



**T.E. (Computer) (Semester – I) Examination, 2010**  
**DIGITAL SIGNAL PROCESSING (New)**  
**(2008 Course)**

Time : 3 Hours

Max. Marks : 100

- Instructions :** 1) 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.
- 2) Answers to the **two** Sections should be written in **separate** books.
- 3) Neat diagrams must be drawn **wherever** necessary.
- 4) Black figures to the **right** indicate **full** marks.
- 5) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is **allowed**.
- 6) Assume suitable data, if **necessary**.

**SECTION – I**

1. A) How an arbitrary DT sequence can be represented by convolution operation ?  
Obtain linear convolution of  $u(n)$  and  $\delta(n)$  using graphical method. 8
- B) State linearity and time invariant properties of a DT system and test it for  
 $y(n) = x(n) - 2x(n-2)$ . 8
- OR
2. A) How a DT system is represented/described in time domain ? Define the impulse response of a DT system and show that for a causal system. 8
- $h(n) = 0$  for  $n < 0$
- B) Why the problem of aliasing is observed during sampling process ? Show that all the frequencies  $F_k = F_0 \pm K.F_s$ ,  $K$ : integer are the aliases of frequency  $F_0$ . 8
3. A) Compare  $N$  point DFT with FT. What is the significance of  $N$  in DFT ? Why it is necessary to have  $N \geq L$  where  $L$  : length of a DT signal. 10
- B) State and prove windowing theorem of a Fourier Transform (FT). 8

OR



4. A) Obtain DT frequencies  $\{W_k\}$  for 6 point DFT. State the convolution and periodicity property of DFT. What is DFT spectral leakage ? 10
- B) Explain how DFT can be used for linear filtering. How N-pt. circular convolution can be used to obtain linear convolution ? 8
5. A) How computational complexity of N-point DFT is reduced using FFT algorithm ? What is in-place computation and bit-reversal indexing in FFT ? 8
- B) Using ZT properties, obtain ZT of a DT signal  $x(n) = 2^n u(-n-1)$  sketch the ROC. 8

OR

6. A) Derive the first stage of DIF (decimation in frequency) FFT algorithm. Draw the basic butterfly structure for the same. 8
- B) Obtain a causal sequence  $x(n)$  from its ZT 8

$$X(Z) = \frac{3}{Z - \frac{1}{4} - \frac{1}{8Z}}$$

### SECTION – II

7. A) Define a system function  $H(Z)$ . What is pole zero plot of a system ? Determine  $H(Z)$  and draw a pole zero plot for a system. 10

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

- B) Express system function  $H(Z)$  for FIR and IIR system from the  $N^{\text{th}}$  order difference equation. How properties of DT system can be described using  $H(Z)$  ? 8

OR

8. A) Knowing  $H(Z)$ , how frequency response of a system can be obtained ? Use simple geometric construction to obtain the frequency response of a system having  $h(n) = \{0.5, 0.5\}$ . 10
- B) Determine the impulse response of a system. 8
- $$y(n) = 2x(n) - x(n-1) - 3y(n-1) - 2y(n-2)$$



9. A) Define a DT filter. What do you mean by a linear phase response ? What is group delay ? State the advantages and disadvantages of FIR filter over an IIR filter. 8

B) What is frequency prewarping ? Design second order low pass filter using BLT method having

$H(S) = \frac{1}{S^2 + \sqrt{2} S + 1}$  with cut-off freq.  $F_c = 1\text{KHz}$  and sampling frequency  $F_s = 10\text{ KHz}$ . Use frequency prewarping. 8

OR

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

B) Stable analog filter always gives stable digital filter. Justify the statement. Explain impulse-invariance method for the design of an IIR filter. 8

11. A) Obtain direct and cascade form FIR filter structure for a system having

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

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

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

OR

12. A) How DSP processors are different than conventional microprocessors ? List the important features of ADSP 21XX DSP processor. What is DAG ? 8

B) How image is represented by digital computer ? Explain the application of DSP in image processing w.r.t. image enhancement. 8

A) Compare N point DFT with FT. What is the significance of N ? It is necessary to have  $N \geq L$ , where L is length of the signal.

Time and prove windowing is \_\_\_\_\_

OR