# DIGITAL SIGNAL PROCESSING ( SEMESTER - 6 )

**CS/B.Tech (EI(O)/EE(O)/EE(N))/SEM-6/EC-611/09**

1. ....................................
   *Signature of Invigilator*

2. ....................................       **Reg. No.**
   *Signature of the Officer-in-Charge*

   **Roll No. of the Candidate**

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**CS/B.Tech (EI(O)/EE(O)/EE(N))/SEM-6/EC-611/09**
**ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009**

## DIGITAL SIGNAL PROCESSING ( SEMESTER - 6 )

Time : 3 Hours ]                                                                 [ Full Marks : 70

### INSTRUCTIONS TO THE CANDIDATES :

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **32 pages**. The questions of this concerned subject commence from Page No. 3.

2. a) In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.

   b) For **Groups – B** & **C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.

3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.

4. Read the instructions given inside carefully before answering.

5. You should not forget to write the corresponding question numbers while answering.

6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.

7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**

8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.

9. Rough work, if necessary is to be done in this booklet only and cross it through.

**No additional sheets are to be used and no loose paper will be provided**
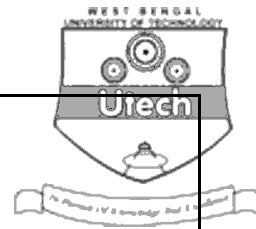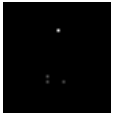
### FOR OFFICE USE / EVALUATION ONLY
#### Marks Obtained

| | | | Group – A | | | | | | Group – B | Group – C | | | | Total Marks | Examiner's Signature |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Question Number** | | | | | | | | | | | | | | | |
| **Marks Obtained** | | | | | | | | | | | | | | | |

...........................................................
**Head-Examiner/Co-Ordinator/Scrutineer**

**6845 ( 15/06 )**

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## ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009
# DIGITAL SIGNAL PROCESSING
## SEMESTER - 6
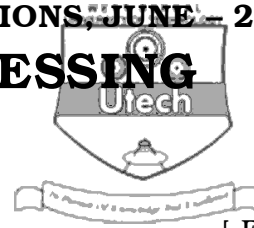
Time : 3 Hours ]     [ Full Marks : 70

### GROUP – A
### ( Multiple Choice Type Questions )

1. Choose the correct alternatives for any *ten* of the following :     $10 \times 1 = 10$

   i)   Infinite memory system is also known as

      a)   FIR system            b)   IIR system

      c)   Digital system        d)   Analog system.

   ii)  The $z$-transform of $u(-n)$ is

      a)   $\dfrac{1}{(1-z^{-1})}$        b)   $\dfrac{z}{(1-z)}$

      c)   $\dfrac{1}{(1-z)}$            d)   $\dfrac{1}{(z-1)}$ .

   iii) For rectangular window used for designing FIR filters, the peak amplitude of side

        lobe is

      a)   – 40 dB               b)   – 3 dB

      c)   0 dB                  d)   – 13 dB.
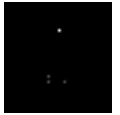
   iv)  The sequence $x(n = (-1)^n$ is periodic with a period of

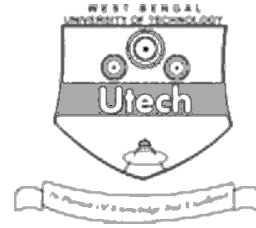      a)   6 samples            b)   4 samples

      c)   2 samples            d)   0 sample.

v) Zero padding a signal

   a) reduces aliasing

   b) increases time resolution

   c) increases frequency resolution

   d) has no effect.

vi) If the Fourier transform of $x(n)$ is $x(\omega)$, then the Fourier transforrm of $nx(n)$ is

   a) $-j \dfrac{dx(\omega)}{d\omega}$

   b) $\dfrac{dx(\omega)}{d\omega}$

   c) $j \dfrac{dx(\omega)}{d\omega}$

   d) none of these.

vii) The digital system in $y(n) = x(n^2)$ is

   a) linear and causal

   b) linear and non-causal

   c) non-linear and causal

   d) non-linear and non-causal.

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

   a) $|x(n)|^2 \pi |x^*(n)|^2$

   b) $|x(n)| = x(n).x^*(n)$

   c) $|x(n)|^2 = x(n).x^*(n)$

   d) none of these.
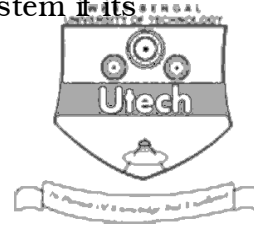
ix) If $x(k)$ represents the 8-point DFT of $x(n) = \{1, 1, 1, 1, 1, 1, 0, 0\}$, $x(o)$ is

   a) 3

   b) 1

   c) 6

   d) 0.

x) A discrete-time LTI system is known as causal system if its

    a) impulse response $h(n)$ is zero for $n < 0$

    b) impulse response $h(n)$ is zero for $n > 0$

    c) impulse response $h(n)$ is positive for $n < 0$

    d) none of these.

xi) $X(n)$ is an energy signal when

    a) $G = \sum\limits_{-\infty}^{+\infty} |x(n)|^2$ is finite

    b) $G = \sum\limits_{-\infty}^{+\infty} |x(n)|^2$ is infinite

    c) $P = \lim\limits_{n \to \infty} \cdot \dfrac{1}{2N+1} \left\{ \sum\limits_{-\infty}^{+\infty} |x(n)|^2 \right\}$ is finite

    d) none of these.

xii) 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) $A^2$                           b) $\dfrac{A^2}{2\omega}$

    c) $\dfrac{A^2}{2}$                      d) $\dfrac{A^2}{\omega}$ .

## GROUP – B

### ( Short Answer Type Questions )

Answer any *three* of the following.        $3 \infty 5 = 15$

2. a) State Parseval's energy theorem.

    b) Compute the convolution of the following signals :

$x(n) = n/2 ; 0 \le n \le 5$                            $h(n) = n/2 ; -3 \le n \le 5$

      $= 0$ ; otherwise                                 $= 0$ ; otherwise.     $1 + 4$

3. Prove that the energy of a real valued energy signal is equal to the sum of the energies of its even and odd components *i.e.* $E_s = E_e + E_o$ .

4. For the analog filter having transfer function $h(s) = \dfrac{1}{s(s+1)}$ . Determine $H(z)$ using impulse invariance method.

5. Find out the relation between Fourier transform and Laplace transform with Z-transform.

6. For a causal LTI system, the output $y(n) = \dfrac{1}{4} y(n-1) + x(n)$. Calculate $y(n)$ while $x(n) = n^3 u(n+1)$.    5
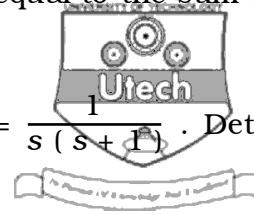
## GROUP – C

### ( Long Answer Type Questions )

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

7. a) Find the circular convolution of two sequences $x_1(n) = \{1, 1, 2, 2\}$ and $x_2(n) = \{1, 2, 3, 4, 5\}$.    7

   b) State and prove intial value theorem regarding z-transform.    3

   c) Compute DFT of the sequence $x(n) = \{1, 0, 0, 1\}$.    5

8. a) Discuss about design method of Low-pass filter.    4

   b) What do you mean by Windowing ?    2

   c) What is rectangular window ?    2

   d) How are rectangular windows used to design FIR filter ?    4

   e) Determine the IDFT of $Y(k) = \{1, 0, 1, 0\}$.    3

9. a) Find the system function and impulse response of the system described by the difference equation $y(n) = x(n) + 2x(n-1) - 4x(n-2) + x(n-3)$.    5

   b) Find the inverse z-transform of $X(Z) = (z + 0.2) / (z + 0.5)(z-1)$, $|z| > 1$.    5

   c) What are the properties of Region of convergence ? Find the z-transform and ROC of the signal $x(n) = -b^n u(-n-1)$.    5

10. a) Find the order of Butterworth filter that has a-2dB passband attenuation at a frequency of 20 rad/sec and – 10dB stopband attenuation at 30 rad/sec.  5

b) Draw the following :  10

i) Direct form I

ii) Direct form II

iii) Cascade

iv) Parallel strutures for the system described by the difference equation :

$$y ( n ) = \frac{3}{4} y ( n - 1 ) - \frac{1}{8} y ( n - 2 ) + x ( n ) + \frac{1}{3} x ( n - 1 ) .$$

11. a) Find the convolution sum of the singnals :

$$x ( n ) = 1 \quad \text{for } 3 \leq n \leq 6$$

$$= 0 \quad \text{otherwise}$$

$$h ( n ) = 1 \quad \text{for } - 4 \leq n \leq 3$$

$$= 0 \quad \text{otherwise.} \quad 5$$

b) What is zero padding ? What are its uses ?  3

c) A discrete-time system is represented by the following difference equation :

$$y ( n ) = 3y^2 ( n - 1 ) - nx ( n ) + 4x ( n - 1 ) - 2x ( n + 1 )$$

is the system

i) linear

ii) time-invariant

iii) causal.

Justify.  2 + 5

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END