Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH(ECE-VLSI)/SEM-2/MVLSI-202/2011

2011

DIGITAL SIGNAL PROCESSING AND APPLICATIONS

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

(Short Answer Type Questions)

1. Answer any *seven* questions briefly : 7 × 2 = 14

   i) Determine which of the following signals are periodic and compute their fundamental period :

      a) $\sin \sqrt{2}\ \pi t$

      b) $\sin 20\pi t + \sin 5\pi t$.

   ii) Why the poles of the TF of a stable system need to be within the unit circle in the z-plane ?

   iii) Test the following systems for time invariance :

      a) $y(n) = nx^2(n)$

      b) $a^{x(n)}$.

iv) Distinguish between DFT and DTFT.

v) How many multiplications and additions are required to compute N-point DFT using Radix-2 FFT ?

vi) What is warping ?

vii) Compare between FIR and IIR filters.

viii) What is Gibbs phenomenon ?

ix) What condition on the FIR sequence $h(n)$ is to imposed in order that this filter can be called a linear phase filter ?

x) What is a window and why is it necessary ?

GROUP – B

(Long Answer Type Questions)

Answer any *four* questions. $4 \times 14 = 56$

2. a) Determine the response of the causal system :

$y(n) - y(n-1) = x(n) + x(n-1)$ to input $x(n) = 2^{-n} u(n)$. Test its stability.

b) What is 1st-order hold ?

c) Compute the output of the causal system

$h(n) = \{1, -1, 1, -1\}$ for the causal input $x(n) = \{1, 0, 2, 5, 4\}$. $5 + 2 + 2 + 5$

3. a) Draw and explain the operation of a sigma-delta ADC.

   b) What are the advantages of it over other types of ADC ?

   c) Explain why we need a filter before down-sampling in a decimator ? 6 + 4 + 4

4. a) Explain the basic principle of an Adaptive filter with the help of proper block diagram.

   b) What is LMS algorithm ? Explain briefly.

   c) Show how the adaptive principle can be used for noise cancellation. 5 + 5 + 4

5. a) Compute an 8-point DFT of the following sequences using radix 2 DIT and DIF FFT algorithms :

   $x(n) = \{1, 2, 3, 2, 1, 2, 3, 2\}$.

   b) Draw amd explain the block diagram of an interpolator.

   c) What are the side-effects of data-truncation ? How can these effects be resolved ? 5 + 4 + 2 + 3

6. a) Get the TF $H(z)$ of tuned digital filter with zero transmission at 0 Hz and 500 Hz and peak at 125 Hz. The highest frequency to be processed is 500 Hz.

   b) Design a differentiator using a 10th order non-recursive filter. Use the rectangular window.

   c) How one can compute linear convolution using circular convolution ? 5 + 7 + 2

7. a) Design a 1-dB ripple Chebyshev HPF with the following specifications :

$G_s \leq -6.3$ dB over $0 \leq w \leq 10$, ripple $r \leq 1$ dB over a passband $w \geq 15$.

The highest frequency to be processed is 80 rads/sec.

b) Get the canonical realization of the

TF $H(z) = \dfrac{5z^3 + 3z^2 + 2z + 1}{z^3 + 2z^2 + 3z + 1}$.

c) Explain how we can get the TF of a BPF from a normalized LPF. 7 + 3 + 4