

# Syllabus for Unit- 1

## **UNIT -I:**

### **Introduction to Automation**

Definition and fundamentals of automation, reasons for Automating, basic elements of an automated system: Power, Program and control system, safety, maintenance & repair diagnosis, error detection and recovery, Automation principles and strategies: USA principle, strategies of automation and production system, automation migration strategy

### **Learning Outcomes:**

At the end of the unit, students will be able to:

- To understand the fundamental concepts of automation and its basic elements
- To understand system safety requirements
- To understand about maintenance and repair strategies
- To know about production system automation

## **Definition of automation:**

- The technique of making an apparatus, a process, or a system operate automatically.
- The state of being operated automatically.

## **Fundamentals of Automation:**

- Sensors to detect the system states,
- Actuators to output the control commands,
- Controllers for the program flow and to make decisions.

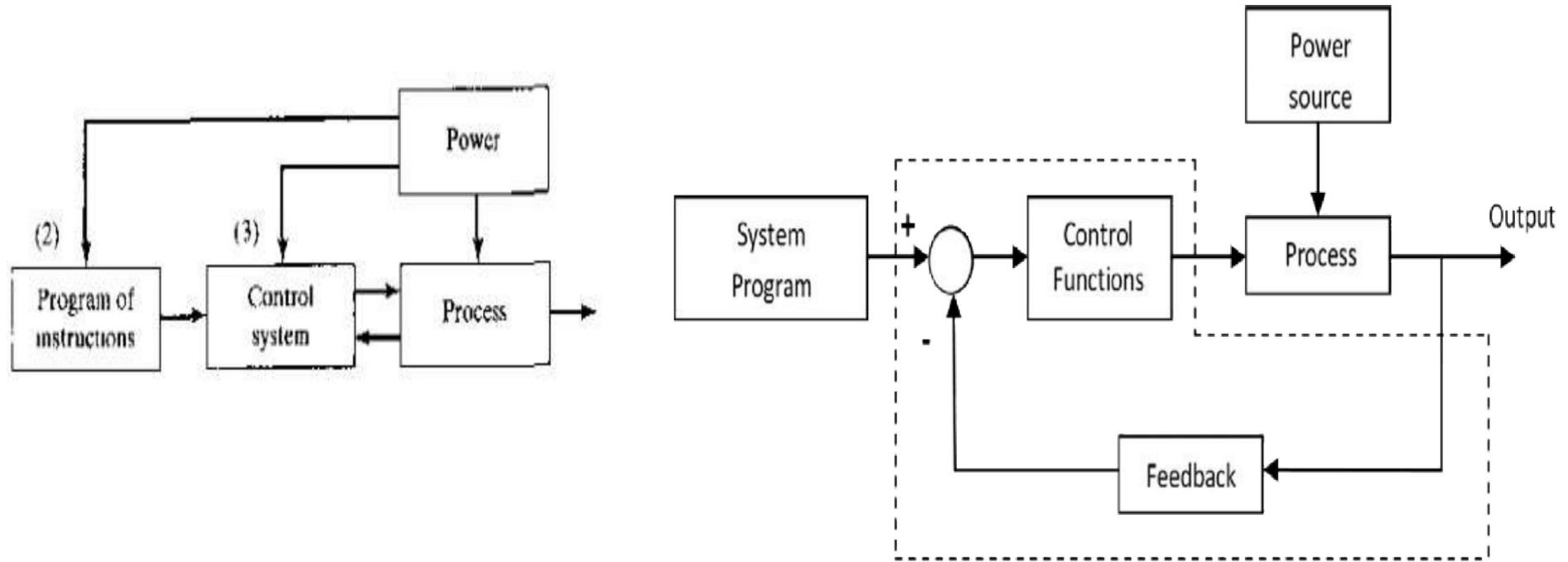
# Reasons for Automation

- Increased labour productivity
- Reduces labour costs
- Mitigates the effects of labor shortages
- Reduces or eliminates routine manual tasks
- Improves worker safety
- Improves product quality
- Reduces manufacturing lead times
- Accomplishes processes that can't be done manually

Reference link: <https://www.inora.com/8-reasons-to-utilize-automation/>

# Basics elements of an automated system:

- Power
- Program
- Control system
- Safety
- Maintenance
- Repair and diagnosis
- Error detection and recovery



**Fig: Basics elements of an automated system**

**Reference links:**

- [https://www.brainkart.com/article/Basic-Elements-of-an-Automated-System\\_6383/#:~:text=An%20automated%20system%20consists%20of,system%20to%20actuate%20the%20instructions.](https://www.brainkart.com/article/Basic-Elements-of-an-Automated-System_6383/#:~:text=An%20automated%20system%20consists%20of,system%20to%20actuate%20the%20instructions.)
- <https://www.britannica.com/technology/automation/Machine-programming#ref390718>

# Power in automation

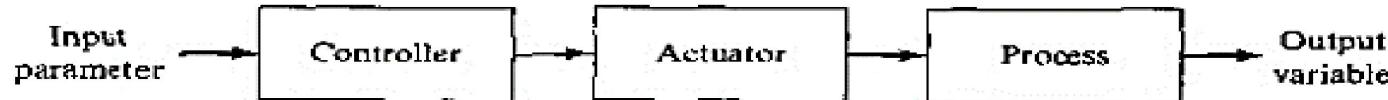
- Power-system automation processes rely on data acquisition; power-system supervision and power-system control all working together in a coordinated automatic fashion. The commands are generated automatically and then transmitted in the same fashion as operator-initiated commands.

# Program in automation

- Automation software are applications that minimize the need for human input and can be used in a variety of ways in almost any industry. At the most basic, automation software is designed to turn repeatable, routine tasks into automated actions.

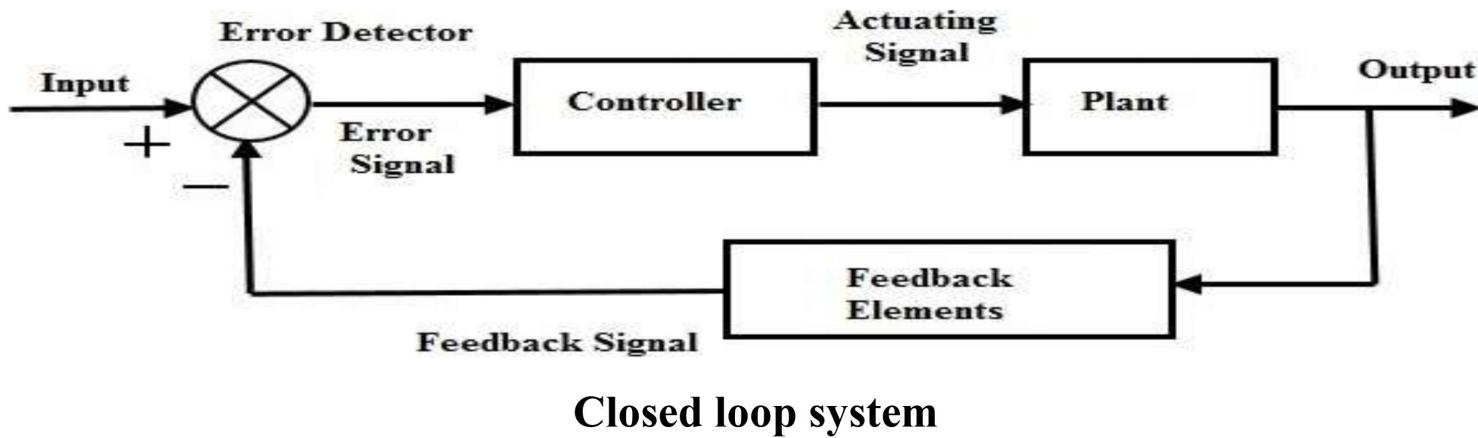
# Control System

- Automation Control System (ACS) is an application of control theories for the regulation of processes without direct human involvement that is used in the various control systems for the operating equipment such as machineries, processes in the productions.



**Figure 3.4 An open loop control system.**

One type of control system in which the output has no influence or effect on the control action of the input signal is called an Open-loop system. An “open-loop system” is defined by the fact that the output signal or condition is neither measured nor feed back for comparison with the input signal or system set point.



A closed loop control system is a set of mechanical or electronic devices that automatically regulates a process variable to a desired state or set point without human interaction. Closed loop control systems contrast with open loop control systems, which require manual input.

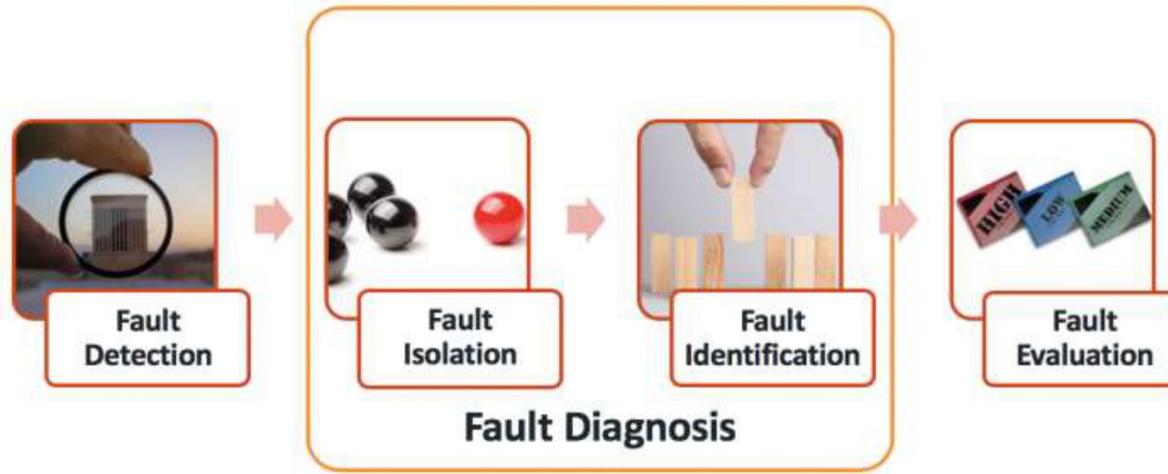
## Safety In Automation

- Automation technology can help. Automated systems can reduce the risk of accidents, as well as help avoid and prevent work injuries, resulting in a safer workplace for everyone. By making the workplace safer, uptime and productivity will also increase.

## Maintainance In Automation

- Through automation, some maintenance tasks can be either made safer or entirely replaced. This chiefly includes remote inspections, which can be done through robotic methods. Take internal tank inspections, for example. These are not only very hazardous, but time-consuming in prep for safely entrance

## Repair and diagnosis



The process of uncovering errors in physical systems while attempting to identify the source of the problem.

# Error detection and recovery

- Error detection and recovery is concerned with decisions that must be made by the system in response to undesirable operating conditions. In the operation of any automated system, malfunctions and errors sometimes occur during the normal cycle of operations, for which some form of corrective action must be taken to restore the system. The usual response to a system malfunction has been to call for human assistance. There is a growing trend in automation and robotics to enable the system itself to sense these malfunctions and to correct for them in some manner without human intervention. This sensing and correction is referred to as error detection and recovery, and it requires that a decision-making capability be programmed into the system.

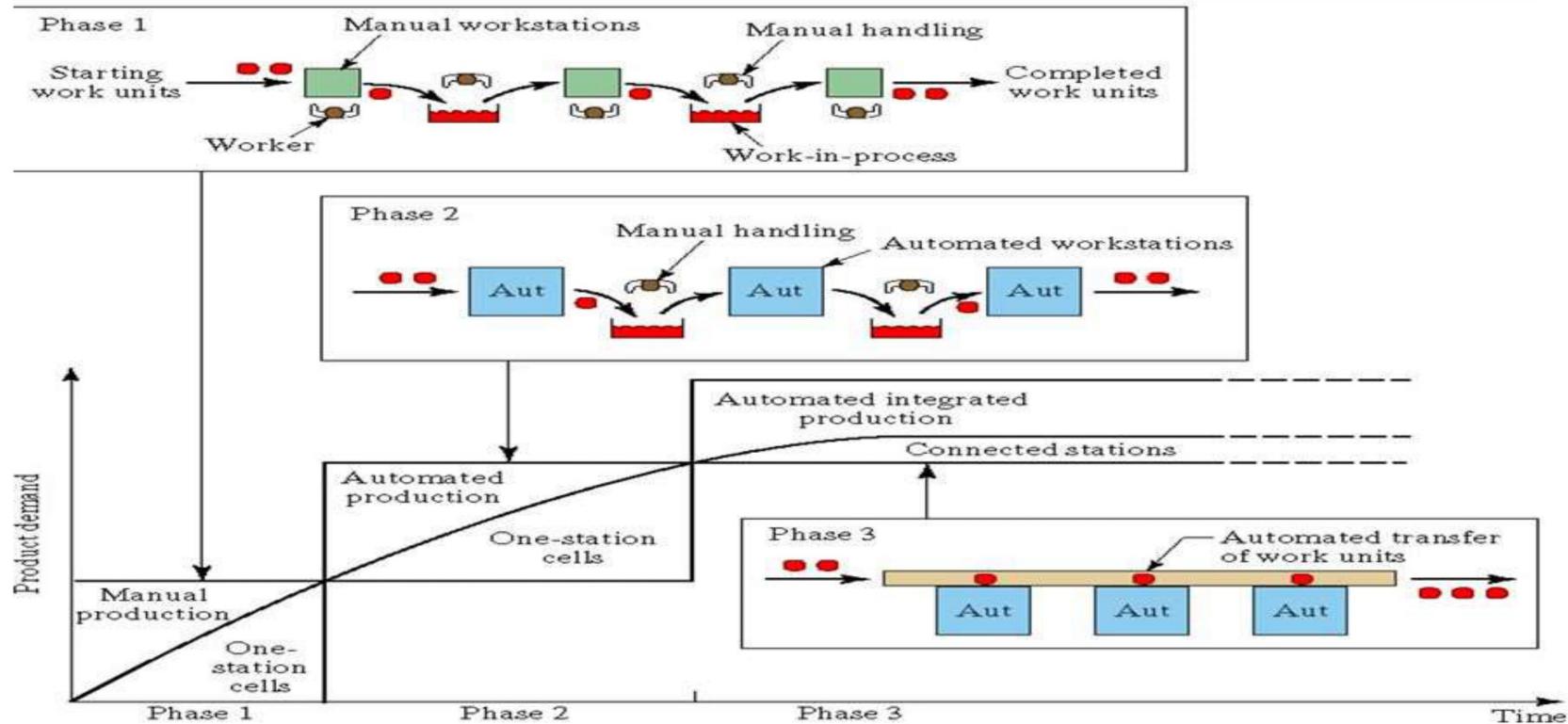
# Automation Principles And Strategy

- Specialization of operations
- Combined operations
- Simultaneous operations
- Integration of operations
- Increased flexibility
- Improved material handling and storage
- On-line inspection
- Process control and optimization
- Plant operations control
- Computer-integrated manufacturing (CIM)

## Reference Link

- [https://faculty.ksu.edu.sa/sites/default/files/10\\_strategies\\_for\\_automation\\_and\\_production\\_systems.pdf](https://faculty.ksu.edu.sa/sites/default/files/10_strategies_for_automation_and_production_systems.pdf)
- <https://electrical-engineering-portal.com/10-strategies-for-automation-and-production-systems>

# Automation Migration Strategy



## Automation Migration Strategy For Introduction of New Products

1. Phase 1 – Manual production
  - Single-station manned cells working independently
  - Advantages: quick to set up, low-cost tooling
2. Phase 2 – Automated production
  - Single-station automated cells operating independently
  - As demand grows and automation can be justified
3. Phase 3 – Automated integrated production
  - Multi-station system with serial operations and automated transfer of work units between stations