

Student ID: _____

CS 151 Quiz 2

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 **35 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.

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Q2: [Mux/Decoder application]

[15 points]

(a) For function $F(a,b,c) = ab'c + a'bc' + a'b'c' + a'b'c + abc$:
Implement F by means of a 4-to-1 multiplexer. You should not simplify the function. (8 points)

(HINT: You can use NOT gates to invert the input to the MUX)

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- (b) For the same function $\mathbf{F}(a,b,c) = ab'c + a'bc' + a'b'c' + a'b'c + abc$:
Implement \mathbf{F} by means of a 3-to-8 decoder. You should not simplify the function.
(7 points)

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Q3: [FSM design]

[10 points]

You want to design a food and water dispenser for your dog. You have decided to implement a circuit that has two buttons, a **RED** button, and a **BLUE** button, and the **ON** switch. As long as the **ON** switch is on, the circuit is enabled. If your dog hits the **RED** button three consecutive times, that means he is hungry, so the signal that triggers the food dispenser is activated (denoted by a signal **F**), and the State Machine should go back to the start state. If your dog hits the **BLUE** button two consecutive times, that means he is thirsty, and the signal that triggers the water dispenser is activated (denoted by a signal **W**), and the State Machine should return to the start state. If your dog hits the wrong button at any time, the circuit resets to the start state. For example, if your dog hits an invalid sequence (**RED, RED, BLUE**), the State Machine should be reset to the start state. Assume your dog can push only one button at a time. If the **ON** switch is off, the State Machine should be reset to the start state.

- a) Draw a black box of the State Machine with the inputs and outputs. (4 points)

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b) Design a State Machine to control this circuit (draw a state diagram). (6 points)