

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 Candidates : 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

$$x(n) = \{1, 2, 3, 1\} \quad [8]$$

- (b) Explain the following with suitable example for discrete time systems :
- Time-Invariant and Time-variant systems. [8]
 - 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

- Roc $|z| > 1$
 - Roc $|z| < 0.5$
 - Roc $0.5 < |z| < 1$ [8]
- (b) Explain the following properties of Z-transform with one suitable example :
- Time Shifting. [8]
 - Convolution of two sequences. [8]

OR

4. (a) Compute the response of the system $y(n) = 0.7y(n-1) - 0.12y(n-2) + x(n-1) + x(n-2)$ to the input $x(n) = nU(n)$. Is the system stable? [8]
- (b) Explain the following properties of Z-transform with one suitable example :
- Scaling in Z-domain. [8]
 - 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 :
- Linearity property [8]
 - Symmetry property. [8]

OR

8. (a) Derive the radix-2 decimation-in-time FFT algorithm. [8]
- (b) Derive the signal flowgraph for the N=16 point, radix 4 decimation in frequency FFT Algorithm. [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 :
- Butterworth filters [8]
 - Chebyshev filters [8]

OR

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

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

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