CUKUROVA UNIVERSITY

ELECTRICAL-ELECTRONICS ENGINEERING

EEE 419 PROGRAMMABLE LOGIC CONTROLLERS LABOROTORY
EXPERIMENT 1

LOGIC STACK OPERATIONS

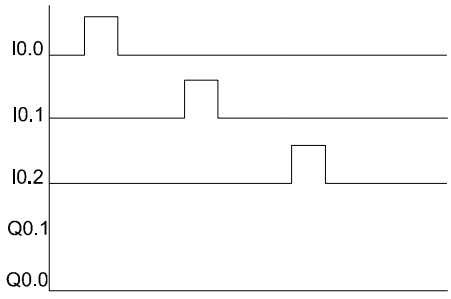
Object: In this experiment basic logic stack operations:LD(load), LDN(load not), A(and), AN(and not), O(or), ON(or not), S(set), R(reset), ALD(and block), OLD(or block), MEND(end of program), and stack concept will be introduced.

PRELIMINARY WORK

P1. Write PLC programs for each logic function given below for both S7-200 and FX5U. The program must be in the form of both ladder diagram and statement list.

1) K1=S1*S2
2) K2=S1+S2
3) K3= S1'*(S2+K3)*S3'
4) K4=X1*X3 + X1*X4 + X2*X3 + X2*X4
5) Q0.0=(I0.0)[(I0.1)[(I0.2) + (I0.3)*(I0.4)'] + (Q0.0)*(I0.5)'[(I0.3)*(I0.2)+(I0.4)']]

P.2 For the given PLC program draw the waveform of the Q0.0 and Q0.1 according to inputs I0.0 and I0.1.



P.3 For the given program segment i) determine the stack contents and positions after each command is executed. ii) determine the logic function Q0.0.

EXPERİMENTAL PROCEDURE

E.1 Verify the programs which are written in P.1 using S7-200 micro and FX5U PLC.

E.2 Verify the program which is written in P.2 using S7-200 micro and FX5U PLC.

E.3 Verify the programs which is written in P.3 using S7-200 micro and FX5U PLC.

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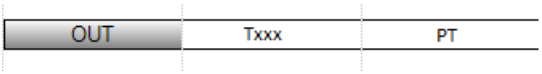
EXPERIMENT 2

TIMERS

Object: In this experiment timers and timer instruction will be introduced. Timers time up while the enabling input is on, and when the time is up, any designed contactor can be enabled.



Operands: Timer

Txxx: timer number

PT: an integer time delay value

PRELIMINARY WORK

P.1 Write a PLC program which energises the output [for S7-200: 0.0(Q0.0=1) and for Mitsubishi FX5U: Y0] after 10 second of input [(I0.0) or (X0) is energised.(for 10 second delay use Txxx=T1, PT=100). The program must be in the form of both ladder diagram.

EXPERIMENTAL WORK

Design a toaster with given properties introduced below:

- Toaster does not work when bread is not placed in.
- Toaster's heater cooks the bread in 10 seconds.
- When toast is ready, toaster activates an alarm for 5 seconds.
- Heater stops when toast is ready.

IO Configuration:

- Toaster Start button : X0
- Toaster Stop button : X1
- Bread placement button : X2
- Heater : Y0
- Alarm : Y1

- Timer : T1

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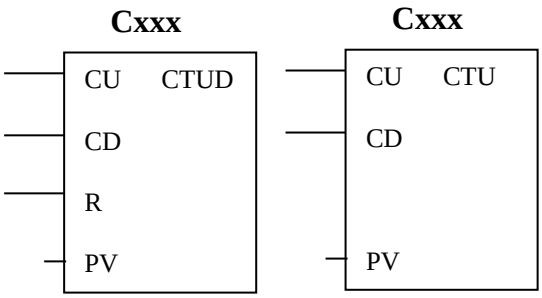
EXPERIMENT 3

COUNTERS

In this experiment S7-200 and Mitsubishi-FX5U counters and counter instructions will be introduced. There are two types of counters: Count Up counter (CTU) and Count Up/Down counter (CTUD).

The Count Up instruction counts up to the maximum value on the rising edges of the Count Up (CU) input. When the current value (Cxxx) is>= to the Preset Value (PV), the counter bit (Cxxx) turns on. The counter resets when the reset input(R) turns on.The Count Up/Down instruction counts up on rising edges of the Count Up input. It counts down on the rising edges of the Count Down (CD) input. When the current value (Cxxx) is >= to the Preset Value(PV), the counter bit(Cxxx) turns on.

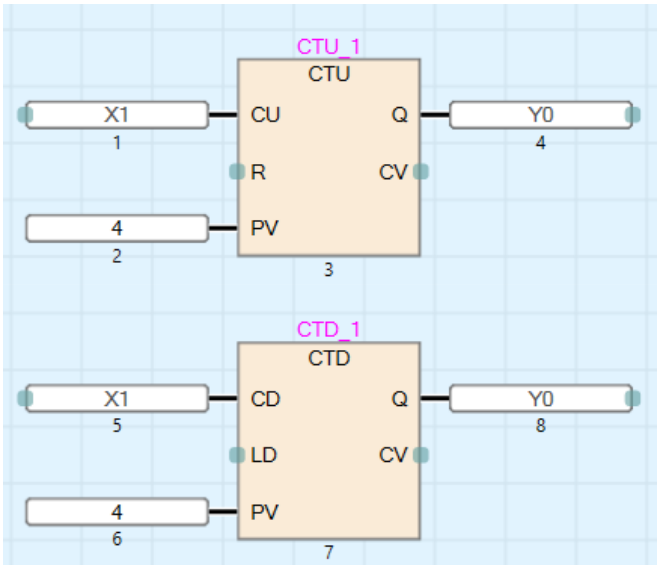
OBJECT FOR S7-200:



PV : Count Value

Fig.1. Counter function blocks for S7-200.

OBJECT FOR FX5U:



PT: Count Value

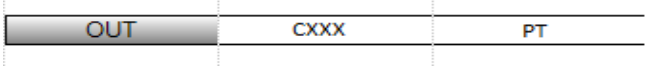


Fig.2. Counter function blocks for FX5U.

EXPERIMENTAL PROCEDURE:

Design a system using the tasks given below:

- When the switch (X0 – I0.0) is activated, siren (Y0- Q0.0) shall ring for 3 seconds.
- When the siren stops, conveyor (Y1 – Q0.1) shall start working.
- The sensor (X1- I0.1) located on conveyor shall stop the conveyor after sensor counts 6 bottles on the conveyor.
- (X2-I0.2) is the emergency stop button, shall have the ability to stop the process at any step.

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EXPERIMENT 4

COMPARE INSTRUCTIONS

OBJECT: In this experiment compare instructions will be introduced. Comparison can be done between two bytes or two words. Compare Byte instruction is used to compare two byte values n1 and n2. A comparison of n1=n2, n1>=n2, or n1<=n2 can be made. Compare Word instruction is used to compare two word values n1 and n2. A comparison of n1=n2, n1>=n2, or n1<=n2 can be made.

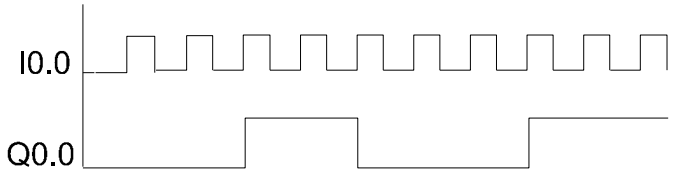
The basic compare instructions which are used in S7-200 PLC are:

LDB=n1, n2	LDB>=n1, n2	LDB<=n1, n2
AB=n1, n2	AB>=n1, n2	AB<=n1, n2
OB=n1, n2	OB>=n1, n2	OB<=n1, n2

And instructions which are used in Mitsubishi FX5U:

Equality	Differentiation	Comparison
LD = n1 n2	LD < > n1 n2	LD < n1 n2, LD > n1 n2
AND = n1 n2	AND < > n1 n2	AND < n1 n2, AND > n1 n2
OR = n1 n2	OR < > n1 n2	OR < n1 n2, OR > n1 n2

P.1 Write a PLC program to obtain output Q0.0 or Y0 using compare instructions. Counter is restricted to count until 5.



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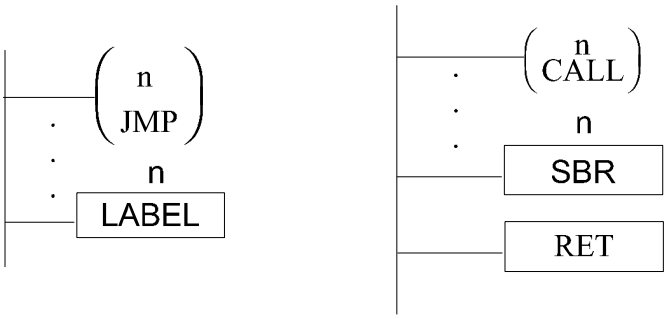
EXPERIMENT 5

SUBROUTINE and JUMP INSTRUCTIONS

Object: In this experiment subroutine and jump instructions will be introduced.

Jump to Label(JMP n): The "Jump to Label" instruction performs a branching to the specified label (n) within the program. When a jump is executed, the top of the stack value is always logic 1. The Label instruction marks the location of the jump destination (n).

Call, Subroutine and Return from Subroutine: The call instruction transfers control to the subroutine (n). The Subroutine instruction marks the beginning of the subroutine (n). When a subroutine is called, the top of the stack value is always logic 1. Return from subroutine instruction is used to terminate each subroutine.



PRELIMINARY WORK

P.1 Write a PLC program, using jump instructions, to control a motor as follows;

When a selection switch S1 is closed, the motor can be run or stop from two different locations; A and B.

When the switch S1 is opened, the motor can be controlled from only one location; A.

P.2 Write a PLC program, using only one timer to control the 3 motors, which are energised one after another. If the input I0.0=1 the motors will be energised with a predefined time interval(10 seconds), if the input I0.0 =0 the system will retain its last situation. And if the input I0.1=1 all the motors are un-energised.(Use jump instructions)

P.3 Write a program for given problem in P.1 using sub-programs.

P.4 Write a program for given problem in P.2 using sub-programs.

EXPERIMENTAL PROCEDURE

E.1 Verify each program written in P.1 using S-7 200 PLC.

E.2 Verify each program written in P.2 using S-7 200 PLC.

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EXPERIMENT 6

PROGRAMMING with SEQUENTIAL CONTROL INSTRUCTIONS

Object: In this experiment sequential control instructions will be introduced. The sequential control instructions used for programming the sequential events or sequential logic circuits. And there are 3 sequential control instructions:

LSCR n :Load sequential control relay
SCRT n: Sequential control relay transition
SCRE Sequential control relay end

PRELIMINARY WORK

P.1 Using sequential control instruction write a PLC program to perform following control operations;

When the push button is pressed first motor will be energised, and if the button is pressed once more the motor will be de-energised. (Use state table given in Figure 1).

P.2 Write a PLC program using sequential control instructions to produce an output signal, when the input signals are applied to the A and B entries with the sequence of AB=00, 01, 11, 10. (Use state table given in Figure 2).

P.3 Write a PLC program using sequential control relay instructions to control the 3 motors as follow;

1) When the stop switch S0 is on all motors will be de-energised.

2) When the switch S1 is on the M1 motor is energised, 20 second later M2 is energised and 30 second after M2 is energised; M3 is energised.

3) When the S2 switch is on, M3 motor is de-energised and 10 second later M2 is de-energised and 5 seconds after M2 is de-energised M1 is de-energised.

	x		
order	0	1	K
a	a	b	0
b	c	b	1
c	c	d	1
d	a	d	0

Figure 1

	AB				
state	00	01	11	10	Z
1	1	2	1	1	0
2	1	2	3	1	0
3	1	1	3	4	0
4	1	1	1	4	1

Figure 2

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EXPERIMENT 7

SCAN ORDER

Object: In this experiment scan order will be introduced.

1. SCAN ORDER

EXPERIMENTAL WORK

Suppose that the spring-released push button P, in Figure 1, is pressed. Then it is pressed again after a period of time. Explain what happens to the output "Lamp". Consider effect of the PLC scan order.

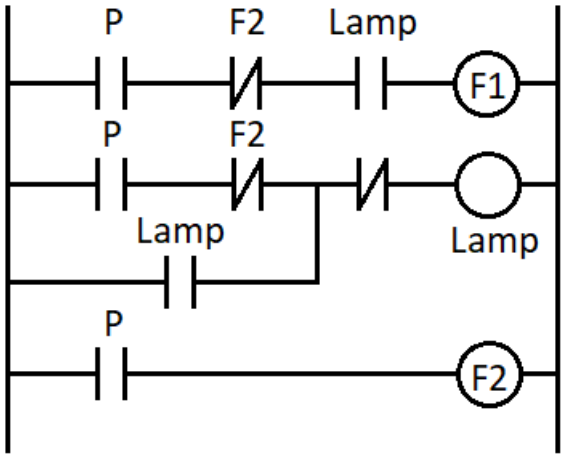

Figure 1

Verify the program shown in Fig.1. above using S7-200 and FX5U PLC.