I-M.Tech(CSE)-DSP(1.3)

M.Tech(CSE) 1st Semester Examination -2019

Sub: Digital Signal Processing

Full Mark – 70 **Time: 3Hrs**

(Answer all questions. Figure in the right hand margin indicate marks.)

1. (a) A discrete time signal x(n) is defined as

$$x(n) = \begin{cases} |n - 0.5|, & -3 \le n \le 3 \\ 0, & \text{otherwise} \end{cases}$$

(i) Sketch the signal x(n). (ii) Find x(-n + 2) (iii) Find x(n). u(-n-1). [5]

(b) Determine whether the system given by input-output relation y(n) = 5x(-n) is time-variant or time-invariant. [4]

(c) The impulse response of a LTI system is $h(n) = (1/2)^n u(n)$. Determine the response of the system to the input signal $x(n) = (1/4)^n u(n)$. [5]

OR

(a) How to determine the stability of a LTI system from its impulse response? Determine range of **b** for which the system with impulse response $h(n) = b^n$, $n < 0$ to be stable. [7]

(b) Determine convolution of the two signals given by $x1(n) = \delta(n) + 3\delta(n-2) + 2\delta(n-1)$ and $x2(n) = \delta(n+1) + \delta(n-1) - \delta(n+2)$. [7]

2. (a) Determine the zero input response of the system described by 2nd order difference equation $y(n) - 3y(n-1) - 4y(n-2) = x(n)$. Consider $y(-1) = 5$, $y(-2) = 0$ [10]

(b) Determine the cross correlation of two sequences $x1(n) = u(n+1) - u(n-2)$ and $x2(n) = \{1,-1,2,1\}$ [4]

OR

Determine the response y(n) for the system described by 2nd order difference equation $y(n) - 3y(n-1) - 4y(n-2) = x(n) + 2x(n-1)$ where the input sequence is $x(n) = 4^n u(n)$. Consider $y(-1) = 5$, $y(-2) = 0$ [14]

3. (a) State and prove the convolution property of z-transform. [7]

(b) Consider a initially relaxed LTI system described by difference equation $y(n) = 0.25\, y(n-2) + x(n)$. Determine the system function and impulse response of the system. [7]

OR

(a) Find inverse z-transform of $X(z) = 1 / \{(1 + z^{-1})(1 + z^{-1})^2\}$. [7]

(b) Find inverse z-transform using long division method of $X(z) = 1 / (1 - 1.5z^{-1} + 0.5z^{-2})$ if ROC: $|z| < 0.5$. [7]

4. Perform the circular convolution of two sequences using both time domain and frequency domain method. Verify your result using matrix method.
$x1(n) = \{2,-1,2,-1\}$ and $x2(n) = \{1,2,3,4\}$ [6+6+2=14]

OR

(a) Find DFT of the sequence $x(n) = \{1,2,-1,2\}$ using linear transformation method. [5]
(b) Determine the DFT transformation matrix for N =8. [5]
(b) State and prove the complex conjugate property of discrete Fourier transform. [4]

5. (a) An FIR filter has unit impulse response $h(n) = \{2,2,1\}$. Determine the output sequence in response to input sequence $x(n) = \{3,0,-2,0,2,1,0,-2,-1,0\}$ using overlap add method. [10]
(b) A sequence is given by $x(n) = n+1$ for $0 \leq n < 4$. Find the discrete Fourier transform using Decimation – in – frequency FFT algorithm. [4]

OR

(a) Determine the direct form II realization of LTI system given by
$y(n) + 3y(n-1) – 4\ y(n-3) = x(n) + 2\ x(n-4)$ [7]
(b) Draw the butterfly structure of an 8-point FFT using Decimation – in – time algorithm. [7]