

Practice Problem Set 4: PLC Programming Practice Problems

Notes: 1) Your program must always include a table where you list your signal names such as X1, Y1, C1, etc. along with a description of each one.

2) Remember, when programming PLCs in this course, the terms “switch” or “button” refer to a momentary pushbutton switch, unless otherwise noted.

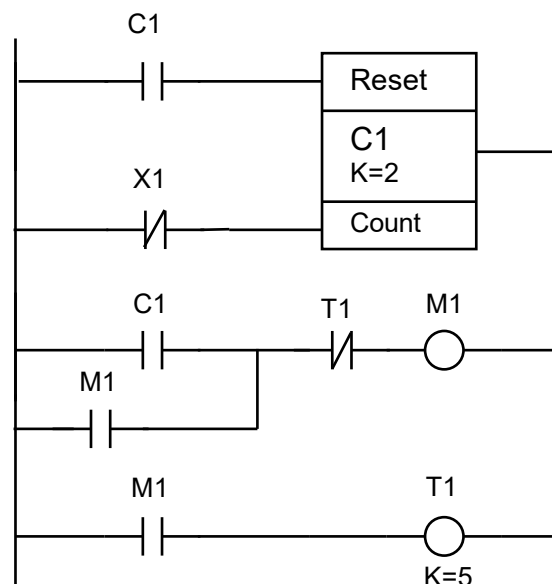
1. Sensors A, B, C and D (all with on/off outputs) are connected to four inputs of a PLC. One of its outputs is connected to a robot. The robot only moves when that output is on. The PLC should command the robot to move when sensor A's output is on and sensor B's output is off or when sensor A's output is on, sensor C's output is off and sensor D's output is on. Write the required program.
2. A motor should turn on when a start button is pressed. It should keep running after the start button has been released unless a stop button is pressed. It should also not start if the stop button is pressed at the same time as the start button. Both switches are normally closed. Write the required program.
3. A conveyor passes parts over a weight sensor. The conveyor motor is started by a normally open pushbutton and stopped by a normally closed pushbutton. The sensor is connected to the PLC's analog to digital convertor and the weight in grams is stored in data register D100. A proximity sensor's output is turned on when the part is over the weight sensor. Write a program to activate a solenoid to eject all parts that are under 50 grams. The solenoid requires 0.25 s on input to work properly. Assume a timer resolution of 0.01 s, and that the conveyor does not have to be stopped for the part weighing and ejecting.
4. Modify your answer to #3 such that the conveyor is stopped, and a warning light is turned on, when more than 50 underweight parts have been ejected. Also, allow the counter to be reset, the warning light turned off, and the conveyor restarted by pressing a normally open switch called “Restart”. Write the required program.
5. Repeat #2 but make your program power failure safe.
6. Repeat #3 for the case when the conveyor must be stopped for 0.2 s for part to stop bouncing before the weight sensor is used. In addition, to eject the underweight parts the solenoid requires a 0.5 s on input (instead of 0.25 s) and the conveyor must be stopped during the ejection. Assume a timer resolution of 0.1 s.
7. Whenever a proximity sensor's output is off, a motor should be turned off for 2 s, then on for 10 s, then off for 2 s, and so on. The motor should be turned off whenever the sensor's output is on. Write the required program. Assume a timer resolution of 1 second.
8. Write the PLC ladder logic to control a personal elevator (i.e., for a single person) in a four storey building. Assume for simplicity the elevator car has no doors. The elevator car is equipped with a proximity sensor. This proximity sensor's output is on when the elevator is at a floor and off otherwise. Each floor is equipped with a single push button switch to call for the elevator. Inside the elevator are four switches corresponding to each of the floors. When one of these is pressed the elevator should be moved to the appropriate floor. Assume only one switch will be pressed when the person is inside the

elevator, and that switches on the other floors cannot be pressed when the elevator is moving. The elevator is moved upwards by one motor and downwards by a second motor. Both motors must be off to stop the elevator, and they can never be turned on the same time. The system is started by a normally open pushbutton and stopped by a normally open pushbutton. Assume that the motors can accelerate and decelerate instantaneously, and that the elevator is sitting at the first floor when the system is started. You may use only one data register, such as D1, in your answer. Assume all switches are normally open pushbuttons.

Hint: Check out the instructions in the “Addendum to Chapter 5”.

9. A conveyor carrying parts is started by a normally open pushbutton and stopped by a normally closed pushbutton. A machine vision system is used to check for defective parts. When a part is defective the system sends an OFF signal to the PLC, otherwise it sends an ON signal. When more than 10 defective parts occur over a two-hour period of conveyor motor operation, the conveyor motor should be stopped, and a warning light turned ON to signal the operator. The system should be reset, warning light turned off, and the conveyor restarted when a normally open “Restart” pushbutton is pressed. Use a retentive timer so that the system functions properly when it is stopped with the stop button, and later started with the start button. Write the required PLC ladder logic. Assume a timer resolution of 1 second.
10. A ladder logic program is shown below. The timer resolution is 0.1 seconds. Draw the timing diagrams for the first 2 seconds of program execution for the signals X1, M1, T1 and C1. Assume the signal X1 is ON for the first 0.3 seconds, then OFF for 0.3 seconds, then ON for 0.3 seconds, and so on. Assume that C1 is OFF when $t=0$.

Program for Question 10:



11. PLC programs known as “anti-tie down circuits” are used in industry to help prevent workers from placing their hands inside operating machinery. This question involves one form of anti-tie down circuit. An actuator is to be controlled by two switches spaced roughly 1 m apart. Both switches are normally open pushbuttons, and the actuator has a 3 second operating cycle. If either button is held down for 1 second or more before the other is pressed the actuator should not start to operate. Only if the buttons are pressed together and held down for the entire operating cycle will the actuator complete its cycle. In other words, the actuator should be shut OFF immediately if the operator releases either button before the cycle completes. The actuator should also be turned OFF when the current 3 second cycle has completed, and it should not start another cycle until both buttons are first released and then pressed together again. The timer resolution is 0.1 s. Write the required ladder logic program.