



Mechanical Engineering

Advanced Thermodynamics and Heat Transfer

Course Introduction

Advanced thermodynamics and heat transfer are crucial fields in mechanical engineering, especially for industries dealing with energy systems, HVAC, and power generation. A deep understanding of these areas allows engineers to optimize processes, improve system efficiency, and reduce environmental impact. Thermodynamics deals with energy transformations and the laws governing these changes, while heat transfer addresses the movement of heat and its management in various systems. Mastering these concepts is essential for designing more efficient engines, refrigeration systems, and renewable energy technologies. This course will provide participants with a comprehensive understanding of advanced thermodynamics and heat transfer principles, applied to real-world engineering challenges.

This training program will explore key advanced topics such as entropy generation, exergy analysis, advanced cycles, and heat exchanger design. Participants will learn about the principles of thermal fluid systems and the latest techniques in heat transfer, including conduction, convection, and radiation. The course will also cover complex heat transfer scenarios, thermodynamic cycles used in power plants, and methods for improving system efficiency.

Target Audience

This course is designed for engineers, designers, and professionals working in energy systems, mechanical engineering, and thermal management.

Learning Objectives

- Understand advanced thermodynamic principles and their applications in energy systems and industrial processes.

- Learn the methods of analyzing and optimizing thermodynamic cycles, including Rankine, Brayton, and refrigeration cycles.
- Gain an in-depth understanding of heat transfer mechanisms: conduction, convection, and radiation.
- Develop the ability to design and analyze heat exchangers, applying advanced heat transfer principles.

Course Outline

• 01 DAY ONE

Advanced Thermodynamics Principles

- Recap of basic thermodynamics concepts (first and second laws)
- Entropy generation and its role in real-world systems
- Exergy analysis: understanding available energy and its use
- The concept of reversible and irreversible processes
- Advanced thermodynamic cycles: Rankine, Brayton, and refrigeration cycles
- Thermodynamic property relations and equations of state

• 02 DAY TWO

Thermodynamic Systems and Applications

- Steady-state and unsteady-state processes in thermodynamics
- Multi-phase systems and phase diagrams
- Thermodynamic systems and control volumes: open vs closed systems
- Heat and work interactions in thermodynamic cycles
- Power and refrigeration systems design and optimization
- Application of thermodynamic principles in sustainable energy systems

• 03 DAY THREE

Heat Transfer Fundamentals and Conduction

- Introduction to heat transfer mechanisms: conduction, convection, radiation
- Fourier's Law of heat conduction and its application
- Thermal conductivity and materials selection for efficient heat transfer
- Steady-state vs transient heat conduction
- Multi-dimensional conduction and its impact on system design

• 04 DAY FOUR

Convective Heat Transfer and Heat Exchanger Design

- Principles of convection heat transfer (laminar vs turbulent flow)
- Nusselt number and its significance in convective heat transfer
- Forced and natural convection in different systems
- Heat exchanger design: types, performance, and sizing
- The role of finned surfaces in heat exchangers
- Thermal design considerations for compact heat exchangers

• 05 DAY FIVE

Radiation Heat Transfer and Advanced Heat Transfer Applications

- Stefan-Boltzmann Law and radiation heat transfer
- Radiation properties of materials and surface finishes
- Heat transfer in vacuum and space applications
- Advanced heat transfer applications in renewable energy systems (solar collectors, geothermal systems)
- Combined heat transfer mechanisms in energy systems
- Optimization of thermal systems in industries: HVAC, automotive, power generation

Confirmed Sessions

FROM	TO	DURATION	FEES	LOCATION
June 23, 2025	June 27, 2025	5 days	4250.00 \$	UAE - Abu Dhabi
Aug. 25, 2025	Aug. 29, 2025	5 days	4250.00 \$	UAE - Dubai
Dec. 8, 2025	Dec. 12, 2025	5 days	4950.00 \$	Austria - Vienna