



Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH(EE)/SEM-6/EC-611/2012

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 any *ten* of the following :

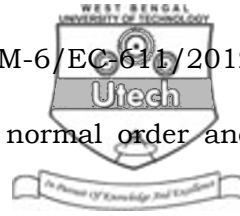
$$10 \times 1 = 10$$

- i) The digital system is $y(n) = x(n^2)$ is

- a) linear and causal
- b) non-linear and causal
- c) linear and non-causal
- d) non-linear and non-causal.



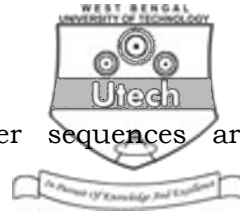
- ii) Zero padding of a signal
- a) reduces aliasing
 - b) increases frequency
 - c) increases time resolution
 - d) has no effect.
- iii) The convolution of $u(n)$ with $u(n-4)$ at $n=5$ is
- a) 5
 - b) 2
 - c) 1
 - d) 0.
- iv) Stability criteria for discrete time LTI system is
- a) $h(n) > 1$
 - b) $h(n) < 1$
 - c) $h(n) = 0$
 - d) $h(n) = 1$.
- v) $\left(\frac{1}{2}\right)^n u(n)$ is
- a) energy signal
 - b) power signal
 - c) both (a) and (b)
 - d) none of these.
- vi) Which one of the following is not used for IIR system realization ?
- a) direct form structure
 - b) linear phase structure
 - c) cascade form structure
 - d) parallel form structure.



- vii) I. In DIF FET algorithm input is normal order and output is bit reversed
- II. Both DIT and DIF algorithms require same number of operation to compute DFT
- III. In DIF algorithm (in butterfly diagram) the complex multiplication takes place after add-subtract operation.

Here

- a) only I is true b) I and II are true
- c) I and III are true d) I, II and III are true.
- viii) For a 32 point sequence, radix 2 FFT algorithm involves
- a) 160 complex additions and 160 complex multiplications
- b) 80 complex additions and 80 complex multiplications
- c) 160 complex additions and 80 complex multiplications
- d) 80 complex additions and 160 complex multiplications.



- ix) I. In overlap add method longer sequences are divided into smaller sequences
- II. In overlap save method each section of the longer sequences are converted to size of the output sequence of sectional convolution
- III. For both overlap add and overlap save methods circular convolution can be used.

Here

- a) I and II are correct
- b) I and III are correct
- c) II and III are correct
- d) None of these.
- x) The ROC of the z-transform causal sequence is
- a) the interior of circle b) the exterior of circle
- c) a rectangle d) an annular region.
- xi) For rectangular window used for designing FIR filters, the peak amplitude of side lobe is
- a) - 41 dB b) - 3 dB
- c) 0 dB d) - 13 dB.
- xii) The sequence $x(n) = (-1)^n$ is periodic with a period of
- a) 6 samples b) 4 samples
- c) 2 samples d) 0 sample.



GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following 3 × 5 = 15

2. Find out inverse z-transform of

$$X(z) = \log(1 - 0.5z^{-1}); |z| > 0.5 \text{ using differential property.}$$

3. a) Determine whether the system is (i) causal (ii) stable

i) $h(n) = 2^n u(-n)$

ii) $h(n) = \delta(n) + \sin n\pi$

- b) Define discrete fourier series. 3 + 2

4. Determine the convolution of the given sequences by z-transform to the input signal

$$h(n) = (0.5)^n u(n)$$

$$x(n) = 3^n u(-n).$$

5. 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. $|z| = 1$.
6. If $x(n) = \{1, 3, 2\}$ and $y(n) = \{1, 2\}$, find the linear convolution $x(n) * y(n)$ using DFT based approach.



GROUP – C

(Long Answer Type Questions)

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

7. a) Find the z-transform of the discrete time signal

$$x[n] = \left(\frac{1}{3}\right)^{n-1} u[n-1]$$

- b) Find the inverse z-transform of

$$X(z) = \frac{z(z^2 - 4z + 5)}{(z-3)(z-1)(z-2)}$$

for ROC i) $2 < |z| < 3$, ii) $|z| > 3$, iii) $|z| < 1$.

7 + 8

8. a) Prove that the LTI system is BIBO stable if the ROC of the system function includes the unit circle.

- b) Find the linear convolution using circular convolution for the two sequences

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

- c) Compute the circular convolution of the two sequences

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

- d) Define phase delay and group delay. $3 + 5 + 5 + 2$



9. a) Explain impulse invariant method of designing IIR digital filter.

b) Design and realize a digital LPF using bilinear transformation method to satisfy the following specifications :

- i) Monotonic stop and pass band
- ii) -3dB cutoff frequency at 0.5π
- iii) Magnitude down to at least 15 dB at 0.75π . 5 + 10

10. a) Design an ideal low pass filter with a frequency response

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

$$= 0, \text{ for } 0 \leq |\omega| < \frac{\pi}{4}$$

using windowing technique.

b) What is Gibb's phenomenon ? What are its effect in digital filter and how to reduce it ? 10 + 5

11. a) Determine the direct form-I and direct form-II structures for the given system

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

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- b) Determine the z-transform of the signal
 $x(n) = (\cos \omega_0 n)u(n)$.

- c) State Sampling theorem. What do you mean by Nyquist rate ?
8 + 5 + 1 + 1

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

- a) Radix-2 DIF algorithm
- b) IIR and FIR filters
- c) Mapping of s-plane into z-plane
- d) BIBO stability
- e) Causal and non-causal systems
- f) TMS320C 6713 architecture.

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