Temp 207 **VLSI Architectures**

Mid Semester Examination 1

Spring 2012

Maximum Marks: 50 **Time: 90 minutes**

General Instructions:

a. There are **two** questions in this question paper. Attempt **ALL** questions
b. Figures in the right margin indicate marks for each question.
c. Answer in your own words as far as practicable.
d. Reasons are to be stated in support of your answers (except objective type questions). *No credit will be given to answers which are mere assertions*.
e. Use of laptops, mobile phones, pagers or any other electronic devices is strictly prohibited inside the examination hall.
f. Books may be opened at the time of the examination.
g. If any assumption is made at any step they have to be clearly stated.

::::::::BEST OF LUCK::::::::

1. Consider an IIR filter given by the equation :

$y_n = a_0 x_n + a_1 x_{n-1} + a_2 x_{n-2} + b_1 y_{n-1} + b_2 y_{n-2}$ ……………………………………………(1)

Draw a data flow graph with multiply and accumulate operation at each node. Suppose that only one multiply-accumulate unit is available. Indicate by means of a scheduled sequencing graph the timing of various operations binding them with appropriate resources. 6+8=14

2. Consider a linear time invariant first order recursive function given by:

$y(k) = ay(k-1) + x(k)$, ………………………………………………………………(2)

where the feedback coefficient a is assumed to be a constant.

Draw a data flow graph depicting the first order feedback loop. Map the data flow graph into a suitable hardware architecture involving adders and multipliers. The first order loops are typically unfolded with the intent of relaxing the timing constraint by inserting additional latency registers into the feedback loop while preserving the original transfer function. Unfold the given recursive function by a factor of 4. Obtain the data flow graph and the hardware architecture for the unfolded loop. Suppose, the feedback coefficient a is no longer constant but varies as a function of time $a(k)$. Hence, we may write:

$y(k) = a(k)y(k-1) + x(k)$ ……………………………………………………………(3)

Prove that for unfolding the loop equation (2), by an arbitrary positive integer p, the loop equation may be rewritten as:

$y(k) = \left(\prod_{n=0}^{p} a(k-n)\right) \cdot y(k-p) + \left(\sum_{n=1}^{p-1}\left(\prod_{m=0}^{n-1} a(k-m)\right) \cdot x(k-n)\right) + x(k)$. Obtain the data flow graph for $p = 4$. 6+6+6+6+6+6=36