BIOMEDICAL SIGNAL PROCESSING (SEMESTER - 6)

CS/B.TECH (BME)/SEM-6/BME-602/09

1. ....
Signature of Invigilator

2. ....
Signature of the Officer-in-Charge

Reg. No.

Roll No. of the Candidate

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.

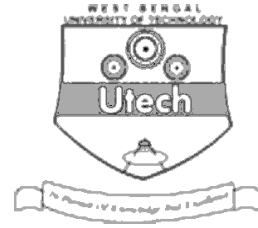### No additional sheets are to be used and no loose paper will be provided

FOR OFFICE USE / EVALUATION ONLY
Marks Obtained

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

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

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ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009
BIOMEDICAL SIGNAL PROCESSING
SEMESTER – 6

Time : 3 Hours]   [Full Marks : 70

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

    i) The sequence $x(n) = \partial(n-k)$ has the ROC

        a) entire Z-plane   b) entire Z-plane except $Z = \infty$

        c) entire Z-plane except $Z = 0$ d) none of these.

    ii) A system function $h(n)$ is expressed as $h(n) = n\,2.5^n\,u(n)$. It is

        a) linear and causal   b) non-linear and causal

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

    iii) What is the Nyquist sampling frequency for the signal
         $x(t) = e^{j\,100\pi t} + 2e^{j\,250\pi t} + 3\cos 400\,\pi t$?

        a) 100 Hz   b) 250 Hz

        c) 400 Hz   d) 800 Hz.

    iv) If $x(n)$ is real and odd, then its DFT in $X(k)$ is

        a) real and odd   b) real and even

        c) imaginary and odd   d) imaginary and even.

    v) A recursive process output depends on

        a) present input only

        b) present and previous inputs

        c) present and previous inputs and previous output

        d) all of these.

vi)   Zero padding technique is used for converting

     a) Z-transform to Fourier-transform

     b)   DFT to Z-transform

     c)   Linear convolution to circular convolution

     d)   DFS to DFT.
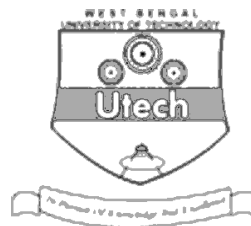
vii)   The linear convolution of $x(n) = [1, 2, 1, -1]$ and $h(n) = [1, 2, 3, 1]$ is

     a) $[1, 4, 8, 8, 3, -2, -1]$

     b) $[1, 4, 2, -3, 1]$

     c) $[1, 4, 8, 8, -5, 7, 9, 1]$

     d)   none of these.
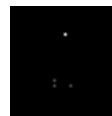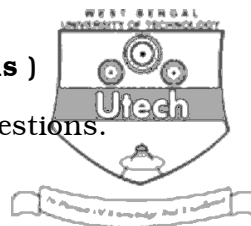
viii)   If $Z[x(n)]$ is $X(z)$ then $Z[x(n-k)]$ is

     a) $X(z-k)$ b) $k \cdot X(z)$

     c) $z^{-k} X(z)$ d) $z^{k} X(z^{-1})$.

ix) Z-transform of $nu(n)$ is

     a) $z/(z-1)$ ROC : $|z| < 1$

     b) $z/(z-1)^2$ ROC : $|z| > 1$

     c) $z/(z-1)^2$ ROC : $|z| < 1$

     d) $z/(z-1)$ ROC : $|z| > 1$.

x)   What is the DFT of $x(n) = [1, 1, 1, 1]$?

     a) $[1, 0, 1, 0]$ b) $[1, 0, 0, 0]$

     c) $[2, 0, 0, 0]$ d) $[4, 0, 0, 0]$.

GROUP – B

(Short Answer Type Questions)

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

2. Find the *Z*-transform and ROC of the following :

    $x (n) = 7 (1/3)^{n} u (n) - 6 (1/2)^{n} u (-n -1)$.   5

3. Find $x1 (n) * x2 (n)$ by DFT and IDFT method, where $x1 (n) = [1\ 2\ 3\ 4\ 5]$ and

    $x2 (n) = [1\ 1\ 1]$, both the signals starting from $n = 0$.   5

4. Find the impulse response for a system when input/output characteristics is

    $y (n) = 4x (n) + 3x (n - 1) + 3y (n - 1) - 2y (n - 1)$. Use *Z*-transform.   5

5. Prove that a discrete time periodic signal frequency *f* is a rational number. What will be

    the expression for discrete time signal acquired from the analog signal

    $x (t) = 2 \cos 2\pi 100t + \sin 250\pi t$ sampled at 500 Hz.   3 + 2
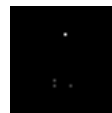
6. What is radix-2 FFT algorithm ? What are decimation in frequency and decimation in

    time in FFT ? How many complex multiplication and complex addition are required for

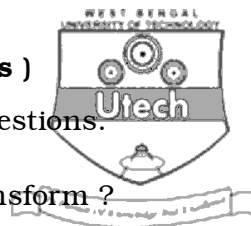   1024 points radix-2 butterfly structure of FFT ?   1 + 2 + 2

7. Find out $y (n)$ if input sequences $x (n)$ and system transfer function are given

    as $x (n) = [1,\ 2,\ 3,\ 2,\ 1]$ and $h (n) = [2,\ 1,\ 0,\ -1,\ -2,\ 3]$.   5

GROUP – C

(Long Answer Type Questions)

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

8. a) What are the Diritchlet conditions for Fourier transform ?

    b) What is the relation between pole location in the z-plane and time-domain behaviour for causal signals ? Illustrate with diagrams.

    c) Perform circular convolution on $x_1(n) = [\, 1, \ -1, \ 2, \ 3, \ -1 \,]$ and $x_2(n) = [\, 1, \ 2, \ 3 \,]$. $3 + 6 + 6$

9. a) Define the cross-correlation and auto-correlation functions. How are they related to cross-energy density spectrum and energy spectral density of energy signal ?

    b) What are the resting potential and action potential ? How are they developed ? What are their voltage ranges ?

    c) Discuss how cross-correlation and auto-correlation are applicable to process the biomedical signals ? $(\, 2 + 3 \,) + (\, 2 + 2 + 1 \,) + 5$

10. a) In discrete system find the impulse response of an ideal low-pass filter of cut-off frequency ω_0.

    b) A system function is $H(s) = 2 / (s + 1)(s + 3)$. Applying bilinear transformation with $T = 0 \cdot 1$ s, find $H(z)$. Implement this system using any one of the forms. $5 + 10$

11. a) A system is defined by the following difference equation :

    $$Y(n) - 2ky(n-1) + k^2 y(n-2) = x(n).$$

    Determine the range of parameter k for which the system is stable.

    b) Determine the transfer function $h(n)$ of the system.

    c) Find $h(0)$ for the above sequence.

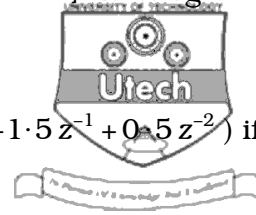   d) Draw the region of convergence. $5 + 5 + 2 + 3$
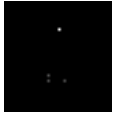
12.   a)   Find the DFS of the periodic signal $x(n) = [\ 1\ 1\ 0\ 1\ ]$ starting from $n = 0$ with a period of $N = 4$.

      b)   Determine the inverse Z-transform of $X(z) = 1/(1 - 1{\cdot}5\,z^{-1} + 0{\cdot}5\,z^{-2})$ if

          i)   ROC : $|z| > 1$

          ii)   ROC : $|z| < 0{\cdot}5$

          iii)   ROC : $0{\cdot}5 < |z| < 1$

          using (a) Long division method (b) Partial fraction method.   5 + 10

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

      a)   BIBO stability

      b)   Overlap-Add and Overlap-Save method

      c)   Recursive and Non-recursive system

      d)   Sampling and quantization

      e)   IIR and FIR process.

END