B. Tech Third Year : 5th Semester

DIGITAL SIGNAL PROCESSING, DEC., 2011

(FOR 5 IT 2 BRANCH OF ENGINEERING)

Times : 3 Hours **Min. Passing Marks : 24** **Total Marks : 80**

Instructions to Condidates : *Attempt overall **five** questions selecting **one** question from **each** unit. All questions carry **equal** marks, (Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitable be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.)*

Unit–'I'

1. (*a*) If the impulse response of a linear time invariant system is h(n) = {1, 2, 1, –1} then determine the response of the system to the input signal

x(n) = {1, 2, 3, 1} **[8]**

(*b*) Explain the following with suitable example for discrete time systems :

(i) Time-Invariant and Time-variant systems.

(ii) Linear and Nonlinear systems. **[8]**

OR

2. (*a*) State and prove the Convolution Sum formula for Linear time invariant system and explain the condition for stability. **[8]**

(*b*) Determine the Zero-Input response of the system described by the different equation

$y(n) - 3y(n-1) - 4y(n-2) = 0$

Given initial conditions are

$y(-2) = 0$ and $y(-1) = 5$. **[8]**

Unit–'II'

3. (*a*) Determine the inverse Z-transform of

$$X(z) = \frac{1}{1-1.5Z^{-1}+0.5Z^{-2}}$$

if

(i) Roc $|z| > 1$

(ii) Roc $|z| < 0.5$

(iii) Roc $0.5 < |z| < 1$ **[8]**

(*b*) Explain the following properties of Z-transform with one suitable example :

(i) Time Shifting.

(ii) Convolution of two sequences. **[8]**

OR

4. (*a*) Compute the response of the system

$y(n) = 0.7\,y(n-1) - 0.12\,y(n-2) + x(n-1) + x(n-2)$

to the input $x(n) = nU(n)$. Is the system stable? **[8]**

(*b*) Explain the following properties of Z-transform with one suitable example :

(i) Scaling in Z-domain.

(ii) Multiplication of two sequences. **[8]**

Unit–'III'

5. (*a*) Derive an expression of Interpolation formula to reconstruct the sample signal. **[8]**

(*b*) Explain Mathematically and graphically Aliasing in sampling process. **[8]**

OR

6. (*a*) State and prove the sampling theorem and Nyquist rate of sampling. **[8]**

(*b*) Explain the sampling in Frequency domain. **[8]**

Unit–'IV'

7. (*a*) Compute the DFT of the four point sequence

x(n) = (0 1 2 3) **[8]**

(*b*) Explain the following properties of DFT with suitable example :

(i) Linearity property

(ii) Symmetry property. **[8]**

OR

8. (*a*) Derive the redix-2 decimation-in-time FFT algorithm. **[8]**

(*b*) Derive the signal flowgraph for the N=16 point, radix 4 decimation in frequency FFT Algorith. **[8]**

Unit–'V'

9. (*a*) Determine the FIR filter coefficients for the direct form structure. Given a three stage lattice filter with coefficients

$K_1 = 1/4,\ K_2 = 1/4,\ K_3 = 1/3$ **[8]**

(*b*) Explain the following :

(i) Butterworth filters

(ii) Chebyshev filters **[8]**

OR

10. (*a*) Determine the Cascade and Parallel realization for the system described by the system function

$$H(z) = \frac{10\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{2}{3}z^{-1}\right)\left(1+2z^{-1}\right)}{\left(1-\frac{3}{4}z^{-1}\right)\left(1-\frac{1}{8}z^{-1}\right)\left[1-\left(\frac{1}{2}+i\frac{1}{2}\right)z^{-1}\right]\left[1-\left(\frac{1}{2}-i\frac{1}{2}\right)z^{-1}\right]}$$

[8]

(*b*) Explain the IIR filter design by Bilinear Transformation. **[8]**