T.E. (Comp.) (Semester – I) Examination, 2010
DIGITAL SIGNAL PROCESSING
(2003 Course)

Time : 3 Hours Marks : 100

Instructions : *1) Answers to the **two** Sections should be written in **separate** books.*
*2) **Neat** diagrams must be drawn **wherever** necessary.*
*3) **Use** of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is **allowed**.*
*4) Assume **suitable** data, if **necessary**.*
*5) Attempt Q. **1** or Q. **2**, Q. **3** or Q. **4**, Q. **5** or Q. **6** from Section **I** and Q. **7** or Q. **8**, Q. **9** or Q. **10**, Q. **11** or Q. **12** from Section **II**.*

SECTION – I

1. A) Explain the sampling process in ADC and discuss the problem of identical sampling. 8

   B) For a DT signal $x(n) = 2[u(n) - u(n-4)]$, obtain following resulting DT signals : 8

   i) $x_1(n) = x(n-2) + \delta(n)$

   ii) $x_2(n) = x(n/2)$

   iii) $x_3(n) = x(-n) + x(n+3)$.

OR

2. A) State linearity and time invariant properties of a DT system and test it for a system – 8

$$y(n) = x(n) - 2x(n-2)$$

   B) Obtain a linear convolution of two DT signals – 8

$$x(n) = h(n) = 1, \quad -1 \le n \le +1$$

P.T.O.

3. A) Define ROC of Z-transform. Describe the ROC properties in detail. **8**

   B) Obtain inverse Z-transform using residue method where $X(Z) = \frac{Z}{(Z-1)^3}$. **8**

OR

4. A) State and prove following properties of Fourier transform i) Periodicity ii) Time Reversal. **8**

   B) Obtain ZT of a given DT signal using ZT properties where –
   $x(n) = 2nu(-n-1)$
   Sketch the ROC. **8**

5. A) Define system function H(Z). How it describes the properties of a DT system ? What is pole zero plot ? What do you mean by all pole and all zero system ? **10**

   B) Determine the impulse response of a system described as
   $y(n) + 3y(n-1) + 2y(n-2) = 2x(n) - x(n-1)$. **8**

OR

6. A) Obtain the frequency response of a system using simple geometric construction having impulse response – $h(n) = \{0.5, 0.5\}$. Obtain the difference equation of the system. **10**

   B) Draw a pole zero plot of a system described as –
   $y(n) = x(n) - x(n-1) + 0.2\ y(n-1) + 0.15\ y(n-2)$ what do you mean by multiple order poles/zeros ? **8**

SECTION – II

7. A) Derive the first stage of DIF FFT algorithm. Draw the basic butterfly structure and obtain the computational complexity. **10**

   B) State and discuss the periodicity and symmetry property of N-point DFT. How can we compute N point circular convolution using DFT and IDFT ? **8**

OR

8. A) Draw a signal flow graph for N = 8 for DIT FFT algorithm. Explain In-place computation and Bit-reversal indexing features of the algorithm. **10**

   B) Obtain DT frequencies $\{W_k\}$ for 4-point DFT. For a DT sequence $x(n) = \{1, -2, 3\}$, obtain 4-point DFT using linear transformation matrix. **8**

9. A) Define a DT filter. Prove that for an ideal frequency response, ∞ number of filter coefficients are required. **8**

   B) Obtain corresponding DT filter using impulse invariance method from a CT filter having transfer function $H(s) = \frac{1}{s^2 + 3s + 2}$ with $F_s = 5$ sps. **8**

OR

10. A) Write algorithmic steps to design an FIR filter using Hanning window. Compare Hanning with rectangular window. **8**

    B) What is frequency warping effect in BLT method ? Write down the design steps of BLT method for IIR filters. **8**

11. A) Draw a functional block diagram of ADSP 21XX processor and briefly explain DAG and MAC functional blocks. **8**

    B) Explain linear phase FIR filter structure and draw it for filter length M = 5. **8**

OR

12. A) Obtain and realize direct and cascade form FIR filter structure for a system having –

$$h(n) = \{1, -3, 5, -3\}$$ **8**

    B) Obtain and realize direct form – II IIR filter structure for a system

$$H(z) = \frac{z^2 + \frac{1}{3}z}{z^2 - \frac{3}{4}z + \frac{1}{8}}$$

What is the advantage of this form over Direct Form – I structure ? **8**
