



Fundamentals of Process & Mechanical
Technology Course





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Introduction

Process engineering is at the core of the chemical, oil, gas, and petrochemical industries. The process and mechanical technology fundamentals course intersects with various engineering disciplines, including electrical and instrumentation engineering, but focuses significantly on mechanical engineering technology.

Process engineers are tasked with the transportation and transformation of solids, liquids, and gasses and place particular emphasis on separation processes such as distillation, heat transfer, Hydraulics, fluid flow, and reaction engineering. The process and mechanical technology fundamentals course also delve into process control and economics to optimize operations.

Mechanical engineers, on the other hand, concentrate on the safe containment and movement of these materials, often at high temperatures and pressures. They investigate failure modes like fracture, fatigue, and creep, delve into corrosion and its minimization, and study material properties, design standards, static and rotating equipment design, inspection, and maintenance. Through solid mechanical engineering principles, they ensure the integrity and functionality of equipment essential for process engineers.

This comprehensive process and mechanical technology fundamentals course covers the fundamentals of process and mechanical engineering. The method and mechanical technology fundamentals course is suited for professionals involved in the maintenance, production, and design aspects of chemical, oil, gas, and petrochemical industries.

By integrating principles of both electrical mechanical engineering technology and mechanical engineering, this program provides an in-depth understanding necessary for mastering the mechanical technology course elements and preparing participants for advanced certifications such as a certified mechanical engineer or for pursuing further educational goals, like a master's in mechanical engineering technology.

What is a Mechanical Technology Course?

A mechanical technology course such as this equips participants with the foundational knowledge and practical skills to tackle the challenges faced by mechanical technicians. On successful completion, individuals will have the confidence to apply these principles effectively in their professional endeavors. They may opt further to pursue certification or advanced degrees in mechanical engineering technology.

Participants who have demonstrated proficiency in the course objectives and competencies may be eligible for a mechanical training certificate or mechanical technician certificate. These credentials can serve as stepping stones towards acquiring a mechanical engineer certification or fundamentals of engineering certificate, crucial for professionals seeking to validate their expertise and advance their careers in mechanical and process engineering fields.

Targeted Groups

- Petroleum Engineers.
- Maintenance and Production Engineers.
- Process Engineers.
- R&D Chemists, Plant Chemists.
- Economists and Business Managers.

Course Objectives

By the end of this mechanical engineering technology program, participants will be able to:

- Apply a practical understanding of central issues in process and mechanical engineering within oil, gas, petrochemical, chemical, and allied facilities.
- Understand and apply fundamental principles in process units and classes of units involved in separations, heat exchange, and reactions.
- Gain practical knowledge of static and rotating mechanical equipment and related condition monitoring and inspection techniques.
- Comprehend mechanical testing methods, failure mechanisms, non-destructive testing NDT, and principles of corrosion and corrosion protection.
- Perform calculations and analyses to aid in the operation, sizing, and troubleshooting of chemical processes and mechanical equipment.

Targeted Competencies

At the end of this process and mechanical technology fundamentals course, the participants will be able to:

- Understand a practical introduction to the fundamentals of process engineering.
- Learn about a practical introduction to the fundamentals of mechanical engineering, equipment, and materials.
- Key areas applicable to significant process industries, especially oil, gas, and petrochemicals.
- Process and mechanical engineering influence safety and risk, failure modes, and maintenance.
- Learn about the links between the two engineering disciplines.
- Understand the mechanical design of pressure equipment and piping systems in compliance with applicable codes, standards, and regulations.
- Understand engineering materials properties and selection criteria for specific applications.
- Learn about the identification and assessment of active degradation mechanisms and the failures they may cause.
- Understand the various static and rotating equipment used in the petrochemical environment.
- Learn about the application of maintenance strategies and philosophies.
- Understand condition monitoring, inspections, and assessments.

Course Content

Unit 1: Introduction and Fundamentals of Process Engineering

- Process engineering basics.
- Mass and energy balances.
- Understand batch and continuous processes.
- Reactor types.
- Learn about process equipment and flow diagrams.
- P&IDs.
- Flammability.
- Electrical area classification.
- Understand risk management and hazard studies.
- Learn about Hydraulics and fluid flow.
- Pressure and head.
- "Bernoulli's Theorem" and its field applications.
- Flow of liquids.
- Reynolds number and pressure drop in pipes.
- Two-phase and multiphase flow.
- Enthalpy and thermodynamics.
- Understand the principle of process relief devices and the process design of relief systems.
- Learn about the principles of pressure vessels and piping design.
- Pumps.
- Compressors.
- Mixers.
- Mechanical equipment - Types and application guidelines.

Unit 2: Heat Transfer and Reaction Engineering

- Fundamentals of heat transfer.
- Thermal conductivity.
- Conduction and convection.
- Insulation.
- Heat transfer coefficients and calculation.
- Learn about heat exchangers, type, and sizing.
- Steam reboilers.
- Condensers and subcooling.
- Introduction to energy recovery.
- Understand catalysis and reaction engineering.
- Chemical reactions.
- Reaction kinetics.
- Introduction catalysis.
- Green chemistry and engineering.
- Reactor design and operation.

Unit 3: Distillation Processes and Equipment

- Distillation basics.
- Phase behavior and vapor/liquid equilibria.
- Gas/liquid separation.
- Distillation equipment - Columns and vessels.
- Columns and vessels - Sizing and selection guidelines.
- Learn about column and vessel internals - Types and selection guidelines.
- Troubleshooting of process equipment.
- Reactor Design and Operation.

Unit 4: Separation Processes and Equipment

- Overview of other separation processes.
- Absorption and adsorption.
- Amine sweetening.
- Solid-liquid separation.
- Effluent treatment [in refinery and petrochemical] industries.

Unit 5: Process Control and Economics

- Process control basics.
- Classification of control systems.
- Measured variables.
- Simple feedback control.
- Process economics.
- Preliminary economic analysis.
- Learn about fixed and variable costs and break-even analysis.
- Calculate raw materials usage.
- Estimate the cost of process equipment and plants.

Unit 6: Introduction to Mechanical Engineering Fundamentals

- Engineering material properties.
- Stress and strain.
- Understand fracture failure, modes, stress concentration, and fracture toughness.
- Learn about fatigue failure, testing, and mechanisms.
- What are temperature considerations and creep failure?
- Identification of damage mechanisms.
- Mechanical design.
- ASME and API.
- Codes and standards.
- Design for static strength.

Unit 7: Materials Selection and Inspection

- Materials selection.
- Materials of construction.
- Carbon steels.
- Alloy steels.
- Stainless steels.
- Nickel-based and titanium alloys.
- Inspection techniques.
- Visual.
- Penetrant.
- Magnetic flux.
- Eddy current inspections.
- X-ray and gamma-ray.
- Ultrasonics - TOFD and Pulse-echo.

Unit 8: Valves, Piping, and Fitness for Service

- Valves.
- Valve types.
- Valve characteristics.
- Valve applications.
- Valve selection.
- Valve actuators.
- Piping and pipelines.
- ASME B31.
- Learn about pipe types, construction, and schedules.
- Steel pipes.
- Understand welded types and sections.
- Flanges and gaskets.
- Learn about plastic pipes and composite pipes.
- Pipe coatings and linings.
- Pipe supports and insulation blocks.
- Stress relief in piping design.
- Pigging.
- Water hammer.
- Overview of API 570 - Inspection and repair of Pipelines and piping.
- API 579 overview.
- Fitness for service.

Unit 9: Corrosion

- Corrosion fundamentals.
- Types of corrosion.
- Corrosion inspection and monitoring.
- Corrosion minimization.
- Coatings.
- Inhibitors.
- Cathodic protection.



Unit 10: Compressors

- Types of compressors.
- Reciprocate, centrifugal, and screw.
- Blading and staging.
- Performance curves.
- Understand compressed air usage and instruments.
- Learn about glands and mechanical seals.

Unit 11: Mechanical Maintenance

- Strategies and philosophies.
- Maintenance system optimization.
- Maintenance management systems.
- Condition monitoring.
- Vibration analysis.
- Shaft alignment.