Industrial Automation Fundamentals – Electrical Basics and Components

1. Basic Electrical Concepts

Voltage (V): electrical potential difference that “pushes” electrons.
Current (I): flow of electric charge (Amperes).
Resistance (R): opposition to current flow (Ohms).

Ohm’s Law:
$V = I \times R$
$I = V / R$
$R = V / I$

Industrial example:
24V sensor drawing 0.1A $\rightarrow$ $R = 24 / 0.1 = 240\ \Omega$

DC (Direct Current): used in PLCs and sensors (typically 24VDC).
AC (Alternating Current): machine power supply (230VAC / 400VAC three-phase).

2. Reading Electrical Schematics and Wiring Diagrams

Electrical diagrams show how components are connected: - Power supply (L, N, PE) - PLC inputs (I0.0) and outputs (Q0.0) - Coils and NO/NC contacts - Terminal numbering **Example:** sensor connected to PLC input I0.0 with 0V common.

3. Sensors and Actuators

1. Inductive sensors: detect metal objects (cylinder end position).
2. Capacitive sensors: detect solid or liquid materials.
3. Photoelectric sensors: optical detection of objects.
4. Relays: switch loads using an electromagnetic coil.
5. Actuators: motors, solenoid valves, pneumatic cylinders.

Example:
Inductive sensor $\rightarrow$ PLC input $\rightarrow$ PLC output $\rightarrow$ solenoid valve $\rightarrow$ pneumatic cylinder.

4. Industrial Safety Basics

Lockout/Tagout: isolate energy sources before maintenance.
Grounding: protection against electrical faults.
Protections: circuit breakers, residual current devices, fuses.
Standards: always use PPE and follow CEI/EN regulations.

5. Automation Systems and Control Panels

A typical automation system includes: - 24VDC power supply - PLC - I/O modules - Relays - Inverters (VFD) - HMI **Process flow:**
Sensor $\rightarrow$ PLC $\rightarrow$ Logic $\rightarrow$ Actuator

Practical example:
If photo sensor = ON, then motor = ON.

Introductory document for students and industrial automation technicians.