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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 :
- $7 \times 2 = 14$
- 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) $a^{x(n)}$.

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- 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.

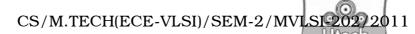
 $4 \times 14 = 56$

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

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

 $G_s \le -6.3 \text{ dB over } 0 \le w \le 10, \text{ ripple } r \le 1 \text{ dB over a}$ passband $w \ge 15.$

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

b) Get the canonical realization of the

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

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

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