T.E. (Computer) (2003 Course) (Semester – I) Examination, 2009
DIGITAL SIGNAL PROCESSING

Time : 3 Hours Max. 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.

6) Q. 7 or Q. 8, Q.9 or Q. 10, Q. 11 or Q. 12 from Section II.

SECTION – I

1. a) Define a DT system. How its properties can be described by means of impulse response h(n) ? **6**

   b) With example explain the time scaling and time reversal operations performed on a DT signal. **6**

   c) Which operations are performed on DT signals in linear convolution ? Obtain the computational complexity of linear convolution. **6**

OR

2. a) What is aliasing ? Show that all the frequencies $F_k = F_0 + K.F_s$, $K = \pm 1, \pm 2, \ldots$ are the aliases of frequency F_0. **6**

   b) Express the general form of N^{th} order general difference equation. How it could be expressed for FIR and IIR system ? **6**

   c) Define :

   1) Quantication
   2) Recursive system
   3) Dynamic system
   4) Sampling **6**

3. a) Using Z-transform properties obatin ZT of $x(n) = (n + 1)\, u(-n)$ specify ROC. **8**

   b) State and prove the time shifting property of Fourier transform. Apply it for $x(n) = \delta(n - 2)$. **8**

OR

4. a) Obtain inverse ZT using residue method for a causal sequence having

$$X(z) = \frac{3z^2 - z}{2.(z-1)^3}.$$ **8**

   b) Obtain the Fourier transform of a DT sequence $x(n) = (a)^n u(n), |a| < 1$.

   Explain how to plot the magnitude spectrum. **8**

5. a) Define system function H(z). How it is obtained from the general difference equation ? How it describes the properties of DT system ? **8**

   b) Solve the difference equation using ZT and obtain the step response,

$\rightarrow y(n) - x(n) + 2y(n-1) = 0$. **8**

OR

6. a) A causal DT system described by means of a pole zero plot has one zero Z1 = 1 and one pole P1 = 0 obtain the difference equation of the system. Obtain frequency response using simple geometric construction. **8**

   b) Determine the closed form expression of a n^{th} term of Fibonacci sequence by solving difference equation.

   (diff.equation : $y(n) = y(n-1) + y(n-2)$) **8**

SECTION – II

7. a) Compare DIF FFT algorithm with DJT FFT algorithm. Draw basic butterfly structure for both. **8**

   b) How circular shifting is different than linear time shifting ? Compute six point circular convolution of the following sequences :

$$x_1(n) = \{1, 1, 1, 1\}$$

$$x_2(n) = \text{Sin}\left(\frac{3\pi n}{8}\right), 0 < n \leq 5$$ **10**

OR

8. a) Define twiddle factor. Compute it for N = 4. Express DFT and IDFT using twiddle factor. Discuss its properties. **8**

   b) How linear convolution can be obtain using circular convolution ? Obtain 4 point DFT using Goertzel algorithm for x(n) = {0.5, 0.5}. **10**

9. a) Define a DT filter. What are the characteristics of ideal filter ? Compare between FIR and IIR filter. **8**

   b) Design IIR filter using BLT method with given specifications $H(s) = \frac{s}{s+1}$, $F_c = 200\ H_z$, $F_s = 2k\ H_z$. Use frequency prewarping. **8**

   OR

10. a) What do you mean by linear phase response ? Show that the FIR filter described as y(n) = x(n) – x(n – 1) has linear phase response. **8**

    b) Compare between Hamming and Hanning window. Write down the design steps of FIR filter using window. **8**

11. a) State the 4 types of GLPS (generalised linear phase system). Draw the linear phase FIR filter structure for M = 7 (order 6). Specify the no. of hardware elements required. **10**

    b) Realize direct form II IIR filter structure for y (n) = 2 x(n) – x(n – 1) + 2y (n– 1). **6**

    OR

12. a) Describe FIR filter by means of H(z) with example. Explain cascade form of FIR filter structure. **8**

    b) List the different types of internal buses and memory pointer registers present in ADSP 2105 processor. What is MAC ? **8**
