Con. 2572-07. (REVISED COURSE) ND-8042

(3 Hours) [Total Marks : 100

N. B. (1) Question No.1 is compulsory
(2) Attempt any four questions out of remaining six questions.
(3) Assume suitable data if required

1. (a) Let h(n) be the unit sample response of a low pass filter with a cutoff frequency ω_c, what type o filter has a unit sample response $g(n) = (-1)^n h(n)$? (4)

(b) Assume that a complex multiply takes 1 μs and that the amount of time to compute a DFT is determined by the amount of time it takes to perform all the multiplications. (8)
(i) How much time does it take to compute a 1024 point DFT directly?
(ii) How much time is required if an FFT is used?

(c) Sequence $x_p(n)$ is periodic repetition of sequence $x(n)$. What is the relationship between C_k of Discrete Time Fourier Series of $x_p(n)$ and DFT $X(k)$ of $x(n)$. (8)

2 (a) A digital filter that is implemented on a DSP chip is described by the linear constant coefficient difference equation

$$y(n) = \frac{3}{4}y(n-1) - \frac{1}{8}y(n-2) + x(n)$$ [8]

In evaluating the performance of the filter, the unit sample response is measured. The internal storage registers on the chip, however, are not set to zero prior to applying the input. Therefore, the output of the filter contains the effect of the initial conditions, which are
$y(-1) = -1$ and $y(-2) = 1$
Determine the response of the filter for all $n \geq 0$ and compare it with the zero state response.

(b) For following linear shift-invariant systems, draw pole zero diagram and Identify the filter type based on pass band. [12

(i) $H(z) = \dfrac{z^{-1} - a}{1 - az^{-1}}$ where $|a| < 1$

(ii) $H(z) = A\dfrac{1 + z^{-4}}{1 + a^4 z^{-4}}$

3. (a) Cosider the following specifications for a low pass filter

$0.99 \leq |H(e^{j\omega})| \leq 1.01$ $\quad 0 \leq |\omega| \leq 0.3\pi$ and

$|H(e^{j\omega})| \leq 0.01$ $\quad 0.35\pi \leq |\omega| \leq \pi$ (10)

Design a linear phase FIR filter to meet these specifications using the window design method.

b) Use the bilinear transformation to design a discrete –time Chebychev high pass filter an equiripple passband with (10)

$0 \le |H(e^{j\omega})| \le 0.1$ $\quad 0 \le |\omega| \le 0.1\pi$ and

$0.9 \le |H(e^{j\omega})| \le 1.0$ $\quad 0.3\pi \le |\omega| \le \pi$

(a) Consider the sequence

$x(n) = \delta(n) + 2\delta(n-2) + \delta(n-3)$

i) Find four point DFT of x(n) (4)

ii) If $y(n)$ is the four point circular convolution of $x(n)$ with itself, find $y(n)$ and the four point DFT $Y(k)$ (4)

iii) With $h(n) = \delta(n) + \delta(n-1) + 2\delta(n-3)$, find the four-point circular convolution of $x(n)$ with $h(n)$. (4)

(b) Explain the pole zero locations for Type I, Type II, Type III and Type IV linear phase FIR filters. (8)

5. (a) The unit sample response of an FIR filter is

$$h(n) = \begin{cases} \alpha^n & 0 \le n \le 6 \\ 0 & otherwise \end{cases}$$ (10)

(i) Draw the direct form implementation of this system.

(ii) Determine system function and use this to draw a flow graph that is cascade of an FIR system with an IIRsystem.

(iii) For both of these implementations, determine the number of multiplications and additions required to compute each output value and the number of storage registers that are required.

(b) Draw a lattice filter implementation for the all pole filter (10)

$$H(z) = \frac{1}{1 - 0.2z^{-1} + 0.4z^{-2} + 0.6z^{-3}}$$

and determine the number of multiplications, additions, and delays required to implement the filter. Compare this structure to a direct form realization of $H(z)$ in terms of multiplies, adds and delays.

6. (a) Determine 8 point DFT for a continuous time signal, $x(t) = \sin(2\pi Ft)$ with $F_s = 50Hz$ using DIF algorithm. (10)

(b) With the help of block diagram , explain architecture of TMS 32 C 5X series of processors. (10)

7. (a) Explain the Goertzel algorithm (6)

(b) Write short note on applications of DCT (6)

(c) Explain briefly any one method of long data filtering (8)