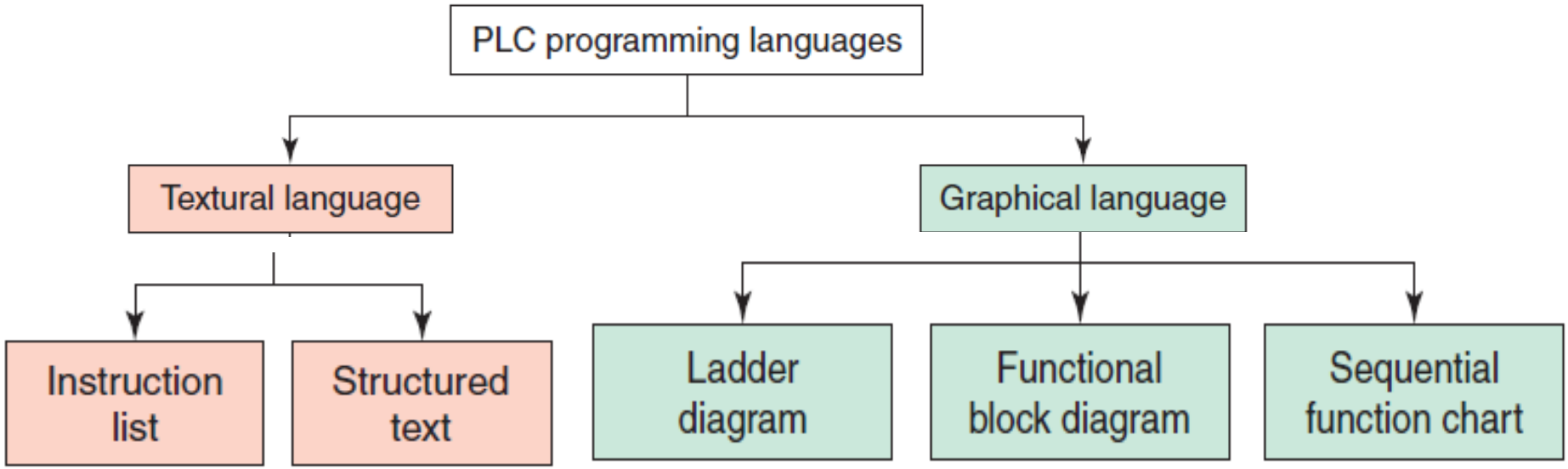
MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

Industrial Automation (ICE 3252)

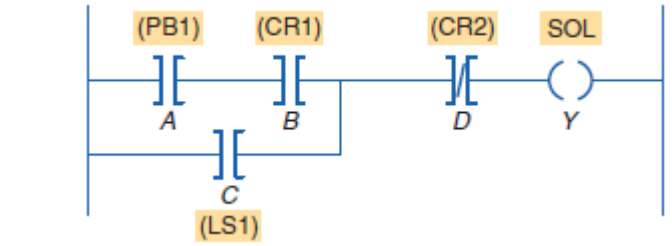
PLC Programming

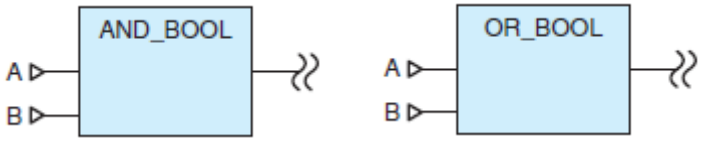
Bipin Krishna
Assistant Professor (Sr.)
ICE Department
Manipal Institute of Technology
MAHE, Karnataka, India

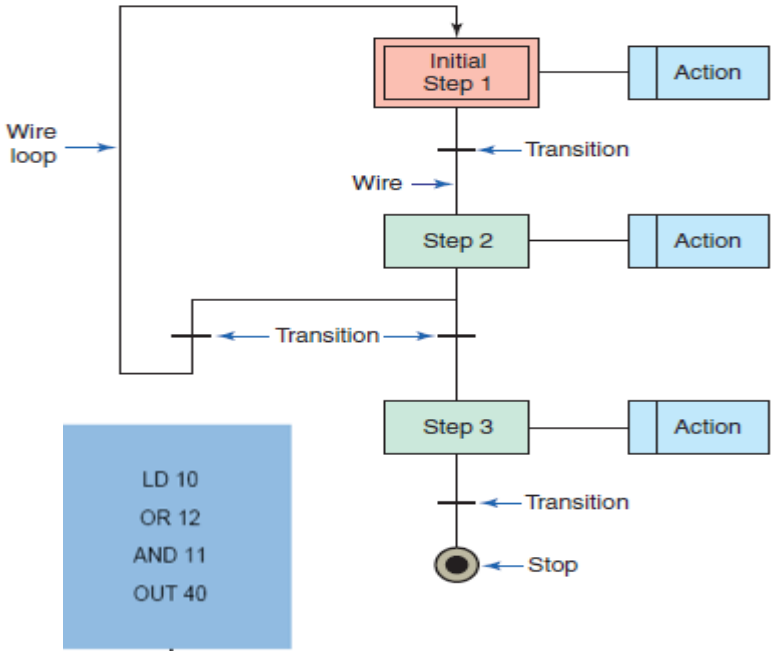
Programming Languages



- **Ladder Diagram (LD): A** graphical depiction of a process with rungs of logic, similar to the relay ladder logic schemes that were replaced by PLCs.
- **Function Block Diagram (FBD):** A graphical depiction of process flow using simple and complex interconnecting blocks.
- **Sequential Function Chart (SFC):** A graphical depiction of interconnecting steps, actions, and transitions.
- **Instruction List (IL):** A low-level, text-based language that uses mnemonic instructions.
- **Structured Text (ST): A** high-level, text-based language such as BASIC, C, or PASCAL specifi cally developed for industrial control applications.

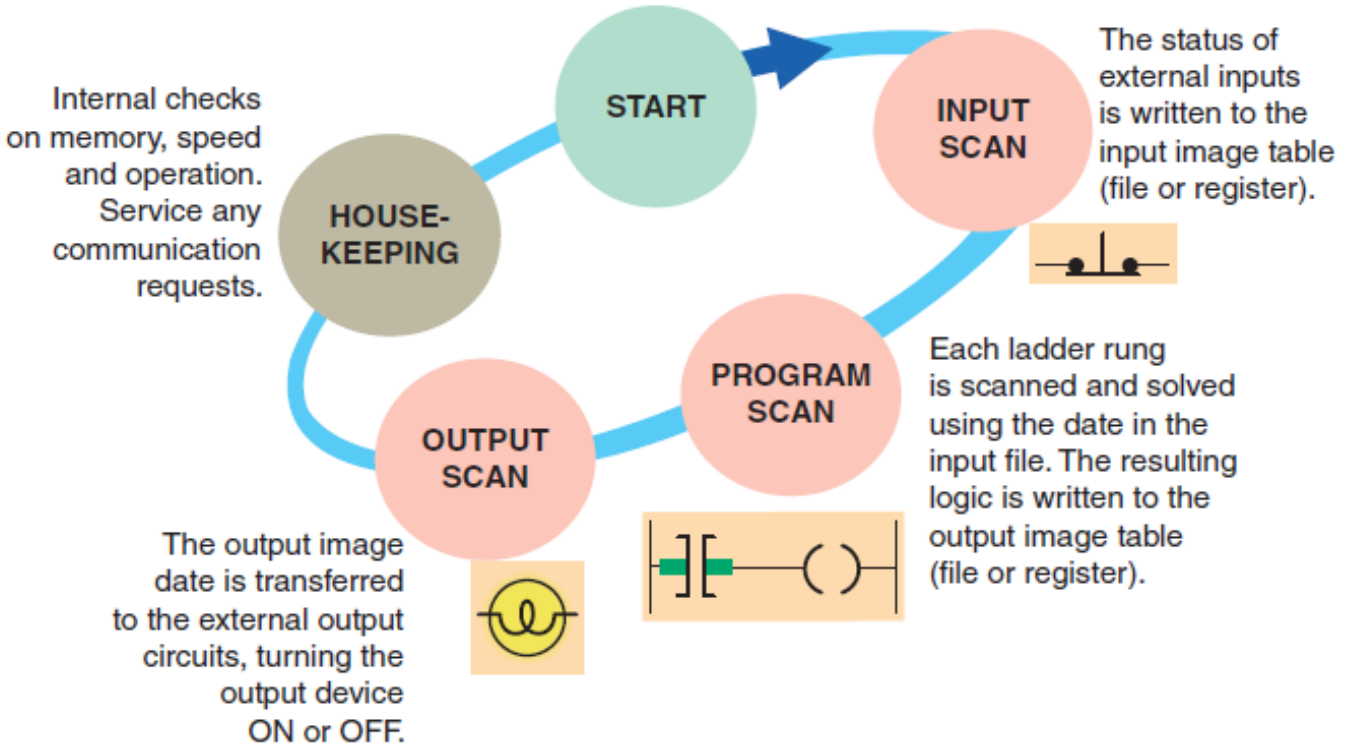







```
IF Sensor_1 AND Sensor_2 THEN
        SOL_1 := 1;
ELSEIF Sensor_3 AND Sensor_4 AND NOT Sensor_5 THEN
        SOL_1 := 1;
END_IF;
```

Program Scan

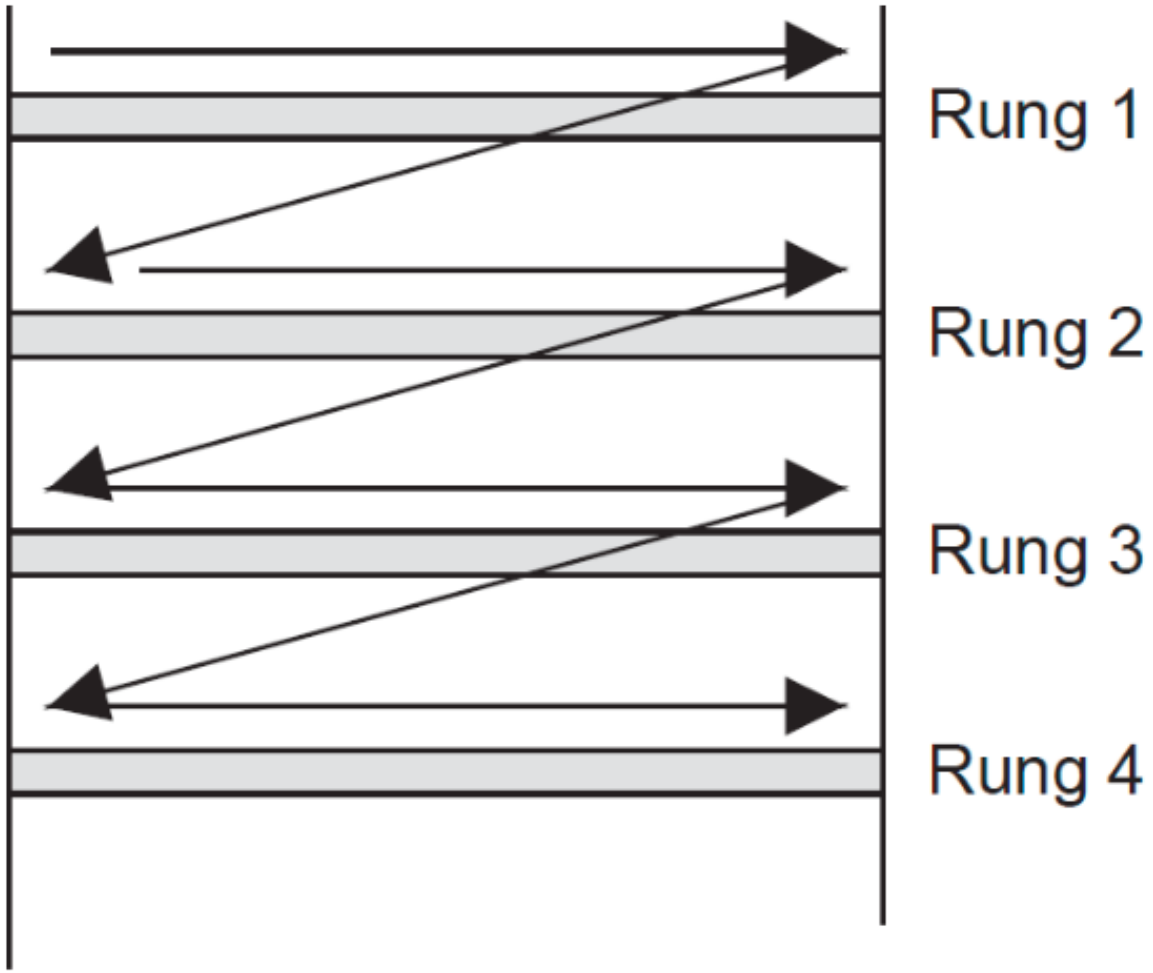


- The time it takes to complete a scan cycle is called the scan cycle time and indicates how fast the controller can react to changes in inputs.
- The time required to make a single scan can vary from about 1 millisecond to 20 milliseconds.

Rules for constructing ladder logic

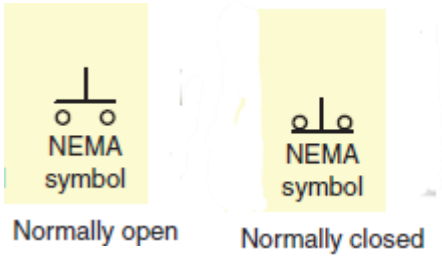
- **Inputs can be used in Series as well as Parallel to form a connection**
- **Outputs (or coil) can be used only in Parallel**
- **One Input can be used in multiple times in one program**
- **One Output cannot be used multiple times in one program, except in Set/Reset and Latch/ Unlatch functions**
- **Input Address cannot be used as an Output Address**
- **Outputs Address can be used as Inputs Address**

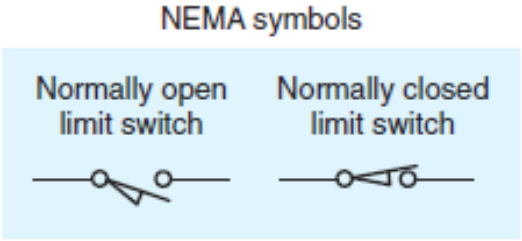
- Some PLC manufacturers have virtually no limitations on allowable series elements, parallel branches, or outputs.
- Generally, a maximum of seven parallel lines and 10 series contacts per rung is possible.
- Only one output per rung and the output must be located at the end of the rung.
- The only limitation on the number of rungs is memory size.

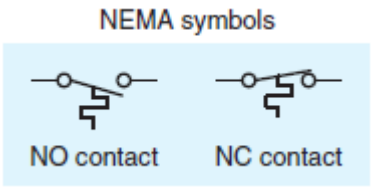

Rung 1
Rung 2
Rung 3
Rung 4

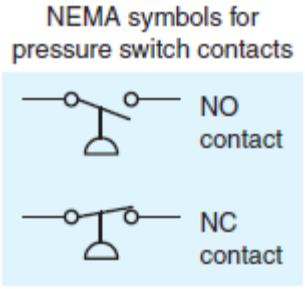
Input Output Representations

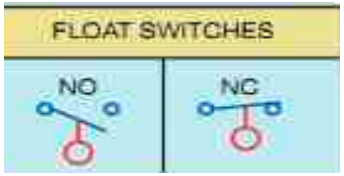
- IEC (International Electrotechnical Commission)
- National Electrical Manufacturers Association (NEMA).
- *Manually operated switches*
- *Mechanically operated switch –Limit switch*
- *Temperature switch*, or *thermostat*
- *Pressure Switch*
- *Level Switch float type*
- *Proximity Sensor*
- *Flow switch*

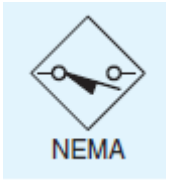




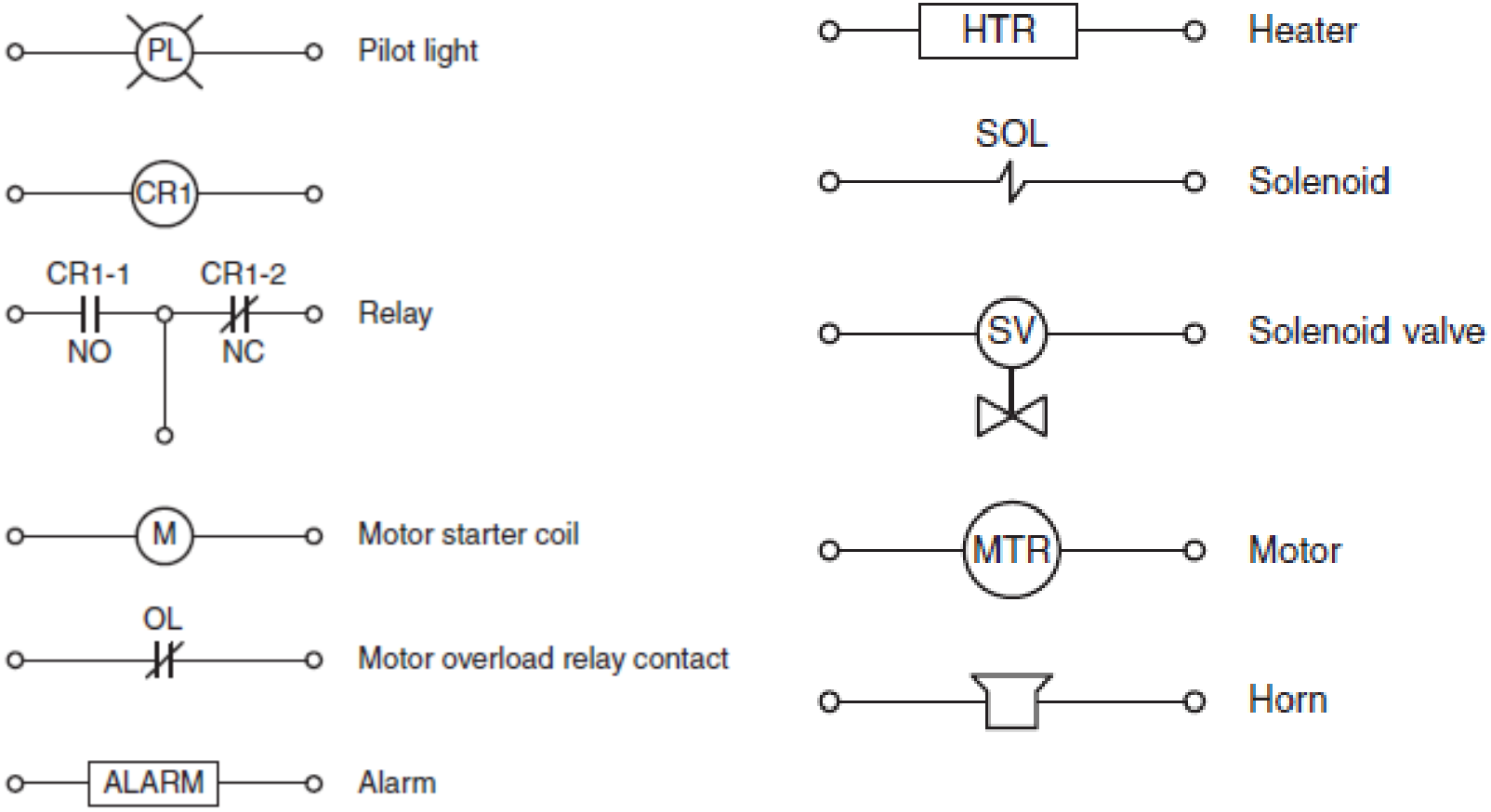




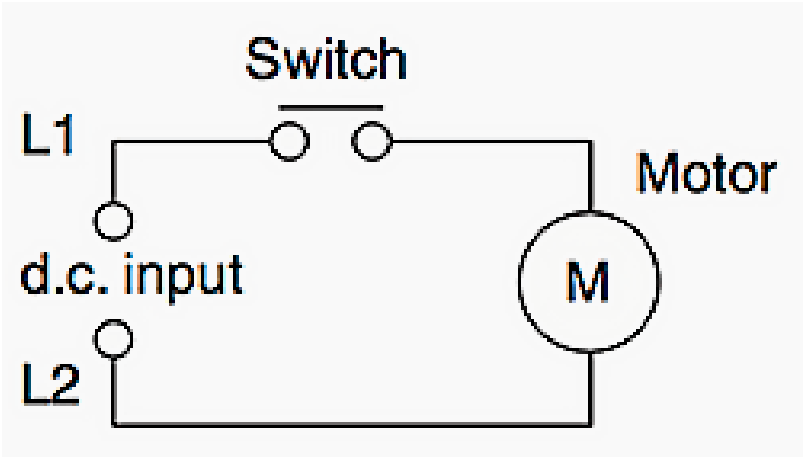


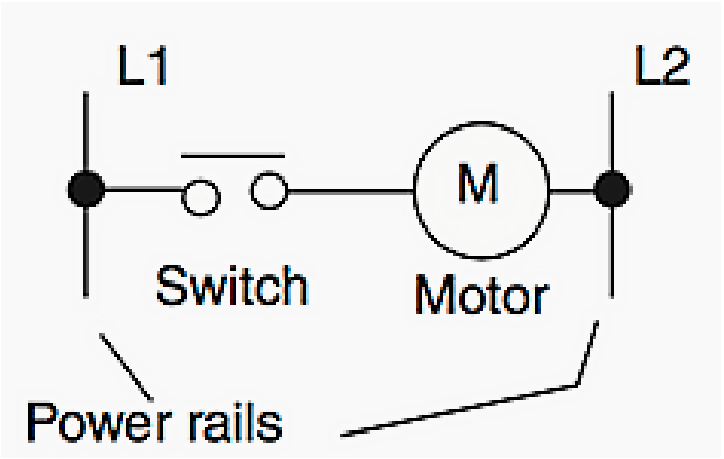


Output Control Devices

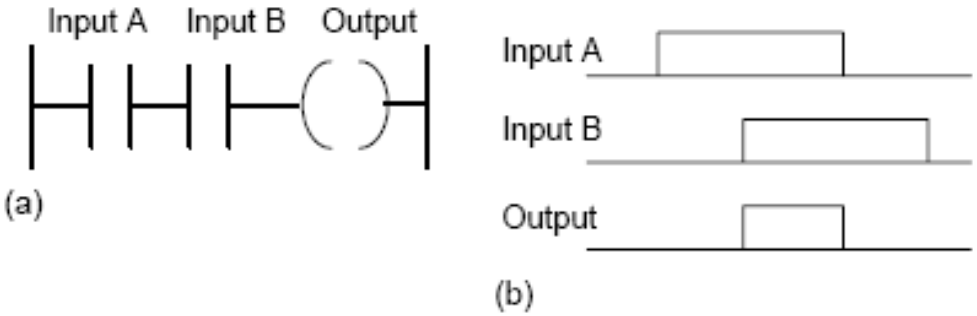


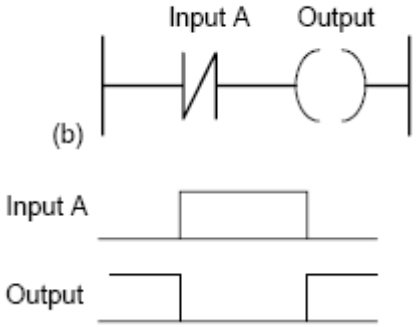
Ladder Diagrams

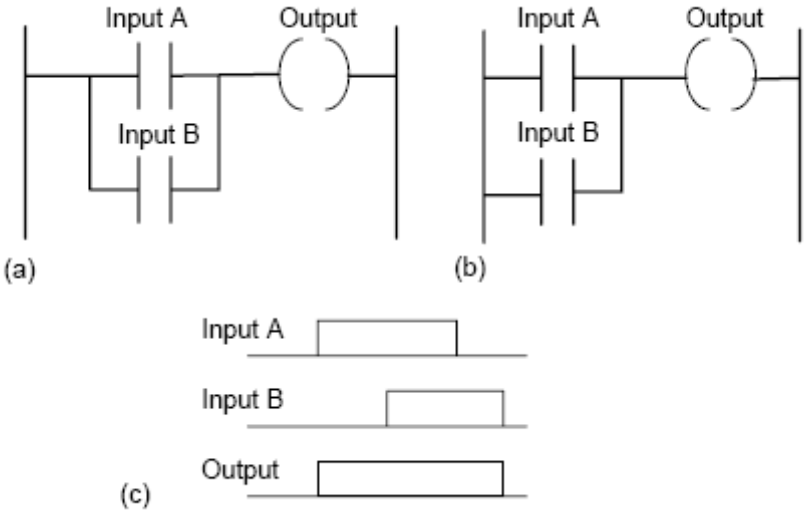




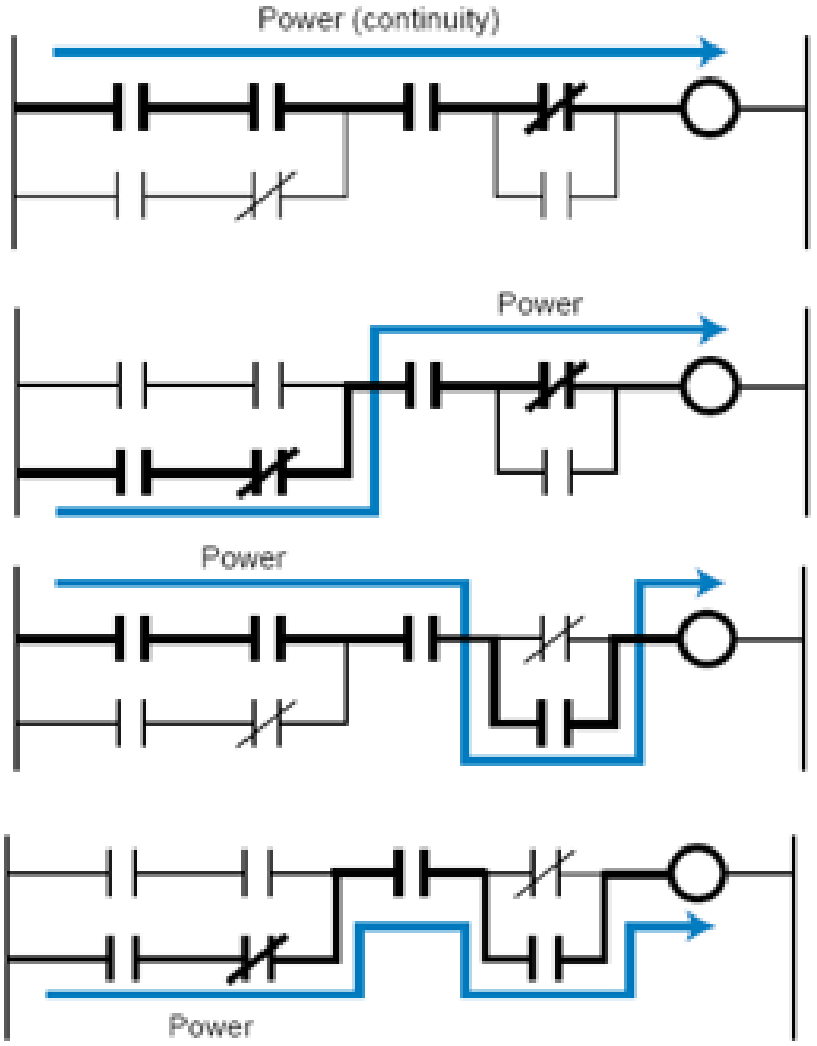
Basic Gate Operation





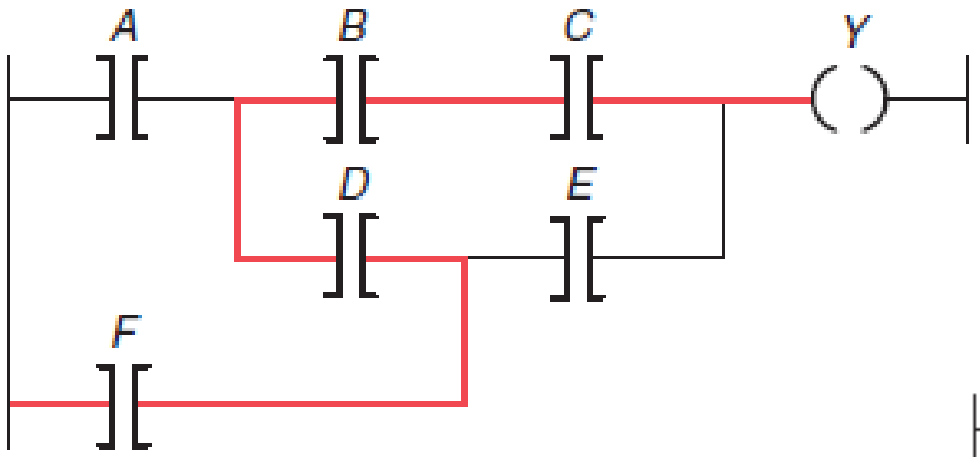


Power Continuity in a rung…

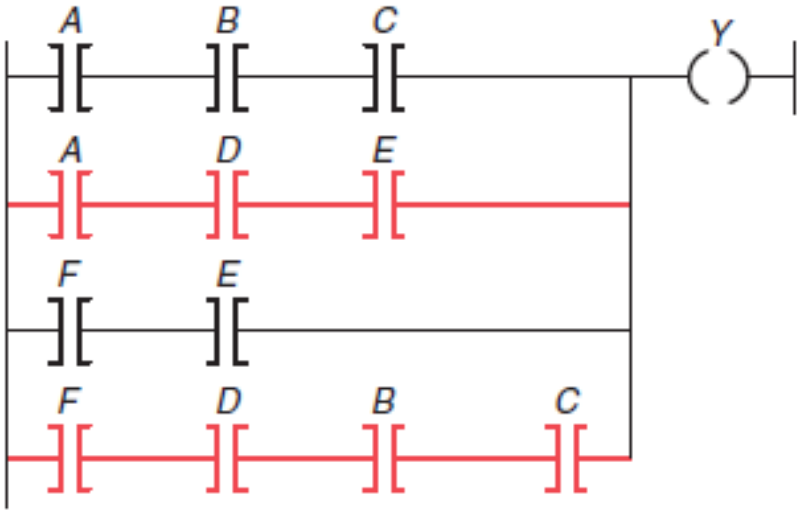


Example: What is wrong in the given solution

Boolean equation: $Y = (ABC) + (ADE) + (FE) + (FDBC)$



Right Answer



Reerence

- Frank D. Petruzella, *Programmable Logic Controllers,* MGH, (2e), 1997.