Pre-Lab:

- A short video (Lab1_Prelab_Video1) (24 min) is available on LMS Week-5. Please watch it as it includes:
    - How to load Control Expert, create variables, and create a LAD file
    - How to use the animation table and the simulator
    - How to export your code and submit on LMS
- A short video (Lab1_Prelab_Video2) (3mins)
    - Usage of Comparator (used in Part 3 of Lab)
    - Usage of Counter (used in Part 5 of Lab)
- A short video (Lab1_Outcomes) (5 mins)
    - Shows working versions of LAD codes for Part 3 & 4 & 5. This should give you a good idea as to what is expected from the Lab.

Lab. Work:

Part 1:

- Create a new project
    - Pick the following
        - Modicon M580 – BME P58 3020
        - BME XBP 0800
    - **For Password just hit "Cancel"**
    - Attach the following modules **(Make sure you select "I/O data type: Topological")**
        - Discrete – BMX DAI 1602 in Slot 2
        - Discrete – BMX DAI 1602 in Slot 3
        - Discrete – BMX DAI 1602 in Slot 4
        - Discrete – BMX DDO 1602 in Slot 5
        - Discrete – BMX DDO 1602 in Slot 6
        - Discrete – BMX DDO 1602 in Slot 7

Submit answers to the following questions for Part1:

- 1.1 – Right click on your power supply to see the "Power Supply and I/O Budget". How much power is your system using?
- 1.2 - Double click on your CPU, in the opened window go to "Overview" tab. And answer the following
    - 1.2.1 – How many discrete I/O ports does your CPU have?
    - 1.2.2 – How many Analog I/O ports does your CPU have?
    - 1.2.3 – How much is the data memory?
    - 1.2.4 – How much is the application memory?
    - 1.2.5 – What is the file size of a picture in your cellphone (give an estimate)?
    - 1.2.6 – If RUN LED is flashing, what does this mean for your CPU?
    - 1.2.7 – What color is the I/O LED and what does it mean if it is On?
- 1.3 Delete you power supply module and replace it with BMX CPS 2000

1.3.1   Check your "Power Supply and I/O Budget". How much power is CPS 2000 able to deliver in Watts? How much of it is not being used (still available) in Watts?

Part 2:

- Double click "Variables & FB Instances" in project browser and create the following variables
  - X (EBOOL), Y (EBOOL), Z (EBOOL), U (EBOOL), V (EBOOL), W (EBOOL), OUT1 (EBOOL), OUT2(EBOOL), OUT3(EBOOL), OUT4 (EBOOL), OUT5 (EBOOL)
- Create a LAD code named (lad_part2) under Tasks/MAST/Logic and code the following
  - (X OR Y) OR Z = OUT1
  - (X NOR Y) **AND** Z = OUT2
  - (X **NAND** W) AND (V OR U) AND (Y OR X) = OUT3
  - (W XOR V) AND (U AND V) AND X = OUT4
  - (OUT4) OR (OUT3) OR (OUT1 AND OUT2) = OUT5
- Create an Animation Table called "Part2_test" and add all your variables to this table. Use it to simulate your code

Part 3:

- Create the following variables by using the I/O objects tab for each module and also the "Variables & FB Instances" table
  - SW_1 (EBOOL @ %I0.3.0), SW_0 (EBOOL @ %I0.4.0), PB_Store (EBOOL), PB_Reset (EBOOL), int_FirstDigit (INT)
- Create a LAD code named (lad_part3) under Tasks/MAST/Logic and code the following functionality
  - If PB_Reset is pressed momentarily:
    - int_FirstDigit is set to "-1" (Use MOVE)
  - If PB_Store is pressed momentarily:
    - If int_FirstDigit has no value (i.e. it is -1) then
      - int_FirstDigit becomes **B**inary**2D**ecimal(SW_1SW_0) (Use MOVE)
        - ex: SW_1=1 SW_0=0 then int_FirstDigit = 2 (b/c 10=2)
        - ex: SW_1=1 SW_0=1 then int_FirstDigit = 3 (b/c 11=3)
        - etc.
    - If int_FirstDigit has a real value, then pressing PB_Store does not do anything
  - Design your code such that it is PB_Reset dominant
- Create an Animation Table called "Part3_test" and add all your variables to this table. Use it to simulate your code

Part 4:

- Create the following variables in "Variables & FB Instances" table
    - C1 (EBOOL), C0 (EBOOL), str_Output0 (String)
- Create a LAD code named (lad_part4) under Tasks/MAST/Logic and code the following functionality
    - If C1=0 & C0=0 then str_Output0 is " "   (Use MOVE)
    - If C1=0 & C0=1 then str_Output0 is "Your Name + Middle Name"   (Use MOVE)
    - If C1=1 & C0=0 then str_Output0 is "Your Last Name"   (Use MOVE)
    - If C1=1 & C0=1 then str_Output0 is "Your Department and Year"   (Use MOVE)
- Create an Animation Table called "Part4_test" and add all your variables to this table. Use it to simulate your code

Part 5: (Garage Door Opener)

- Create the following variables in "Variables & FB Instances" table
    - PB_Open (EBOOL), PB_Close (EBOOL), Limit_Switch_Up (EBOOL), Limit_Switch_Down (EBOOL – initial value 1), Motor_UP (EBOOL @ %Q0.5.0), Motor_DOWN (EBOOL @ %Q0.6.0), int_DoorOpenCount (INT)
- Create a LAD code named (lad_part5) under Tasks/MAST/Logic and code the following functionality
    - If Door is fully closed (i.e. Limit_Switch_Down = 1) then
        - Pressing PB_Open momentarily will
            - Start opening the door (Motor_UP = True)
            - Make Limit_Switch_Down = False
            - Door will open until fully open (fully open when Limit_Switch_Up = TRUE)
            - When door is fully open, motor will stop (Motor_UP = False)
            - When door is fully open, increment int_DoorOpenCount by 1 (Use CTU)
    - If Door is fully opened (Limit_Switch_Up = 1) then
        - Pressing PB_Close momentarily will
            - Start closing the door (Motor_DOWN = True)
            - Make Limit_Switch_Up = False
            - Door will close until fully closed (fully closed when Limit_Switch_Down = TRUE)
            - When door is fully closed, motor will stop (Motor_DOWN = False)
    - If both PB_Open and PB_Close are pressed at the same time, then int_DoorOpenCount is set to "0" (Reset CTU)
- Create an Animation Table called "Part5_test" and add all your variables to this table. Use it to simulate your code

Your Submission should include the following:

1- A .pdf document with your answers to Part 1
   a. Please include your name, student number on this document
2- Submission of your project file
   a. Make sure .sta and .stu files are included
   b. Create a .rar or .zip of your project file (otherwise LMS will not accept the filetype)

Rules:

- Submissions for Lab 1 are done on LMS.
- **Lab 1 Submission deadline is 25 October 2024, 23:59.**
- **For early submission bonus (+2%), submit everything by 24 October 2024, 23:59.**
- No late submissions will be accepted.
- No make-ups are allowed for Lab work unless for medical reasons with valid proofs.