EET165 Lecture #1

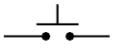
1) Go over Syllabus.

2) PLC Overview

   a) **<u>Field Devices:</u>** There are many different industrial switches, sensors, lights, motors, and other items used in manufacturing today. These devices are connected to the equipment that are used in the production of many different items. These devices are called Field Devices. Some field device schematic symbols are shown below.

N.O. Toggle Switch

N.C. Toggle Switch



N.O. Push Button

N.C. Push Button

N.O. Pressure Switch

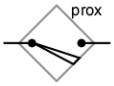
N.C. Pressure Switch

N.O. Float Switch

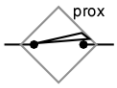
N.C. Float Switch

N.O. Temperature Switch

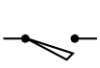
N.C. Temperature Switch



N.O. Proximity Switch

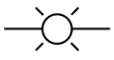


N.C. Proximity Switch

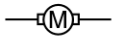


N.O. Limit Switch

N.C. Limit Switch

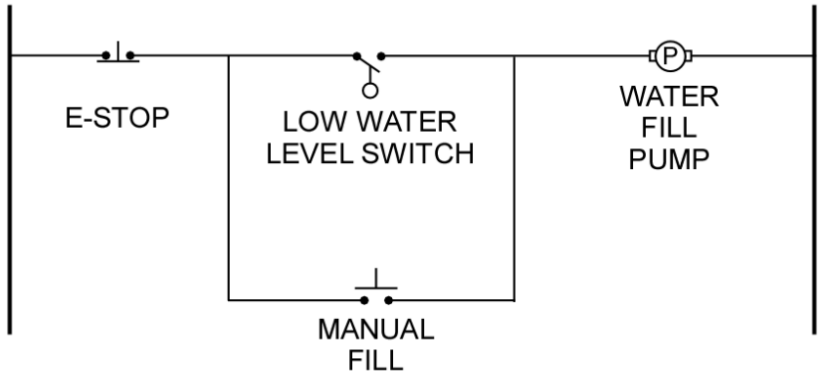


Lamp

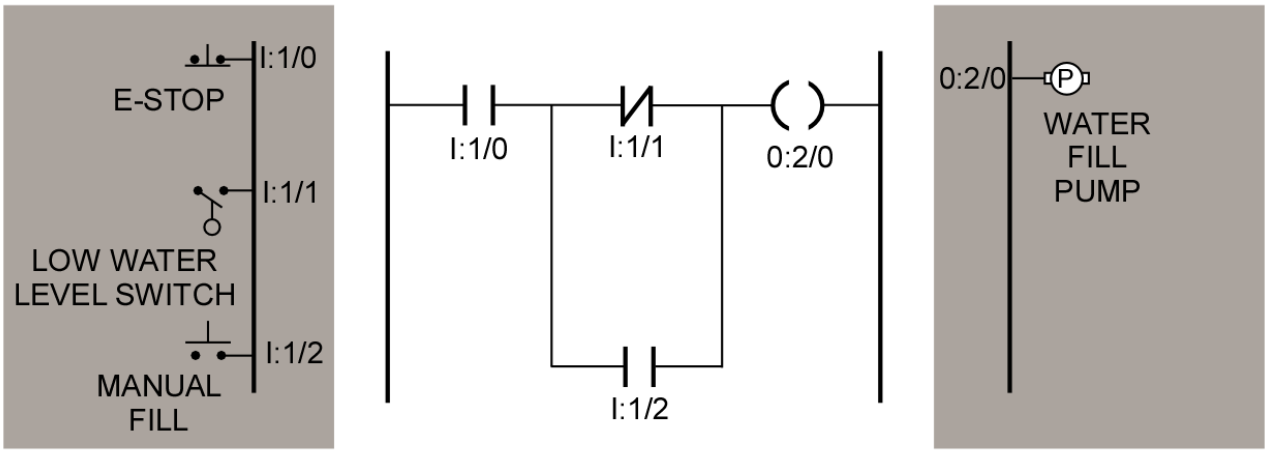


Motor

b) **Electrical Ladder Logic:** These field device schematic symbols are used to generate **Electrical Ladder Logic Diagrams** that demonstrate how they are wired together to make a piece of equipment function. Relay panels are hard wired. If the job of the panel changes, wires need to be removed and new wires installed. An example of an engineering ladder logic diagram is shown below.



PLC Ladder Logic: In a PLC, these field device schematic symbols are connected to the inputs and the outputs of the PLC. The **PLC Ladder Logic Diagram** does not use the symbols. It uses the points where they are connected. The connections are made with code and not physical wires so changing the system is very easy. An example of a PLC ladder logic diagram is shown below.



c) Below is a picture of a Relay Panel that would be built using an Engineering Ladder Logic Diagram.

Below is a picture of a PLC Panel that would be built using a PLC Ladder Logic Diagram.

d) PLCs were designed to replace relay logic and now they are the most widely used industrial process control. PLC panels have a bank of inputs and a bank of outputs. Between these two banks is an industrial microcontroller that can be programmed. This program replaces the wires in a relay panel. If the job of the panel changes, the program is changed and re-loaded into the PLC's CPU.

e) The programmable and reprogrammable nature of the PLC leads to a lot of advantages over a relay-based circuit.

   i. **Fewer Errors:** You can't make a wiring error. If you put a wire on the wrong input on a PLC, you can just change the program and the program will work.

   ii. **Flexible:** Because the wires are replaced with a program, the panel becomes very flexible.

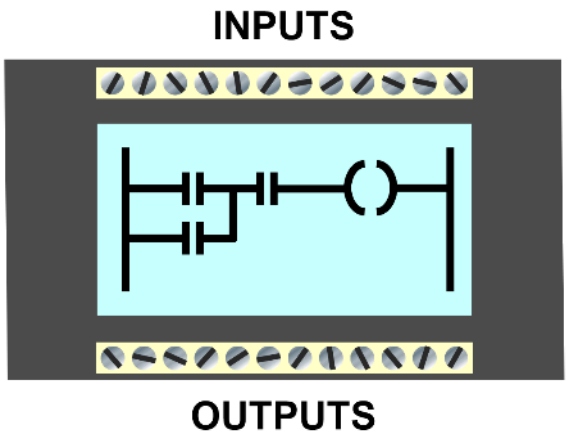
   iii. **Communication:** PLCs can communicate with other PLCs or Computers through serial communications and networks (using TCP/IP or UDP/IP).

   iv. **Speed:** PLCs are faster than Relays.

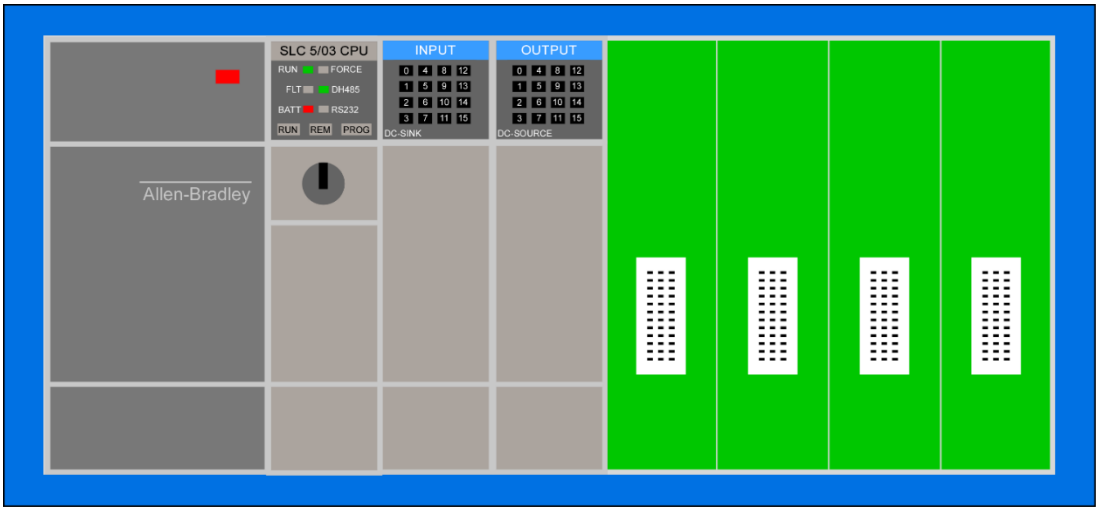
   v. **Troubleshooting:** PLCs are easier to troubleshoot because the code allows you to monitor and watch the connections being connected and disconnected in real time.

f) **Forms of a PLC:** There are different PLC manufacturers and different types of PLCs. There are two major types, Fixed and Modular.

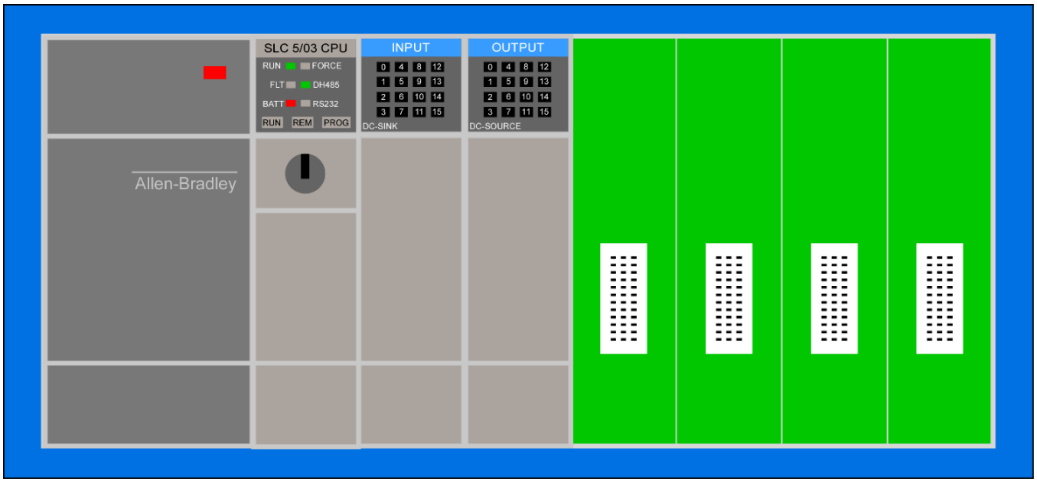
i. **Fixed IO:** Some PLC units have the power supply, inputs, outputs, and CPU as one unit. These are called Fixed IO modules. These are smaller and not expandable. If anything goes wrong with any subsystem, the entire unit needs to be replaced.



ii. **Modular IO:** Our lab uses a modular system where each part is purchased separately. This system is larger and more expensive. But it is expandable and if any part breaks, the one part can be replaced.



g) The parts of a modular PLC are covered below.



i. **Backplane:** A backplane is a custom printed circuit board that is behind the entire PLC unit. It has plugs on the board that you plug each module into. In this diagram, there are four open slots where you can see the backplane and four unused plugs.

ii. **Power Supply:** On the far left is the power supply that will power the PLC Unit. The more modules you need, the more powerful the power supply needs to be.

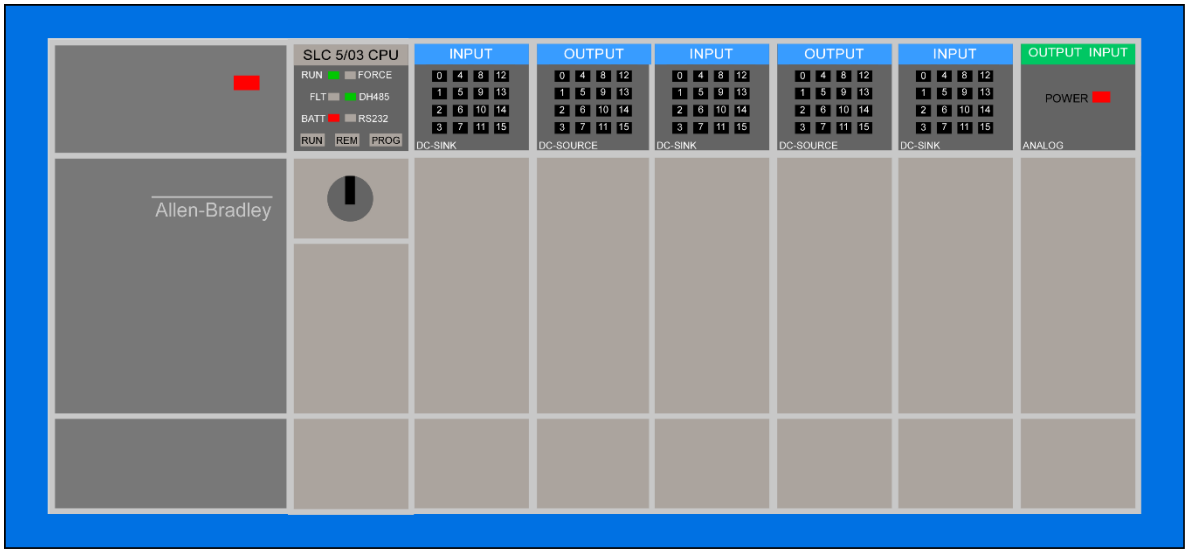
iii. **CPU:** Next is the CPU, it is the brain that hold the code. It is always in SLOT 0.

iv. **Inputs:** Any module can be put in any of the slots and they can be in any order. In our lab, next to the CPU is an Input card. This input card has 16 inputs that are numbered 0 to 15.

v. **Outputs:** Any module can be put in any of the slots and they can be in any order. In our lab, next to the Input card is the Output Card. This input card has 16 outputs that are numbered 0 to 15.

vi. **Remaining Slots:** In this diagram there are 4 more slots that are open. In our lab these are filled with more modules.

h) **<u>The PLC in this lab:</u>** The PLC in our lab is shown below.



i. On the far left is the power supply that powers the system.

ii. In Slot 0 is the CPU that holds the program. The CPU is always in Slot 0.

iii. In Slot 1 is an input card. This card is connected to the 16 switches on the panel. As the switches are turned, you can see the corresponding LED on the card light up.

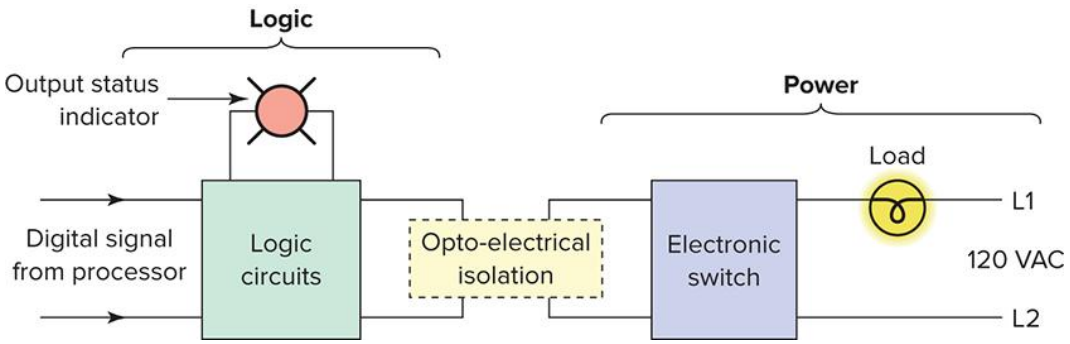
iv. In Slot 2 is an output card. This card is connected to the 16 lamps on the panel. When the signal to light the lamp is sent, the corresponding LED on the card will light up.

v. In Slot 3 is another input card and it is connected to the thumb wheel switches on the right panel.

vi. In Slot 4 is another output card and it is connected to the 7 segment displays above the thumb wheel switches on the right panel.

vii. Slots 5 and 6 are used together and are connected to an analog temperature sensor.

3) **<u>Add if needed:</u>** The logic and the field devices are isolated from each other to prevent damage. There are a few different ways to isolate the “Brains” from the “Brawn”.



Go over how an opto isolator works.