Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech (ECE)/SEM-2/MCE-203/2010

2010

ADVANCED DIGITAL SIGNAL PROCESSING

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP - A

(Marks : 30)

Answer Question No. 1 and any *two* from the rest.

1. Answer *all* questions : 10

   a) What are the advantages of using a digital signal processor over analog signal processor ?

   b) Explain the necessity of using a separate multiplier in a DSP chip.

   c) What is the CSSU ?

   d) What are the differences between a Von Neumann architecture and Harvard architecture of processors ?

   e) Distinguish between an SIMD array and a systolic array in the light of processing digital signals.

2. Design a systolic array to perform the convolution of two signals. Show all the steps of your design procedure. 10

3. Explain the functionalities of the following units with respect to DSP processor :

   a) MAC unit

   b) Barrel shifter

   c) Auxiliary register arithmetic unit.

   Explain the necessity of having pipelining and multi-access memory in DSP chips. (3 × 2) + 4

4. Compare and contrast between a superscalar and a VLIW processor for processing digital signals. What do you mean by perceptual coding of digital audio ? What do you mean by image compression and image enhancement ? 4 + 2 + 4

GROUP - B

(Marks : 40)

Answer *all* questions.

5. Answer *all* questions : 2 × 4

   a) What are recursive and non-recursive systems ? Give a proper graphical and mathematical representation of FIR and IIR systems. How can both of these systems be used in filters ?

   b) What are the fundamental elements for building digital implementation for IIR and FIR filters ? Make the proper schematic representation of the elements.

6. Answer any *three* questions : 3 × 4

a) Write down the definitions of the following terms with proper mathematical expression :

i) Causality of a system

ii) Stability of a system

iii) Aliasing effect of a continuous signal

iv) Sampling theorem

v) Aliasing effect.

b) Consider the convolution of the sequence. Show the graphical representation of $Y[n]$.

$$x(n)=\begin{cases}1 & 10\le n\le 20\\ 0 & Otherwise\end{cases}$$

$$h(n)=\begin{cases}n & -5\le n\le 5\\ 0 & Otherwise\end{cases}$$

c) Find the convolution of the given figure below. Show its graphical representation.

d) Find the complex symmetric and anti-symmetric of the following complex sequence signal.

$$X*1[n]=[1-j4,-2-j5,3+j2,-7-j3,-1-j].$$

7. Answer any *two* : 2×10

a) Suppose a digital system is represented as it is shown in the figure below. How can you design the system response, and what is the $y[n]$ in the difference equation form ?

b) Determine the poles and zeros of the following LTID systems :

i) $H[z] = \dfrac{z}{z^2 - 3z + 2}$

ii) $H[z] = \dfrac{1}{(z - 0\cdot1)(z - 0\cdot5)(z + 0\cdot2)}$

iii) $H[z] = \dfrac{z^2(2z - 1\cdot5)}{(z + 0\cdot4)(z - 0\cdot5)^2}$

iv) $H[z] = \dfrac{z^2 + 0\cdot7z + 1\cdot6}{(z^2 - 1\cdot2z + 1)(z + 0\cdot3)}$.

c) What is SFFT ? How is it used to chaos detection in signal processing application ? Discuss how wavelet transform helps to data compression in real time signal processing in computer vision application.