

Student ID: _____

CS 151 Quiz 3

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 midterm 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.

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Q1: [FSM Design]

[30 points]

On an intersection there is a traffic light which is initially Red. When a car arrives at the intersection, it triggers the following sequence:

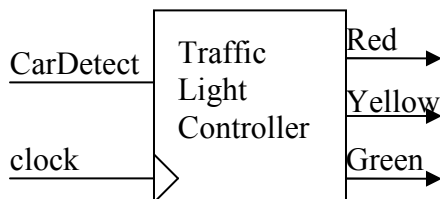
- A)** Traffic light remains Red for 2 cycles,
- B)** Traffic light turns Green for 4 cycles,
- C)** Traffic light turns Yellow for 3 cycles,
- D)** Traffic light returns to Red,

When traffic light is Green if another car is detected at the intersection then the traffic light remains Green for an additional 4 cycles from that instance.

This process is repeated for a maximum of 2 cars when the traffic light is Green.

Assume when the traffic light is yellow, cars pass through the intersection and do not affect the behavior of the traffic light controller:

In this question you will design the controller for the traffic light. Assume the output signals of the controller are Green, Yellow and Red signal to the traffic light.



- a. Capture the FSM. (15 points)

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b. Create the architecture (3 points)

c. Encode the states (use a simple binary encoding) (2 points)

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- d. Create the state table (5 points)

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- e. Implement the combinational logic (no need to draw the gates, just write the equations) (5 points)

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Q2: [Combinational component usage] _____ [15 points]

Design a combinational circuit that converts a 2-digit BCD number to a binary number using **minimum number** of **4 bit Adders** with **no additional gate or component**.

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Q3: [Counter usage]

[15 points]

Using only one 3-bit binary counter and minimum number of components listed below; design a counter that generates the following sequence repeatedly:

3 → 6 → 9 → 12 → 15 → 18 → 21 → 24 → 3

- a) Shifter
- b) Adder
- c) Subtractor
- d) Comparator