    - a)  $L - M + 1$
    - b)  $L + M - 1$
    - c)  $\max(L, M)$
    - d) None of these.
  - ii) Zero padding technique is used for converting
    - a) Z-transform to Fourier transform
    - b) DFT to Z-transform
    - c) linear convolution to circular convolution
    - d) circular convolution to linear convolution.
  - iii) The output of a causal system
    - a) does not depend on the inputs
    - b) depends on the present and past inputs
    - c) depends on the present and future inputs
    - d) depends on the past and future inputs.

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- iv) Which of the following is incorrect ?
- ROC contains  $N$  number of poles
  - ROC is a ring in the  $z$ -plane centered at the origin
  - ROC of an LTI stable system contains the unit circle
  - ROC must be connected region.
- v) If  $x(n)$  is a finite duration two sided sequence then the ROC is entire  $z$ -plane except at
- $z = 0$
  - $z = \infty$
  - $z = 0$  and  $z = r$
  - $z = 0$  and  $z = \infty$ .
- vi) The linear convolution of  $x(n)$  and  $h(n)$  where  $x(n) = h(n) = \{1, 2, -1\}$  is
- $\{1, 4, 2, -3, 1, 8\}$
  - $\{1, 2, -1\}$
  - $\{1, 4, 2, -3, 1\}$
  - none of these.
- vii) In discrete Fourier transform the range of the summation index  $n$  ranges from
- 0 to  $N$
  - 0 to  $N - 1$
  - 0 to  $N + 1$
  - $-\infty$  to  $+\infty$ .
- viii) The impulse response of FIR filters is computed for
- finite number of samples
  - infinite number of samples
  - depending on the value of  $H(z)$
  - all of these.
- ix) What condition on the FIR sequence is to be imposed in order that the filter can be called as a linear phase filter ?
- Symmetric condition  $h(n) = h(N - 1 - n)$
  - Anti-symmetric condition  $h(n) = -h(N - 1 - n)$
  - Both (a) and (b)
  - None of these.

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- x) The Fourier transform of a unit step signal  $u(t)$  is
- a) 1                                      b)  $1/j\omega$
- c)  $\pi\delta(\omega) + 1/j\omega$                   d) none of these.

## GROUP – B

**( Short Answer Type Questions )**

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

2. Define FIR and IIR filters with proper examples.
3. Find the Z-transform and ROC of  $x(n) = r^n \cos(\omega_0 n) \cdot u(n)$ .  
State whether the system is stable or not.
4. Find the circular convolution of  $x(n) = \{2, 0, 0, 1\}$  and  $h(n) = \{4, 3, 2, 1\}$  using DFT and IDFT.
5. Differentiate between any two of the following :
  - a) Overlap add method and Overlap save method
  - b) FIR and IIR filters
  - c) DIT FFT and DIF FFT Algorithm.
6. Draw the Direct Form I and Direct Form II realization for the system described by the difference equation :
$$y(n) - 0.75(n-1) + 0.11y(n-2) = x(n) - 0.5x(n-1)$$

### GROUP – C

**( Long Answer Type Questions )**

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

7. Find the inverse  $Z$ -transform of

$$X(z) = \frac{(z^2 + z)}{(z-1)(z-3)} ; \text{ROC} : |z| > 3 \text{ using}$$

- i) PFE method
- ii) Residue method
- iii) Convolution method.

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8. a) Derive the butterfly structure for computing 8 pt. DFT using DIF FFT Algorithm.
- b) For the given analog signal, determine the rate at which the signal must be sampled to avoid aliasing. Also obtain the discrete time signal.

$$x(t) = 4 \cos 50\pi t + 8 \sin 300\pi t - \cos 100\pi t \quad 10 + 5$$

9. Design an ideal High-pass filter with a frequency response

$$H_d(e^{j\omega}) = 1, \pi/4 \leq |\omega| \leq \pi$$

$$0, |\omega| < \pi/4$$

using Rectangular window. Also find the values of  $h(n)$  for  $N = 11$ . Find  $H(z)$ .

10. a) Determine the digital filter for the given analog filter using Impulse Invariance method, for

$$H(s) = \frac{(s+a)}{(s+a)^2 + b^2}.$$

- b) What is Warping effect ? What is its effect on magnitude and phase response ? 10 + 5
11. a) What is the need for employing window technique for FIR Filter design ? What are the desirable characteristics of a Window ? Explain the various types of windows.
- b) Explain Gibbs phenomenon. 12 + 3

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