National University of Computer and Emerging Sciences, Lahore Campus

Course:	Digital Logic Design Lab	Course Code:	EL227
Program:	BS (Electrical Engineering)	Semester:	Spring 2020
Date:		PLO:	3
Exam:	Lab Project	CLO:	4
Submission/Evaluation	10th June 2020	Section:	EL-C1

Project Statement
Mini Computational Unit (MCU)

You are required to design and implement a MCU that performs the following micro-operations:

- **Data Transfer:** Transfer binary data from one register to other and load binary data in a register
- **Arithmetic:** Performs arithmetic operations on data stored in registers
- **Logic:** Perform bit manipulation on data in registers

The micro-operations are performed on data stored in registers. There are **two 3-bit** data registers R0 and R1. These registers contain data that is provided by the user. The user provides a unique **4-bit operation code (OPCODE)** to perform the desired micro-operation on data. Table below shows the detail of each micro-operation along with its OPCODE.

Micro-operation	OPCODE	sub operation	Source	Destination	Symbol
Data Transfer	**00**00	Load	User	R0	R0 ← U
	0001	Load	User	R1	R1 ← U
	0010	Move	R1	R0	R0 ← R1
Arithmetic	**01**00	Addition	R0, R1	R0	R0 ← R0 + R1
	0111	Increment	R1	R1	R1 ← R1 + 1
Logic	**11**00	XOR	R0, R1	R0	R0 ← R0 ⊕ R1
	1101	Circular shift Right	R1	R1	R1← cshr R1
	1111	Up counter	R0	R0	R0 ← R0

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 flags:

- **Idle (I):** If no OPCODE is given, and MCU is in waiting state (waiting for an OPCODE) then this flag is 1, otherwise when any of the operation is performed it is 0.
- **Carry /Borrow (C):** If there is a carry in arithmetic operation then this flag is 1, for no carry/borrow it is 0.

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

It is also required to show the Micro-operation number on 7 segment display, for Arithmetic micro-operation code “1” should be displayed on 7 segment.

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 and/or sequential circuit (discussed in this course) for your implementation. The whole project should be implemented on Logic Works. The project can be done in a group of 2 students. There should be at the maximum 2 students in a group. The students should be off the same section. Inter-section grouping is not allowed.

The project evaluation will be done in the last two lab sessions. 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.