جامعة بيرزيت
BIRZEIT UNIVERSITY

**Faculty of Engineering and Technology**
**Department of Electrical and Computer Engineering**
**ENCS 211, Second Semester 2015/2016**
**Digital Electronics and Computer Organization Lab**
**Course Project**

## Introduction:

Each student will need to implement the project by him/herself and will demo the project alone. Choose one of the two design projects given below. The design needs to be implemented using HDL and downloaded to the in lab FPGA where it is demonstrated. Part of the project is to select the proper inputs/outputs (from those available on the kit). The student may go beyond the minimal functionality specified and will be credited for that.

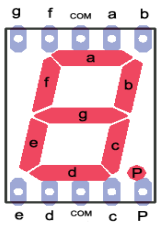
The result needs to be demonstrated to the instructor/teaching assistant and you will be evaluated on your ability to introduce changes to the design. The presentation of your project is limited to 10 minutes at most, including questions, so please be ready for that.

## Projects and Selection:

The project selection depends on student preference. The projects are of comparable difficulty and here is a description of each.

**Project 1:** The purpose of this project is to create a simulator of an elevator system using LED's and toggle switches.

**Description:** The system is represented by the following:

| | Going Up or Down? | Call Elevator | Specify Desired Floor | Elevator called? | Elevator at this floor? | |
|---|---|---|---|---|---|---|
| 3rd Floor | Toggle Switch (SW3) | Push Button (KEY3) | Toggle Switches SW9-SW8<br>'00' = Ground<br>'01' = 1st<br>'10' = 2nd<br>'11' = 3rd<br>SW7 = enable | Red LED (LEDR3) | Green LED (LEDG3) |  <br>Display current floor |
| 2nd Floor | Toggle Switch (SW2) | Push Button (KEY2) | | Red LED (LEDR2) | Green LED (LEDG2) | |
| 1st Floor | Toggle Switch (SW1) | Push Button (KEY1) | | Red LED (LEDR1) | Green LED (LEDG1) | |
| Ground Floor | Toggle Switch (SW0) | Push Button (KEY0) | | Red LED (LEDR0) | Green LED (LEDG0) | |

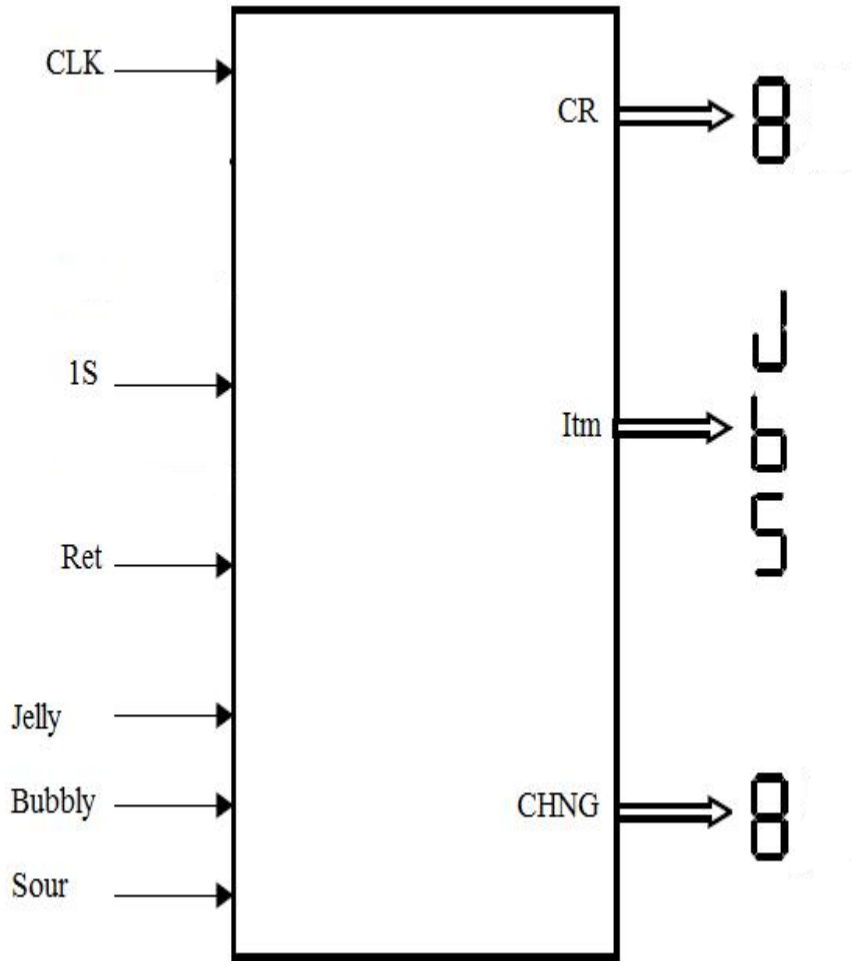
Your code must enforce the following rules:

1) The users first specify the direction in which they're going (0 = DOWN, 1 = UP) using a toggle switch (SW0-SW3), and then call the elevator by pushing a push-button (KEY0-KEY3).
2) The elevator will only move when there are pending calls, otherwise it will remain at the last floor that a user asked for.
3) The "Elevator called?" red indicators will remain lit until the elevator stops at that floor.
4) Once the elevator stops to pick up a user, the system must be told the desired floor using 3 switches. Two switches (SW9-SW8) specify the floor (00 = $1^{st}$ floor, …, 11 = $4^{th}$ floor), and a switch (SW7) will enable the reading of the other 2 switches.
5) The elevator will take 2 seconds to move from floor to floor, turning on the green light at each floor that it passes by, or stops at.

**Project2:** A *SweetMachine*

**Description:**
Using Quartus, design a *SweetMachine*

**Description:**
*SweetMachine* is a vending machine that accepts 1 shekel coins, and dispenses *jellybeans*, *bubbly chocolate bars*, or *sour sweets*.




The machine has a coin slot and the following inputs:

- **1S**: becomes 1 when a 1 shekel coin is deposited in the coin slot.

The following press buttons:
- **Ret**: becomes 1 when the coin return button is pressed.
- **Jelly**: becomes 1 when the jellybeans selection button is pressed (price 2 shekels).
- **Bubbly**: becomes 1 when the chocolate bar selection button is pressed (price 5 shekels).
- **Sour**: becomes 1 when the sour sweet selection button is pressed (price 3 shekels).

In addition to these "user" inputs, the machine has one-control input:

- **CLK**: a timing signal that sequences the state transitions of the machine.

The machine has three outputs:

- **CR**: the amount of money deposited so far and available to make a purchase; **CR**, in shekels, should be displayed on the **upper 7-segment display digit**.
- **Itm**: the item that was just purchased should be displayed on **the blue 7-segment display digit**: **J** for jellybeans, **b** for chocolate bar, and **S** for sour sweet, as indicated in figure.
- **CHNG**: the amount of money returned in change, or as a result of pressing the coin return button should be displayed on the lower **7-segment display digit**.

The machine should behave according to the following specifications:

1. A customer needs to deposit a sufficient amount of money *before* that he or she is selecting an item for purchase.
2. If the item costs less than the deposited amount, the item is dispensed and the correct change is returned. If the item costs more than the deposited amount, the machine waits for more coins to be inserted or for a cheaper item to be selected.
   **Items needs 10 seconds to be dispensed.**
3. The coin slot in the machine will only accept a single coin.
4. Attempts to make multiple selections (e.g. selecting Jelly and Sour at the same time) are ignored.
5. At any time, pressing the coin return button causes the credit amount to be returned.
6. The selection and return buttons close the coin insertion slot; it prevents the coin from being inserted.
7. Finally, the machine should return to its initial sate (credit =0)

## Requirements:

1. A **one page** description of the project and work done. Submit the report on Ritaj and bring it with you (hard copy) to the demo/presentation.

2. The functioning project as a simulation and downloaded to the FPGA kit.

3. A formal presentation and demo (up to 10 minutes).

## Important Dates:

1. Project Dispatch – Monday April 25th, 2016

2. Project Submission on Ritaj – Friday May 13, 2016

3. Demonstration of working project to instructor/TA – May 14-19, 2016 during regular lab meeting time.

We will try to open the lab for possible testing and announce the times later. Students are strongly encouraged to have Quartus on their computers for work on the project.

## Evaluation Points:

1. Clear statement of the problem: the inputs, outputs and the test cases (7%).
2. The project design and the HDL/Quartus implementation of the design (25%).
3. Simulation demo/results (10%).
4. Functioning FPGA implementation with clear designation of inputs/outputs (25%).
5. Ability to introduce modifications to the design during the discussion to show clear understanding of the project (15%).
6. The project Report (8%).
7. The Quality of the presentation (10%).

**Good luck**