National University of Computer & Emerging Sciences, Lahore
Department of Computer Science (Spring 2023)

EL1005 – Digital Logic Design
Lab Project Statement (BCS-2D2)

Demo Date:

Mini Computational Unit (MCU)

You are required to design and implement an MCU that performs some predefined operations. These operations are categorized into three groups that are as follows:

- **Data load Operations:** To load the data in a register
- **Arithmetic & Logic Operations:** To perform arithmetic & bitwise logic operations on data stored in register

The operations are performed on data stored in registers. There are **two 4-bit** data registers. These registers contain data that is provided by the user. The user provides a unique **2-bit operation code (OPCODE)** to perform the desired operation on data. Table below shows the detail of each operation along with its opcode.

Group	Opcode	Operation	Source	Destination	Symbol
Data Loading	00	Load	User	R0	R0 ← U
	11	Load	User	R1	R1 ← U
Arithmetic & Logic operations	01	Addition	R0, R1	R0	R0 ← R0 + R1
	10	bitwise XOR	R0, R1	R0	R0 ← R0 $\oplus$ R1

When the source is User (**U**), it means that user have to load data in specified register using binary switches. The data should be loaded in **parallel**.

You are also required to show the status of the following two flags:

- **Overflow Flag (OV):** This flag detects the overflow during arithmetic operation. If any overflow occurs then it is 1, otherwise it is 0.
- **Carry (C):** If there is a carry in arithmetic operation then this flag is 1, for no carry it is 0.

The result of the operations is displayed on LEDs along with the status of the two flags.

A **selection switch** is also used, which holds the status of the registers when the switch is in low state and presumes the normal operation of MCU when switch is in high state.

All registers should be synchronous. Moreover, an Asynchronous input (**RESET**) is provided to indicate the starting point. When **RESET** is 1, then the whole system resets, clearing all the contents of registers and waiting for an input in the form of opcode.
You are required to design this system using any combinational or sequential circuit (discussed in this course) for your implementation. The whole project should be implemented on hardware. The project can be done in a group of 2 students. There should be at the maximum 2 students in a group.

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The project evaluation will be done in the last lab session. You have to submit a project report. The project report should contain the whole design of the project.
In case of cheating, you may get an "F" or may be the case should be forwarded to DC committee for necessary action.