	Utech
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CS/B.Tech (EE(O)/EIE (O))/SEM-6/EC-611/2010	

#### CS/B.Tech (EE(O)/EIE (O))/SEM-6/EC-611/2010 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. \quad \hbox{Choose the correct alternatives for any $\it ten$ of the following:}$ 

 $10 \times 1 = 10$ 

i) The fundamental period of the signal

 $x(n) = 3 \cos (\pi n/4 + \pi/3) - \sin (\pi n/8) + \cos (\pi n/20)$  is

a) 8

b) 16

c) 4

d) 20.

ii) The energy & power of unit step sequence are

a) ∞, 2

b) 0, 2

c)  $\infty$ , 1/2

d) 0, 1.

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- iii) The system y(n) = x(n) + nx (n + 1) is
  - a) Non-causal & time variant
  - b) Causal & time variant
  - c) Causal & time invariant
  - d) Non-causal & time invariant.
- iv) Consider a system of transfer function  $X(z) = 1/(1-\alpha z^{-1})$ . The ROC of the system is
  - a) |z| > |1/a|
- b) |z| > |a|
- c) |z| < |1/a|
- d) |z| < |a|.
- v) The Fourier transform of the sequence  $x^*(-n)$  is
  - a)  $X^*$  ( $-\omega$ )

b)  $X^*(\omega)$ 

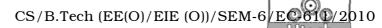
c)  $X(-\omega)$ 

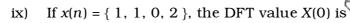
- d)  $X(\omega)$ .
- vi) The Z transform of the sequence 2u(n) is
  - a)  $1/1-2z^{-1}$
- b)  $4/2-2z^{-1}$
- c)  $2/1-2z^{-1}$
- d)  $1/1-4z^{-1}$ .
- vii) We may use convolution to find the output for the
  - a) Linear time variant system
  - b) Causal system
  - c) Linear time invariant system
  - d) Non-causal system.
- viii) For a rectangular window of M samples, width of the main lobe is
  - a)  $2\pi/m$

b)  $6\pi/m$ 

c)  $4\pi/m$ 

d)  $\pi/m$ .

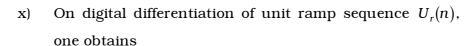




a) 1 + i

0 b)

c) 1 - j d) 2.



- unit impulse sequence a)
- b) unit ramp sequence
- unit step sequence c)
- none of these. d)

If  $x_1(n)$  and  $x_2(n)$  are finite length sequences of sizes L xi) and M respectively, their linear convolution has the length

- L + M 2a)
- b) L + M 1

L + Mc)

d)  $\max\{L, M\}$ .

If  $x^*(n)$  is the complex conjugate of x(n) then

- a)  $|x(n)|^2 \neq |x^*(n)|^2$  b)  $|x(n)| = x(n) \cdot x^*(n)$
- c)  $|x(n)|^2 = x(n) \cdot x^*(n)$  d) none of these.

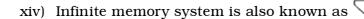
xiii) The energy of constant amplitude complex valued exponential function  $x(n) = A \exp(jn\omega)$  where A and  $\omega$ are constants, is given by

 $A^2$ a)

c)  $\frac{A^2}{2}$ 

d)  $\frac{A^2}{G}$ .

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- a) FIR system
- b) IIR system
- c) Digital system
- d) Analog system.
- xv) The even & odd parts of a unit step sequence are
  - a)  $[1/2+1/2\delta(n)], [1/2\delta(n)]$
  - b)  $[1/2 + \delta(n)], [1/2\delta(n)]$
  - c)  $[1/2+1/2\delta(n)], [1/2sgn(n)]$
  - d)  $[1+\delta(n)], [1/2\delta(n)].$

### GROUP – B ( Short Answer Type Questions )

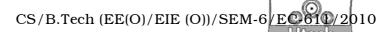
Answer any three of the following.

 $3 \times 5 = 15$ 

- 2. Consider the transfer function of an analog filter as  $H(s) = (s+3)/(s^2+4s+13)$ . Now design the digital filter using impulse invariance method. Consider the sampling interval T=0.1s.
- 3. Write short note on any one of the following topics :
  - a) Design of FIR filter using windowing technique.
  - b) Effect of finite register length on digital system.
- 4. Compute the circular convolution of the two sequences

$$X1(n) = \{ 2, 1, 2, 1 \} & X2(n) = \{ 1, 2, 3, 4 \}$$

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5. Obtain the cascade form structure for the system characterized by

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

6. Design a low-pass digital filter with a 3 dB bandwidth of  $0.2\pi$ . Use Bilinear transformation applied to the analog filter  $H_a(s) = \Omega_c/(S + \Omega_c)$ .

## GROUP – C ( Long Answer Type Questions )

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

- 7. a) Find the circular convolution of two sequences  $x_1(n) = \{1,\ 1,\ 2,\ 2\} \text{ and } x_2(n) = \{1,\ 2,\ 3,\ 4\}\,.$ 
  - b) State and prove the initial value theorem regarding Z-transform.
  - c) Determine the DFT of the sequence

$$x_1(n) = \frac{1}{4} \text{ for } 0 \le n \le 2$$

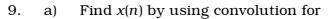
= 0 for otherwise.

7 + 3 + 5

- 8. a) Discuss about design method of low-pass filter.
  - b) What is rectangular window?
  - c) How is a rectangular window used to design FIR filter?
  - d) Determine the IDFT of  $X(k) = \{3, (2 + j), 1, (2 j)\}.$

4 + 2 + 4 + 5

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$$X(z) = \frac{1}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 + \frac{1}{4}z^{-1}\right)}.$$



b) Find the inverse z-transform of

$$X(z) = \frac{1}{(z - 0 \cdot 25)(z - 0 \cdot 5)}, \text{ ROC} : |z| > 0 \cdot 5.$$

c) Check whether the following digital system is BIBO stable or not :

$$y(n) = ax^2(n).$$

6 + 5 + 4

- 10. a) Discuss in brief on the effect of Finite Register Length in Digital Signal Processing.
  - b) Using Linear Convolution find  $y(n) = X(n)^*h(n)$  for the sequence X(n) = (1, 2, -1, -2, 0, 1, 3, -1) and H(n) = (1, 2). Compare the result by solving the problem using (i) Overlap Save Method (ii) Overlap Add method.
  - c) For the difference equations in which x(n) is input and y(n) is output  $y(n) = 3y^2(n-1) nx(n) + 4x(n-1) 2x(n-1)$

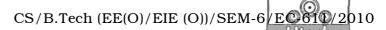
Determine whether the system is

- i) linear
- ii) time invariant
- iii) causal.

In each case justify the answer.

4 + 7 + 4

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- 11. Write short notes on any three of the following:
  - a) Circular convolution
  - b) Utility of FFT over DFT
  - c) BIBO stability in Z domain
  - d) Architrure of digital Signal processor
  - e) Mapping of S-plane into Z-plane.

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