

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech (EE-N)/SEM-6/EC-611/2011**

**2011**

**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 × 1 = 10

i) The system described by  $y(n) = x(n) + 2x(n-2) + 3x(n-3)$  is

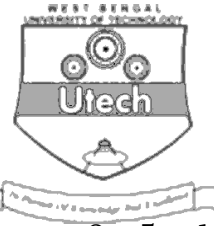
- a) causal and stable
- b) causal and unstable
- c) noncausal and stable
- d) noncausal and unstable.

ii) If  $x(n) = \{ 2, 1, 3, 0, 1, 2, 4 \}$ , then  $x(-n+2)$  is given by

- a)  $\{ 2, 1, 3, 0, 1, 2, 4 \}$
- b)  $\{ 2, 1, 3, 0, 1, 2, 4 \}$
- c)  $\{ 4, 2, 1, 0, 3, 1, 2 \}$
- d)  $\{ 4, 2, 1, 0, 3, 1, 2 \}$ .







**GROUP – B**

**( Short Answer Type Questions )**

Answer any *three* of the following.

3 × 5 = 15

2. The impulse response of an LTI system is  $h(n) = \{1, 2, 1, -1\}$ .

Determine the response of the system to the input signal

$$x(n) = \{1, 2, 3, 1\}.$$

3. 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.,  $|z|=1$ .

4. Explain the relationship between S-plane and Z-plane.

5. a) Find the DTFT of the sequence  $x(n) = \{1, -1, 1, -1\}$ .

b) Find the IDTFT of  $X(e^{j\omega}) = e^{-j\omega} \left( \frac{1}{2} + \frac{1}{2} \cos \omega \right)$ . 2 + 3

6. Determine the convolution of the two following sequences

using overlap add method :

$$x(n) = \{3, 2, 1, 2\} \quad h(n) = \{1, 2, 1, 1\}.$$



**GROUP – C**

**( Long Answer Type Questions )**

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

7. a) Justify whether the system is LTI or not.

$$y(n) = y(n-1) + \sum_{k=0}^2 x(n-k).$$

- b) Compute the circular convolution of the two sequences given below.

$$x(n) = \{2 \ -1 \ 0 \ 1 \ -2 \ 3 \ 0 \ 1\}.$$

$$h(n) = \{1 \ 2 \ -1 \ 1\}.$$

- c) Determine the linear convolution of the above sequences using over-lap save method.

8. a) What is ROC ? State its properties.

- b) Find the system function & impulse response of the system described by  $y(n) = x(n) + 2x(n-1) - 4x(n-2) + x(n-3)$

- c) Find the Inverse Z-transform of

$$X(Z) = Z(Z^2 - 4Z + 5)/(Z-3)(Z-2)(Z-1)$$

- d) Prove that an LTI system is BIBO stable if the ROC system function includes the unit circle.  $2 + 5 + 5 + 3$



9. a) Find the 8-point DFT using decimation in time FFT algorithm for a sequence  $x(n) = \{1, 3, 5, 7, 2, 4, 6, 8\}$ .

b) What do you mean by zero padding ?

c) Using linear convolution find  $y(n) = x(n) * h(n)$  for the sequence  $x(n) = \{1, 2, -1, -2, 0, 1, 3, -1\}$ . Compare the result by solving the problem using

i) overlap save method

ii) overlap add method.

5 + 2 + 8

10. Following specifications are given for a filter function :

$$\alpha_{\text{pass}} = 4 \text{ dB}, \alpha_{\text{stop}} = 48 \text{ dB}, f_{\text{stop}} = 7 \text{ kHz}, f_{\text{pass}} = 2 \text{ kHz}, f_{\text{sampling}} = 20 \text{ kHz}$$

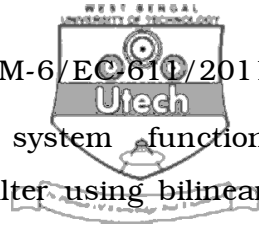
Determine an IIR filter using Butterworth approximation and impulse invariant method.

11. a) Design a digital Butterworth IIR filter for the given frequency response :

$$0.85 \leq |H(e^{j\omega})| \leq 1, \quad \text{for } 0 \leq \omega \leq 0.2 \pi$$

$$|H(e^{j\omega})| \leq 0.02, \quad \text{for } 0.45 \pi \leq \omega \leq \pi$$

Use impulse invariant method.



- b) Convert the analog filter with system function  $G(s) = \frac{s + 0.1}{(s + 0.1)^2 + 16}$  into a digital filter using bilinear

transformation. The digital filter should have a resonant frequency of  $\omega_r = \frac{\pi}{4}$  radian. 8 + 7

12. Write short notes on any *three* of the following : 3 × 5

- a) Causal and non-causal system
- b) Circular convolution and linear convolution
- c) DIT-FFT algorithm
- d) Difference between DTFT and DFT
- e) Bilinear transformation.

=====