Printed Pages : 4 TEC – 602

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 3092 Roll No.

B. Tech.

(SEM. VI) EXAMINATION, 2008-09

DIGITAL SIGNAL PROCESSING

Time : 3 Hours] *[Total Marks : 100*

Note : (i) Attempt **all** questions.

(ii) All questions carry **equal** marks.

1 Attempt any **four** parts of following : 5×4

(a) Show that a periodic sequence $x_p(n)$ can be expressed in terms of samples of the spectrum $X(w)$ as

$$x_p(n) = \frac{1}{N} \sum_{k=0}^{N-1} X\left(\frac{2\pi}{N} k\right) e^{J\,2\pi\, kn/N},$$

$n = 0, 1, \ldots, N-1$.

Does it imply that $X(w)$ can be recovered from the samples ?

(b) Show that Fourier transform $X(w)$ can be obtained from the equally spaced samples of $X(z)$ on unit circle in z plane. Compare Fourier transform and z transform critically.

(c) Show that N-point circular convolution of sequences $x_1(n)$ and $x_2(n)$ given by

$$x_1(n) = x_2(n) = \begin{cases} 1, & 0 \le n \le N-1 \\ 0, & otherwise \end{cases}$$

is inverse DFT of $X(k)$ where

$X(k) = X_1(k)X_2(k)$.

(d) Find N point DFT of following sequences

(i) $u(n) - u(n-n_0),\ 0 < n_0 < N$

(ii) $\cos^2\left(\frac{2\pi n}{N}\right),\ n = 0,\ 1,\ldots\ldots,N-1$.

(e) Find inverse DFT of

(i) $X(k) = \begin{cases} 3, & k = 0 \\ 1, & 1 \le k \le 5 \end{cases}$

(ii) $Y(k) = e^{j\,2k\,\frac{2\pi}{10}}\,X(k)$

where $X(k)$ is 10 point DFT and $x(n)$.

(f) State and prove the linearity and symmetry properties of DFT.

2 Attempt any **two** parts of following : 2×10

(a) What do you mean by FFT ? Introduce DIT and DIF FFT algorithms. What properties of complex exponential sequence is used to reduce the amount of mathematical operations. Derive mathematical expressions of Geartzel algorithm and explain its features.

(b) Derive the expression for computation of 16 port DFT using radix 4 decimation in time algorithm and draw the flow graph. Explain the use of butter fly computation.

(c) How 4N-point DFT of real valued square may be computed using N point FFT algorithm ? Comment on the amount of mathematical operation reduction as compared to direct DFT computation.

3 Attempt any **two** parts of following : 2×10

(a) What are different structures for realization of FIR filter ? Discuss frequency sampling structure. A linear shift invariant has unit sample response given in table below :

$h(0)$	$h(1)$	$h(2)$	$h(3)$	$h(4)$	$h(5)$	$h(6)$
−0.01	0.02	−0.10	0.40	−0.10	0.02	−0.01

Implement this system with minimum number of multipliers. What maximum value does $y(n)$ can attain if system is bonded with $|x(n)| < 1$ for all n.

(b) What are different structures of an IIR filter ? Discuss with the help system function. Show that FIR filter having unit sample response

$$h(n) = \begin{cases} a^n & 0 \le n \le N \\ 0 & otherwise \end{cases}$$

Can be implemented by cascading an FIR system with an IIR system.

(c) What do you understand by lattice structure ? Explain with the help of mathematical expressions. Give some applications of this structure with justification.
Determine the FIR filter coefficients for the direct form structure having three stage lattice filter coefficients as

$$K_1 = \frac{1}{4}, \quad K_2 = \frac{1}{4}, \quad K_3 = \frac{1}{3}.$$

4 Attempt any **two** parts of following : 2×10

(a) Compare FIR filter and IIR filter. on the basis of design and implementation. What do you mean by symmetric and antisymmetric FIR filter, deduce the expressions for these frequency response and mention the area of application.

(b) Discuss the FIR filter design technique using Windows, with mathematical expressions. Discuss the disadvantages of this methods.

(c) Write short notes on frequency sampling method for design of FIR filter.

5 Attempt any **two** parts of following : **2×10**

(a) Transfer function of an analog filter is given by

$$Ha(s) = \sum_{k=1}^{N} \frac{C_k}{S - P_k}$$, find the corresponding system function of digital filter is given by

$$H(z) = \sum_{k=1}^{N} \frac{C_k}{1 - e^{P_k T} z^{-1}}.$$

(b) Derive the expression for design of IIR filter from analog transfer function using bilinear transformation. Vestigate the characteristics of bilinear transformations.

(c) Write short note on matched z transformation method for design of IIR filter, also mention the limitation of this transformation.
