

SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35.

Accredited by NBA – AICTE and Accredited by NAAC – UGC with ‘A++’ Grade

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai.

DEPARTMENT OF AUTOMOBILE ENGINEERING

23GET102 – BASIC CIVIL MECHANICAL ENGINEERING

I YEAR / I SEMESTER

UNIT 3 - OVERVIEW OF MECHANICAL ENGINEERING

Topic : Mechanical & Automation



Understanding Automation: A Comprehensive Overview

Automation transforms manufacturing through intelligent systems that enhance precision, efficiency, and productivity. Let's explore the fundamental domains that shape modern automation.

Manufacturing Automation

Automated production systems that streamline manufacturing processes, reduce human intervention, and improve quality control.

Computer Science Integration

Software algorithms and programming that drive intelligent decision-making in automated systems.

Robotics & Mechatronics

Mechanical systems combined with electronics and computing to create intelligent machines.

Industrial IoT

Connected devices and sensors that enable real-time monitoring and data-driven optimization.

- ❑ **Key Challenge:** Integrating these diverse technologies requires interdisciplinary knowledge and continuous learning to stay current with rapid technological advancement.

Today's Learning Journey

01

Why Automation?

Discover the driving forces behind automation adoption in modern manufacturing and its impact on industry.

02

Automation Fundamentals

Build a strong foundation by understanding core principles, mechanisms, and control systems.

03

Key Terminologies

Master essential vocabulary including kinematics, dynamics, CNC, CAM, FMS, and AGV systems.

04

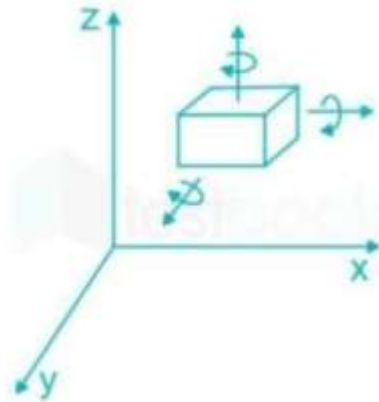
Real-World Applications

Explore how automation solves practical engineering challenges across diverse industries.



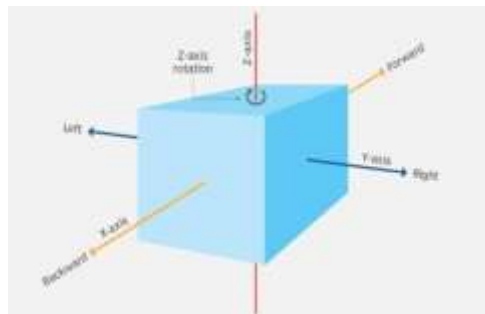
Fundamental Concepts: Degrees of Freedom

Degrees of Freedom (DOF)



Definition: The number of independent values in a system that can vary freely without breaking any constraints. In robotics and automation, DOF determines the range and complexity of motion.

Independent Variables



Definition: A variable in an experiment or study that is manipulated or controlled by the researcher to observe its effect on a dependent variable.

Understanding these concepts is crucial for designing and programming automated systems with precise control.

Why Study Automation Fundamentals?

Design Thinking: Empathize

"Automation fundamentals provide the foundation for understanding how machines, control systems, and processes work together to achieve efficiency, accuracy, and productivity in modern engineering."



How Machines Work

Understand mechanical principles, linkages, and motion systems that form the backbone of automation.



Basic Working Principles

Learn fundamental concepts of sensors, actuators, controllers, and feedback systems.



System Integration

Comprehend how different components integrate to create complete automated solutions.



Essential Automation Terminologies

Design Thinking: Define

Master the language of automation with these critical concepts that define performance and capability in automated systems.



Kinematics

The study of motion without considering forces. Analyzes position, velocity, and acceleration of machine components and robot arms.



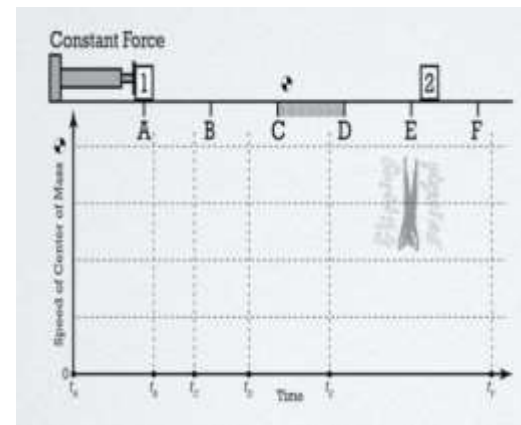
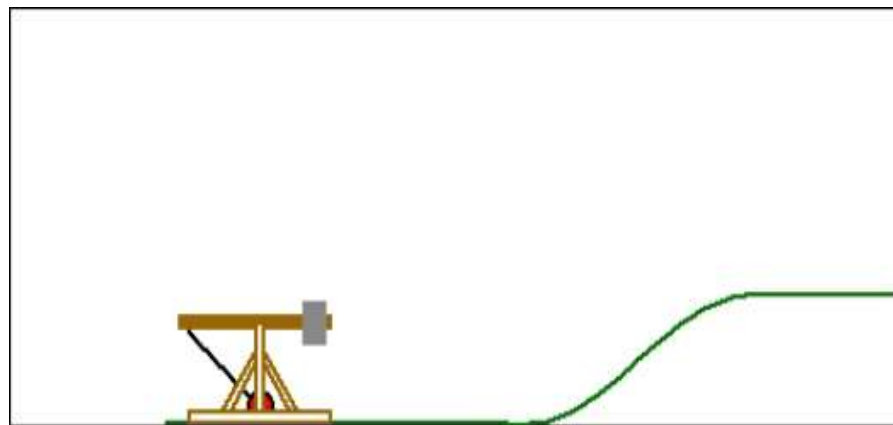
Dynamics

Studies forces and torques that cause motion. Essential for understanding power requirements and structural stability.



CNC (Computer Numerical Control)

Automated control of machining tools via computer programs. Enables precision manufacturing with repeatable accuracy.



- **Key Metrics:** Cycle time measures the total duration to complete one operation, while production rate quantifies units produced per time period in automated systems.

Advanced Automation Systems

Design Thinking: Define (continued)

CAM (Computer-Aided Manufacturing)

Software that converts CAD designs into machine instructions, enabling automated tool path generation and optimization for efficient production.

FMS (Flexible Manufacturing System)

An integrated system of CNC machines, robots, and material handling equipment that can automatically switch between different products with minimal downtime.

AGV (Automated Guided Vehicle)

Self-navigating mobile robots that transport materials throughout facilities using magnetic strips, lasers, or vision systems for guidance.



Impact: These systems revolutionize manufacturing by enabling lights-out production, reducing labor costs, and improving safety.



Interactive Learning Activity

Try This: Family Tree Mapping Exercise

Apply your understanding of hierarchical systems by mapping your family structure to automation concepts. This exercise helps visualize parent-child relationships in control systems.



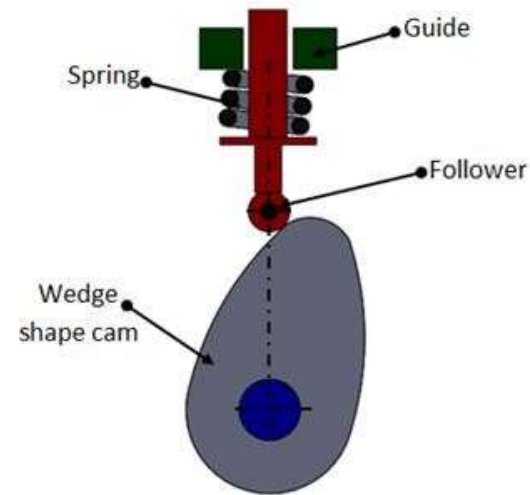
Challenge Questions:

1. **Who is the root?** Identify the top-level controller in your family system
2. **Parent-child relationships:** Map dependencies and command structures
3. **Find the siblings:** Locate parallel processing units at the same level
4. **Count automated nodes:** Identify family members who make independent decisions

This analogy helps understand hierarchical control architectures used in automation systems.

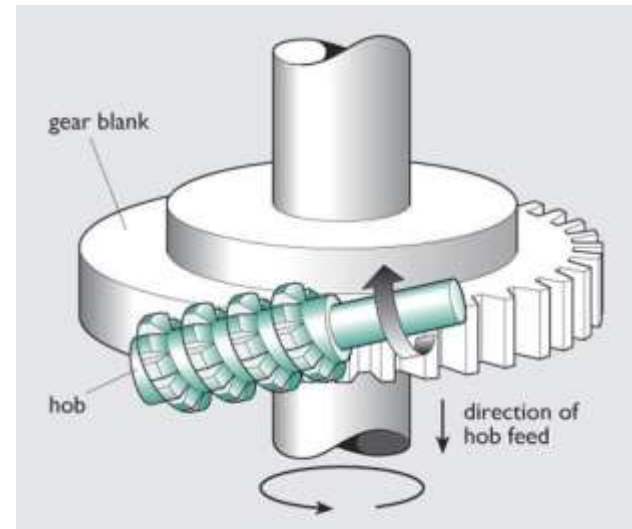
Real-World Applications of Automation

Automation transforms theory into practice across diverse engineering domains. Explore how fundamental concepts drive innovation in manufacturing.



Cam & Follower Mechanisms

Basic automation principle where a rotating cam drives a follower to create precise, repeatable motion patterns in machinery.



Gear Cutting Machines

Automated systems that precisely generate gear tooth profiles by systematically removing material from blanks using specialized cutters.



CNC Machining Centers

Multi-axis computer-controlled machines that execute complex cutting operations with exceptional precision and repeatability.



AI Decision Systems

Decision trees and minimax algorithms enable AI systems to make intelligent choices in game engines, robotics, and process control.

Automation Knowledge Map

A comprehensive visual summary connecting all aspects of automation we've explored today.



Key Takeaway: Automation is an interconnected ecosystem where fundamentals, terminology, and applications work together to drive manufacturing innovation. Continuous learning and hands-on practice are essential for mastery.