

CS/B.Tech/EE/EVEN/SEM-6/EE-605A/2016-17

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Paper Code : EE-605A

**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 of the following : 10 x 1 = 10

i) In a signal  $x(n)$ , if 'n' is replaced by  $\frac{n}{3}$ , then it is called

- a) Up-sampling
- b) Folded version
- c) Down sampling
- d) Shifted version.

ii) The discrete time system,  $y(n) = x(n - 3) - 4x(n - 10)$  is a

- a) Dynamic system
- b) Memory less system
- c) Time varying system
- d) none of these.

iii) The ROC of the sequence  $x(n) = u(-n)$  is

- a)  $|z| > 1$
- b)  $|z| < 1$
- c) No ROC
- d)  $-1 < |z| < 1$ .

iv) If the z-transform of  $x(n)$  is  $X(z)$ , then z-transform of  $(0.5)^n x(n)$  is

- a)  $X(0.5z)$
- b)  $X(0.5^{-1}z)$
- c)  $X(2^{-1}z)$
- d)  $X(2z)$

v) The linear phase realization structure is used to represent

- a) FIR system
- b) IIR system
- c) both FIR & IIR systems
- d) all discrete time systems.

vi) In N-point DFT of L-point sequence, the value of N to avoid aliasing in frequency spectrum is

- a)  $N \neq L$
- b)  $N \leq L$
- c)  $N \geq L$
- d)  $N = L$ .

vii) The symmetric impulse response having even number of samples can be used to design

- a) Low-pass & High-pass filter
- b) Low-pass & Band-pass filter
- c) Low-pass & Band-stop filter
- d) only Low-pass filter.

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viii) In Hamming window spectrum the side-lobe magnitude remains constant with

- a) decreasing  $\omega$
- b) constant  $\omega$
- c) increasing  $\omega$
- d) none of these.

ix) In an  $N$ -point sequence, if  $N = 16$ , the total number of complex additions & multiplications using Radix-2 FFT are

- a) 68 & 80
- b) 80 & 64
- c) 64 & 32
- d) 24 & 12.

x) The z-transform of  $x(n) = \left[ \sin \frac{\pi}{2} n \right] u(n)$  is

- a)  $\frac{z}{z+1}$
- b)  $\frac{z^2}{z^2+1}$
- c)  $\frac{1}{z+1}$
- d)  $\frac{z}{z^2+1}$

xi) Which of the following signals is the example for deterministic signal ?

- a) Step
- b) Ramp
- c) Exponential
- d) All of these.

xii) In overlap save method, the convolution of various sections are performed by

- a) Zero padding
- b) Linear convolution
- c) Circular convolution
- d) both (b) and (c).

**GROUP - B**

**( Short Answer Type Questions )**

Answer any three of the following. 3 x 5 = 15

2. a) What is the relationship between z-transform & DFT ?  
b) State & prove the differentiation property of z-transform. 2 + 3
3. Compare the DFT of the sequence  $x(n) = \cos \frac{n\pi}{2}$ , where  $N = 4$  using DIF FFT algorithm.
4. Find circular convolution of two finite duration sequences :  $x_1(n) = \{1, -1, -2, 3, -1\}$ ,  $x_2(n) = \{1, 2, 3\}$ .
5. a) How one can design digital filter from analog filter ?  
b) What are the advantages and disadvantages of Bi-linear transformation ? 2 + 3
6. Discuss overlap save method.

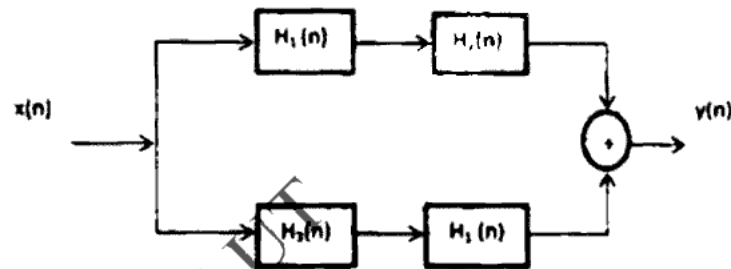
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**GROUP - C**

**( Long Answer Type Questions )**

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

7. a) Determine the overall impulse response of the interconnected discrete time system shown below, where  $H_1(n) = a^n u(n)$ ,  $H_2(n) = \delta(n-1)$ ,  $H_3(n) = \delta(n-2)$ .



- b) Determine whether the signal  $x(n) = \left[ \cos \frac{2\pi}{5} n + \cos \frac{2\pi}{7} n \right]$  is periodic or not. If periodic, then find fundamental period.
- c) When a discrete time system has input,  $x(n) = \{2, 5, 11, 17, 13, 12\}$  and impulse response  $h(n) = \{2, 1, 3\}$ , then what will be the output of the system? 5 + 5 + 5

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8. a) Find inverse z-transform of  $X(z) = \frac{z^2}{\left(z - \frac{1}{4}\right)^2}$ , for

ROC  $|z| > \frac{1}{4}$ , using Residue method. Also determine the stability of the system.

- b) Determine  $x(0)$  if the z-transform of  $x(n)$  is  $X(z) = \frac{2z^2}{(z+3)(z-4)}$ .

- c) Determine the z-transform of  $x(n) = [-(1/2)^n u(-n-1) + 2^n u(-n-1)]$ . Also depict the ROC & pole-zero location in z-plane. (4 + 1) + 4 + (4 + 2)

9. a) What is zero padding?  
 b) Find IDFT of the sequence  $X(k) = \{5, 0, 1, -j, 0, 1, 0, 1 + j, 0\}$ .  
 c) Given  $x(n) = 2^n$  and  $N = 8$ , find  $X(k)$  using DIT-FFT algorithm. 1 + 6 + 8
10. a) What is the difference between FIR & IIR filter?  
 b) Determine the direct form II realization for the following system:  
 $y(n] = [-0.1y(n-1) + 0.72y(n-2) + 0.7x(n) - 0.252x(n-2)]$

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- c) Design a Butterworth filter using the impulse variance method for the following specifications :

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

$$|H(e^{j\omega})| \leq 0.2, \quad 0.6\pi \leq \omega \leq \pi. \quad 2 + 5 + 8$$

- 11 a) What is the need for employing window technique for FIR filter design ?
  - b) Design a band-pass filter to pass frequencies in the range 1-2 rad/sec using Hamming window  $N = 5$ .
  - c) Discuss the effect of Finite Register Length in digital signal processing. 2 + 8 + 5
12. Write short notes on any three of the following : 3 x 5
- a) Gibbs' phenomenon
  - b) Overlap add method
  - c) Mapping from S-plane to Z-plane
  - d) Twiddle factor
  - e) Comparison of linear and circular convolution.

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