CS 151
Quiz 3

Name : __________________ , __________________
      (Last Name)     (First Name)

Student ID : ______________

Signature : ______________

Instructions:

1. Please verify that your paper contains 6 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 50 points.
5. To receive credit you must show your work clearly.
6. For possible re-grade request make sure that your write clearly.
7. Calculators are NOT allowed.
Q1: [Controller Design] [20 points]

Consider the FSM shown below:

a) Create the architecture for this FSM. [8 points]
b) Given the state encoding shown below, draw the state table. [8 points]

A = 00, B = 01, C = 10, D = 11

c) Write the equations for the outputs. [4 points]
Q2: [Reverse Engineering]       [16 points]

Given the state table below and the corresponding encoding of the states, design the FSM.

<table>
<thead>
<tr>
<th>Present state</th>
<th>Next State</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X=0</td>
</tr>
<tr>
<td>000</td>
<td>000</td>
</tr>
<tr>
<td>001</td>
<td>010</td>
</tr>
<tr>
<td>010</td>
<td>011</td>
</tr>
<tr>
<td>011</td>
<td>100</td>
</tr>
<tr>
<td>100</td>
<td>001</td>
</tr>
</tbody>
</table>

The encoding for the states is:
A = 000
B = 001
C = 010
D = 011
E = 100

The start state should be A.
Q3: [Registers] [14 points]

Implement a 4-bit register with the functionality specified in the following table. (A = \(a_3a_2a_1a_0\) is the output of the register.)

Use the black box template below, and complete the design within the black box to implement this register.

NOTE: Specify the select lines of each multiplexer as well as the inputs. You can use the following components if needed.

- Adder
- Comparator
- Logic gates
- Multiplexers

<table>
<thead>
<tr>
<th>(S_0S_1)</th>
<th>Action</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Load</td>
<td>(b_3b_2b_1b_0)</td>
</tr>
<tr>
<td>01</td>
<td>Keep current value</td>
<td>(A)</td>
</tr>
<tr>
<td>10</td>
<td>if (B&gt;A) Load (B/2); else Load (B*2)</td>
<td>if (B&gt;A) (B/2); else (B*2)</td>
</tr>
<tr>
<td>11</td>
<td>if (B&lt;A/2) Load (B); else keep current value</td>
<td>if (B&lt;A/2) (B); else (A)</td>
</tr>
</tbody>
</table>