Student ID: ____________

CS 151
Quiz 7

Name                      : _________________ , _________________
(Last Name)                 (First Name)

Student ID               : _________________

Signature                 : _________________

Instructions:

1. Please verify that your paper contains 8 pages including this cover.
2. Write down your Student-Id on the top of each page of this quiz.
3. This exam is closed book. No notes or other materials are permitted.
4. Total credits of this quiz are 60 points.
5. To receive credit you must show your work clearly.
6. No re-grades will be entertained if you use a pencil.
7. Calculators are NOT allowed.
Q1 [Carry Look-Ahead adder] [30 points]

In this problem we are going to design a 12-bit hierarchical carry look-ahead (CLA) adder out of 4-bit CLA components (as shown below). [15 points]

a) Draw the interface between the 4-bit CLAs and the CLA Logic that should be added to implement the 12-bit adder. Use the black box below. (At this stage you do not need to implement the circuit inside the blocks.) [15 points]
<This page was left blank intentionally>
b) Write the equations for the outputs of the CLA Logic block. [15 points]
Q2 [Add and Shift Multiplier] [15 points]

We want to multiply two 4-bit unsigned binary numbers using add and shift method with a data path shown below. The multiplicand is equal to 0101 and the multiplier is equal to 0111. The table on the next page shows an algorithmic step-by-step view of the process and the contents of registers Multiplicand, Multiplier and Running Sum. We have filled on the first 5 steps. Complete the table for executing the multiplication until it is done and show content of the registers after each step of adds and shifts.
<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Multiplicand reg (md)</th>
<th>Multiplier reg (mr)</th>
<th>Running Sum reg (rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Load mr</td>
<td>0101</td>
<td>0000</td>
<td>00000000</td>
</tr>
<tr>
<td>2</td>
<td>Load md</td>
<td>0101</td>
<td>0111</td>
<td>00000000</td>
</tr>
<tr>
<td>3</td>
<td>Check mr0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Load rs (rs = rs+md)</td>
<td>0101</td>
<td>0111</td>
<td>01010000</td>
</tr>
<tr>
<td>5</td>
<td>Shift right rs</td>
<td>0101</td>
<td>0111</td>
<td>00101000</td>
</tr>
</tbody>
</table>
Q3 [Carry Select Adder] [15 points]

Design a 16-bit carry select adder out of 8-bit adders and multiplexers. Below is the diagram of a 8-bit adder.