Name: _____

CS 4/55111   # Midterm Exam   **VLSI Design**
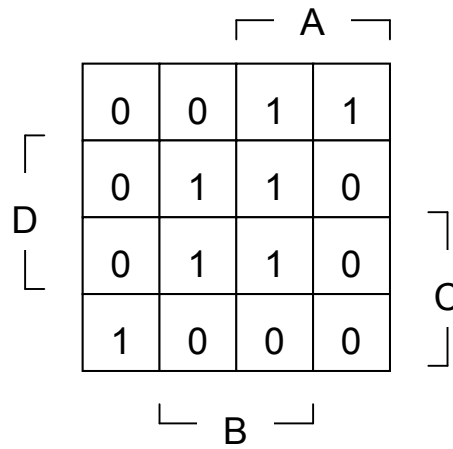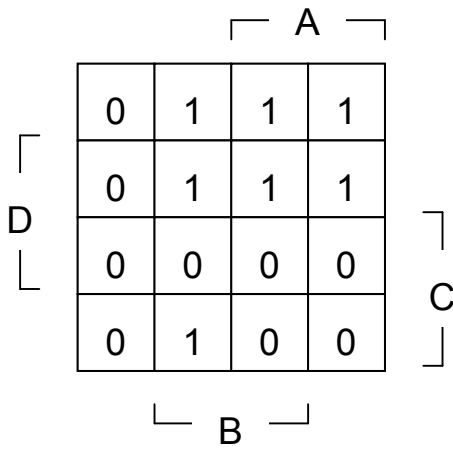
Wednesday 3 November 2004

1. Given the two 4-variable Karnaugh maps below, circle the 1's and write the minimized
    expression below each map. (20 points)

	⌐ A ⌐		
0	1	1	1
0	1	1	1
0	0	0	0
0	1	0	0

D (left), C (right), B (bottom)

	⌐ A ⌐		
0	0	1	1
0	1	1	0
0	1	1	0
1	0	0	0

D (left), C (right), B (bottom)

2. Suppose signal D is connected to the input of both a D latch and a rising-edge triggered D
    flip-flop. Show the output produced by the latch (QL) and the flip-flop (QF). Do not show
    the short propagation delay through each device. (15 points)

CLK

D

QL

QF
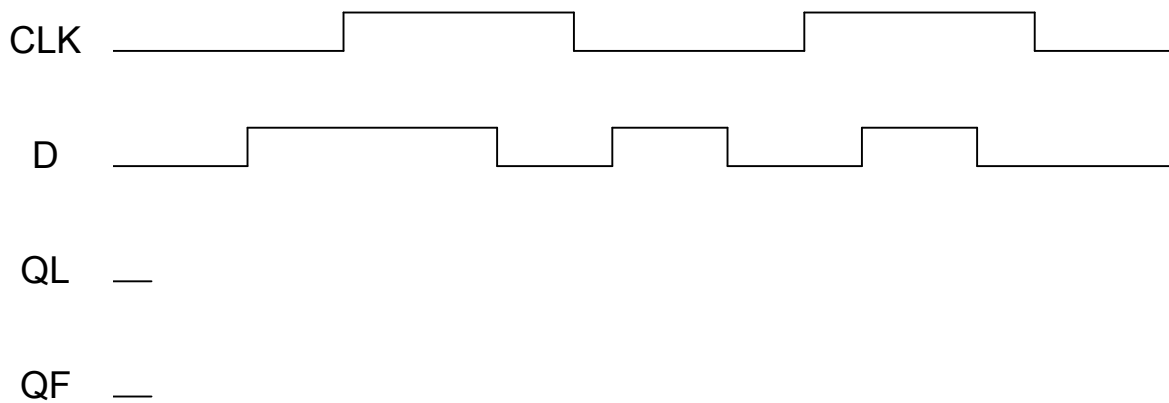
3. What is a tri-state device, and what can it be used for? (10 points)

4. What capabilities are provided by Altera's graphical editor for schematic capture that make it more suitable for entering circuits than a typical drawing package (for example, using the drawing tools in Microsoft Word)? (10 points)

5. When doing a project on the Altera UP1 board, it is occasionally necessary to have two versions of a design — one to simulate, and a slightly different one to run on the board. Why is this necessary? Explain and cite one or two specific examples. (10 points)

6. Consider the following AHDL code fragment:

```
count[ ].clk = clock;

IF load THEN
    count[ ].d = d[ ];
ELSEIF enable THEN
    count[ ].d = count[ ].q + 1;
ELSE
    count[ ].d = count[ ].q;
END IF;

q[ ] = count;
```

a. Explain what the IF…ELSEIF…ELSE..END IF statement is doing. (10 points)

b. What would happen if the first line ("count[ ].clk = clock;") and the last line ("q[ ] = count;") were interchanged? Explain. (10 points)

7. The electronic lock discussed in class recognized a 5-digit password by starting in state s0, moving from that state to states s1, s2, s3, s4, and s5 with each successfully-entered digit, eventually ending up in state s5 which unlocked the lock. When the lock was in state s0, a "ready" or "start" LED was lit up; when it was in states s1 through s4 an "active" or "more" LED was lit up; and when it was in state 5 an "unlock" LED was lit up. To avoid letting the user know when an incorrect digit was entered, the state machine was modified to add another set of states. Draw a diagram showing the resulting states and state transitions, and explain this modification. (15 point)