

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech(EE-N)/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.*

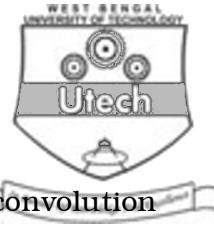
**GROUP – A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any *ten* of the following :

$$10 \times 1 = 10$$

- i) If a discrete time signal is anticausal then ROC will include
  - a)  $z = 0$
  - b)  $z = 0$  and  $z = \infty$
  - c)  $z = \infty$
  - d) none of these.
- ii) Poles of butterworth filter lie on
  - a) circle
  - b) ellipse
  - c) circle and ellipse
  - d) none of these.
- iii) Given a system with  $h(n) = a^n u(n)$ ,  $a$  is constant, then the system is
  - a) IIR system
  - b) FIR system
  - c) IIR system and FIR system
  - d) none of these.



- iv) Overlap save method is used to find
- a) circular convolution      b) linear convolution
- c) DFT      d) Z-transform.
- v) The Z-transform of  $u(-n)$  is
- a)  $\frac{1}{(1 - z^{-1})}$       b)  $\frac{z}{(1 - z)}$
- c)  $\frac{1}{(1 - z)}$       d)  $\frac{1}{(z - 1)}$  .
- vi) The transfer function of a system with impulse response  $h(n) = u(n) - u(n - 1)$  is
- a) 2      b)  $z/(z - 1)$
- c) 1      d)  $z/[(z - 1)(z + 1)]$
- vii)  $y(n) = \cos[x(n)]$  is
- a) linear time invariant system
- b) linear time variant system
- c) nonlinear time invariant system
- d) nonlinear time variant system.
- viii) 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 or more non-zero denominator coefficients
- c) if all the poles lie outside the unit circle
- d) if system function has only zeros.



- ix) If  $x(n)$  is a complex sequence, then
- each sample value of  $x(n)$  is complex
  - some sample values of  $x(n)$  must be complex
  - at least one sample value should be complex
  - no sample value has real component.
- x) The Fourier transform of  $\delta(n)$  is
- 1
  - 0
  - $\pi \delta(\omega)$
  - $\delta(\omega)$ .
- x) For a system with output - input relationship as  
 $y(-n) = x(n-1)$
- the system is causal for all  $n$
  - the system is linear and causal for all  $n$
  - the system is stable, linear and causal for all  $n$
  - none of these.
- xii) Zero padding indicates
- zero appearing in  $x(k)$  sequence
  - value of  $x(k)$  is zero
  - dummy samples added with zero value in  $x(k)$
  - none of these.

a) 5                                  b) 2

c) 1                                  d) 0.

a) - 40 dB                      b) - 3 dB

c) 0 dB                          d) - 13 dB.

a)  $-j \frac{dx(w)}{dw}$       b)  $j \frac{dx(w)}{dw}$   
c)  $\frac{dx(w)}{dw}$       d) none of these.

**( Short Answer Type Questions )**

$$3 \times 5 = 15$$

- $$x(n) = e^{j(\pi n/4 + \pi/8)} \quad 2 + 3$$

- $$y(n) = \cos[x(n)] \quad 1 + 4$$



4. a) Define ROC.  
b) Determine the Z-transform and ROC of the following signal.

$$x(n) = \left(\frac{2}{3}\right)^n u(n) + \left(\frac{3}{4}\right)^n u(n). \quad 1 + 4$$

5. a) State Parseval's energy theorem.  
b) Compute the convolution of the following signals :

$$\begin{aligned} x(n) &= n/2; 0 \leq n \leq 5 & h(n) &= n/2; -3 \leq n \leq 5 \\ &= 0; \text{otherwise} & &= 0; \text{otherwise} \end{aligned} \quad 1 + 4$$

6. Write down the procedure for designing FIR filter using frequency sampling method.

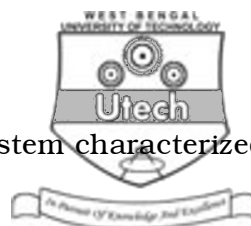
### GROUP – C

( Long Answer Type Questions )

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

7. Let  $x(n) = 0, 0 < n < N - 1$  be a sequence with an  $N$ -point DFT  $X(k); 0 \leq k \leq N - 1$  :

- a) If  $x(n)$  is symmetric sequence satisfying the condition  $x(n) = x(N - 1 - n)$ , show that  $X(N/2) = 0$ , for  $N$  even.  
b) If  $x(n)$  is symmetric sequence satisfying the condition  $x(n) = -x(N - 1 - n)$ , show that  $X(0) = 0$ , for  $N$  even.  
c) If  $N$  is even and  $x(n) = -x(n + N/2)$ , then  $X(k) = 0$  for  $k$  even.  $5 + 5 + 5$



8. a) Obtain a cascade realization of the system characterized by the transfer function

$$H(z) = 2(z + 2) / \{z(z - 0.1)(z + 0.5)(z + 0.4)\}$$

- b) Determine the direct form - II and transposed direct form - II for the given system :

$$y(n) = 0.5y(n-1) - 0.25y(n-2) + x(n) + x(n-1).$$

9. a) 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.,  $|z| = 1$ .

- b) Determine the output sequence of the system with impulse response  $h[n] = \left(\frac{1}{2}\right)^n u[n]$ , when the input is the complex exponential sequence

$$x[n] = Ae^{j\pi \frac{n}{2}}; -\infty < n < \infty. \quad 5 + 10$$

10. a) Convert the following analog filter with  $H(s) = (s + 0.1) / (s^2 + 16)$  into a digital IIR filter by means of bilinear transformation. The digital filter is to have a resonant frequency  $\omega_r = \pi/2$ .

- b) Find the relation between analog frequency and digital frequency, due to bilinear transformation.
- c) What do you mean by warping and prewarping ?
- d) What is the difference between linear convolution and circular convolution ?

5 + 3 + 5 + 2



11. a) Find the DFT of the sequence  $\{ 1, 1, 1, 1, 2, 2, 2, 2 \}$  using radix-2. Decimation-in-time FFT. Sketch the magnitude and phase plot.

b) What is the need of FFT ?

c) What is bit-reversal ?

10 + 3 + 2

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