T.E. (ETRX) Sem VI
Discrete Time Signal Processing

Con. 5958-09. SP- 8027

(3 Hours) [Total Marks : 100

11/01/10
2.30 to 5.30

N. B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions from remaining **six** questions.
(3) Assume **suitable** data if **necessary**.

1. (a) Determine if the system having the system function is stable. 5

$H(z) = 1/(1-1{\cdot}75\, z^{-1} + 0{\cdot}5z^{-2})$

(b) State and explain Parseval's Theorem in DFT. How it can be used to find the energy of a finite duration sequence ? 5

(c) Determine whether the following systems are causal or non causal. 5

(i) $y(n) = x(3n)$ (ii) $y = x(-n)$

(d) Test linearity and time invariance of the following system – 5

(i) $y(n) = |x(n-1)|$

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

(iii) $y(n) = b^{x(n)}$

(iv) $y(n) = ax(n) + bnx(n-3)$

2. (a) Determine the impulse response for the cascade of two LTI systems having impulse response. 5

$h1(n) = (\frac{1}{2})^n u(n)$

$h2(n) = (\frac{1}{4})^n u(n)$

(b) Determine crosscorrelation sequence of the sequences – 5

$x(n) = \{ \ldots\ldots 0, 0, 2, -1, 3, 7, 1, 2, -3, 0, 0, , \ldots\}$
$\uparrow$

$y(n) = \{\ldots\ldots 0, 0, 1, -1, 2, -2, 4, 1, -2, 5, 0, 0, \ldots\}$
$\uparrow$

(c) Compute the autocorrelation of the signal $x(n) = a^n u(n)$, $0 < a < 1$. 5

(d) Compute the convolution x(n) of the signal using z-transforms 5

$x_1(n) = \{1, -2, 1\}$

$x_2(n) = 1, \quad 0 \le n \le 5$

$= 0$ elsewhere

3. (a) Determine the z–transform of the signal $x(n) = \left(\frac{1}{2}\right)^n u(n)$. 5

(b) Determine the z-transform of the signal $x(n) = -a^n u(-n-1) = 0, \quad n \geq 0$ 5

$= -a^n, \quad n \leq -1$

(c) Determine the response of the system 5
$y(n) = (5/6)\, y(n-1) - (1/6)\, y(n-2) + x(n)$ to the input signal $x(n) = \delta(n) - (1/3)\, \delta(n-1)$.

(d) Evaluate the inverse z–transform of $X(z) = 1 / (1 - az^{-1})$, $|z| > |a|$ using complex inversion integral. 5

4. (a) Perform the circular convolution of the following two sequences : 10

$x_1(n) = \{2, 1, 2, 1\}$

$x_2(n) = \{1, 2, 3, 4\}$

(b) By means of DFT and IDFT, determine the sequence $x_3(n)$ corresponding to the circular convolution of the sequence $x_1(n)$ and $x_2(n)$. 10

$x_1(n) = \{2, 1, 2, 1\}$

$x_2(n) = \{1, 2, 3, 4\}$

5. (a) Consider a Causal LTI system having transfer function 15
$H(z) = (3 - 4z^{-1}) / (1 - 3{\cdot}5z^{-1} + 1{\cdot}5z^{-2})$.
Implement the system in each of the following forms :

(i) Direct Form – I

(ii) Direct Form – II

(iii) Cascade Form

(iv) Parallel Form.

(b) Compute the DFT of the four point sequence $x(n) = (0, 1, 2, 3)$ using matrix (of the linear transformation) W_N. 5

6. (a) Using FFT and IFFT, find the ouput of the system, if 10

$x(n) = \{2, 2, 4\}$

$h(n) = \{1, 1\}$.

(b) Compute the 8 point DFT of the sequence 10
$x(n) = \left\{\frac{1}{2}, \frac{1}{2}, \frac{1}{2}, \frac{1}{2}, 0, 0, 0, 0\right\}$ Using in–place radix–2 decimation in time FFT algorithm.

7. Attempt any **four** of the following :– 20

(a) DSP Processor

(b) Computational complexity of DFT and FFT

(c) Auto correlation and cross correlation

(d) Comparison between IIR and FIR system

(e) Filtering of long data sequences.
