ME 576 Lab Assignment **Session 8**

This week's laboratory experiment involves programming of PLCs. Generate PLC programs for two examples covered in the class: i) drilling operation and ii) conveyor line with bin bags.

In the lectures, two examples of PLC programming have been introduced: i) automated drilling station and ii) conveyor belt with vision detector. Please review the lecture handouts to recall how these two systems work.

In this week's laboratory, you need to generate PLC programs for these two applications and simulate them on the NUM CNC. You need to call the timer function to complete both of the programs.

As the NUM CNC is not physically connected to a drilling station or conveyor, you still need to use the buttons and LEDs on the front panel to mimic the inputs (limit switches and vision detectors) and the outputs (actuators). The I/O port assignment is the same as that in lab 7, which can be found at the last page of this manual.

For the first case, the following functions need to be added. After drilling is completed (lower limit switch E8 is touched), there will be 2 seconds dwelling time before the drill begins to retract. Also, when the drill arm finishes retracting (upper limit switch E9 is touched), the spindle motor must stop. Assume that the spindle motor is in operation only while the output to A1 is high.

In addition to the procedure provided in the lecture handout, the following functions need to be added: 1) After drilling is completed (lower limit switch E8 is touched), there will be 2 seconds dwelling time before the drill begins to retract (A2 is high); 2) when the drill arm finishes retracting (upper limit switch E9 is touched), the spindle motor must stop (A1 is low).

The spindle should be in operation while the drilling arm is moving down, dwelling and moving up. The spindle motor is in operation only when the output to A1 is high.

In both problems, you should make the PLC programs more comprehensive by adding more functions to make the operations more robust.

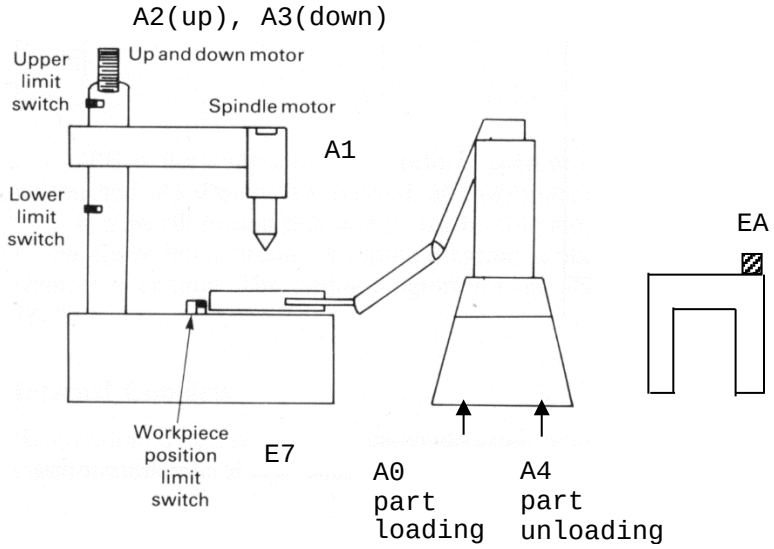
Generate truth tables for each problem and verify the truth tables by simulating both programs on the NUM PLC (Flexium Tool). **To save the simulation results, take pictures of the CNC front panel in representative cases.**

The report must include instruction lists, ladder diagrams, truth tables and **simulation results** of both problems.

Use the following input and output memories:

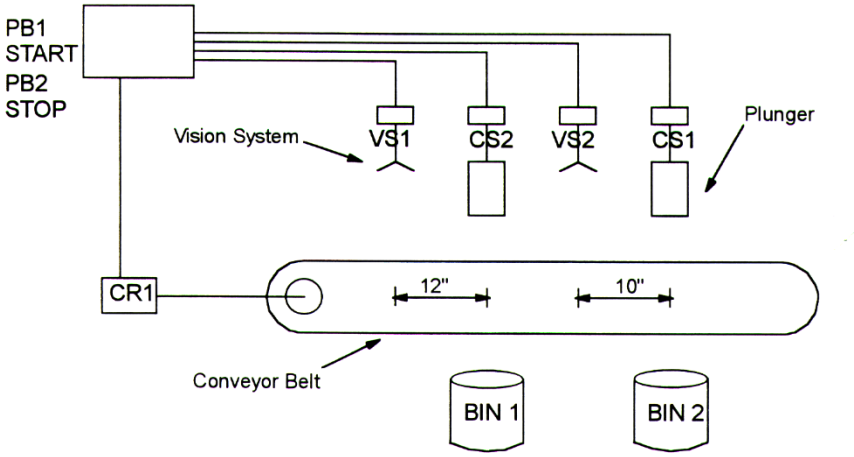
Problem 1:

E7	Workpiece location
E8	Spindle lower limit
E9	Spindle upper limit
EA	Workpiece on conveyor
A0	Part Loading
A1	Spindle Motor
A2	Up Motor
A3	Down Motor
A4	Part Unloading



Problem 2:

E0	Start (PB1)
E1	Stop (PB2)
E2	Visual System VS1
E3	Visual System VS2
E4	Bin 1 Overfill Sensor
E5	Bin 2 Overfill Sensor
A0	Conveyor Motor
A1	Plunger CS1
A2	Plunger CS2



Note: CS1 will response to VS2 with a time delay of 1.2s and CS2 will response to VS1 with a time delay of 1.0s.

Note: The following operators are helpful for this lab assignment:

CAL

IEC Operator: Calling a function block or a program

Use CAL in **IL** to call up a function block instance. The variables that will serve as the input variables are placed in parentheses right after the name of the function block instance.

Example:

Calling up the instance Inst from a function block where input variables Par1 and Par2 are 0 and TRUE respectively.

CAL INST(PAR1 := 0, PAR2 := TRUE)

TON

Timer function block, implements a turn-on delay. When the input gets TRUE, first a certain time will run through until also the output gets TRUE.

Inputs:

IN : BOOL; Rising edge starts counting up ET.

PT : TIME; Upper limit for counting up ET (delay time).

Outputs:

Q : BOOL; Gets a rising edge as soon as ET has reached the upper limit PV (delay time is over).

ET : current state of delay time.

Example in IL:

Example in IL:

```
CAL      TONinst  (
       IN:= VarBOOL1 ,
       PT:= T#5s ,
       ET=> VarTimeCur )
LD       TONinst.Q
ST       VarBOOL2
```

```
5   LD     A5
    AND    E9
    ST     T1.IN
    CAL    T1(
         PT:= T#2s)
    LD     T1.Q
    ST     QT1
```

Note: The input IN and PT can be assigned by ST before the CAL block or := inside the CAL block. The output Q or ET can be extracted by LD outside the CAL block or => inside the CAL block.

The PLC will recognize the timer function TON if you use IN and PT as the input variables, so you don't need to include the keyword TON in your Instruction List (IL).