Heat Transfer in Reactor Systems Training Course

Professional Development Training Course Outline

Category	General Training	**Duration**	5 Days
Base Fee	$1,500 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

Heat transfer in reactor systems is a cornerstone of modern chemical, nuclear, and process engineering, governing the efficiency, safety, and scalability of industrial operations. Heat Transfer in Reactor Systems Training Course is designed to deliver a deep, application-driven understanding of reactor heat transfer mechanisms, thermal control strategies, and energy balance optimization in high-performance industrial systems. Participants will explore conduction, convection, and radiation phenomena within reactors, while mastering thermal hydraulics, heat flux management, and temperature regulation techniques essential for safe and efficient reactor operation.

With increasing global demand for energy-efficient reactors, decarbonization technologies, process intensification, and advanced thermal systems design, engineers must be equipped with cutting-edge competencies. This course integrates simulation-based learning, real-world industrial case studies, and AI-enhanced thermal modeling approaches to prepare professionals for next-generation reactor challenges. Emphasis is placed on improving process reliability, heat exchanger integration, reactor safety, and optimization of thermal performance under dynamic operating conditions across chemical, petrochemical, and nuclear industries.

Programme Curriculum

Heat Transfer in Reactor Systems Training Course

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Course Duration

5 days

Course Objectives

1. Master reactor heat transfer fundamentals and thermal energy balance modeling
2. Apply advanced conduction, convection, and radiation heat transfer principles
3. Optimize reactor thermal efficiency and process intensification strategies
4. Analyze steady-state and transient heat transfer in reactor systems
5. Design high-performance heat exchange systems for reactors
6. Implement computational heat transfer simulation
7. Improve thermal stability and reactor safety management systems
8. Evaluate boiling heat transfer and phase-change mechanisms
9. Integrate heat transfer optimization in chemical reaction engineering
10. Apply AI-driven predictive thermal analytics for reactor performance
11. Control thermal runaway prevention and emergency cooling systems
12. Enhance energy recovery and waste heat utilization systems
13. Develop sustainable and low-carbon reactor thermal designs

Target Audience

1. Chemical Engineers
2. Mechanical Engineers
3. Process Engineers
4. Nuclear Engineers
5. Energy Systems Engineers
6. Plant Operators and Technicians
7. R&D Scientists in Thermal Systems
8. Graduate Students in Chemical & Mechanical Engineering

Course Modules

Module 1: Fundamentals of Heat Transfer in Reactor Systems

- Modes of heat transfer: conduction, convection, radiation
- Governing equations of thermal energy balance
- Reactor thermal boundary conditions
- Material thermal conductivity behavior
- Introduction to reactor heat flux analysis

- **Case Study:** Thermal gradient analysis in an exothermic batch reactor failure incident

Module 2: Reactor Thermal Design Principles

- Design of isothermal and non-isothermal reactors
- Heat removal and heat addition strategies
- Jacketed reactor thermal systems
- Coil heat transfer configurations
- Thermal scaling in industrial reactors
- **Case Study:** Optimization of a pharmaceutical stirred tank reactor cooling system

Module 3: Computational Heat Transfer & CFD Modeling

- CFD fundamentals for reactor systems
- Meshing and boundary condition setup
- Turbulence modeling in thermal flows
- Multiphase heat transfer simulation
- Validation of simulation results
- **Case Study:** CFD simulation of temperature distribution in catalytic reactor bed

Module 4: Convection and Fluid Dynamics in Reactors

- Forced and natural convection mechanisms
- Reynolds number and heat transfer correlation
- Mixing and turbulence effects
- Heat transfer enhancement techniques
- Fluid flow-induced thermal instability
- **Case Study:** Cooling efficiency improvement in stirred tank bioreactor

Module 5: Phase Change and Boiling Heat Transfer

- Nucleate boiling and film boiling regimes
- Condensation heat transfer mechanisms
- Latent heat applications in reactors
- Critical heat flux analysis
- Safety implications of phase change
- **Case Study:** Boiler tube overheating in industrial reactor system

Module 6: Heat Exchangers in Reactor Systems

- Shell and tube heat exchanger design
- Plate heat exchanger applications
- Fouling and thermal degradation
- Heat exchanger network integration
- Performance optimization techniques
- **Case Study:** Heat exchanger fouling impact in refinery reactor unit

Module 7: Reactor Safety and Thermal Runaway Control

- Exothermic reaction heat management
- Emergency cooling system design
- Thermal runaway prediction models

- Safety instrumentation systems
- Risk assessment methodologies
- **Case Study:** Thermal runaway prevention in polymerization reactor

Module 8: Advanced & Sustainable Reactor Heat Systems

- Waste heat recovery systems
- Renewable integration in thermal systems
- AI-based thermal optimization
- Low-carbon reactor design strategies
- Energy efficiency benchmarking
- **Case Study:** Energy recovery optimization in petrochemical reactor plant

Training Methodology

This course employs a participatory and hands-on approach to ensure practical learning, including:

- Interactive lectures and presentations.
- Group discussions and brainstorming sessions.
- Hands-on exercises using real-world datasets.
- Role-playing and scenario-based simulations.
- Analysis of case studies to bridge theory and practice.
- Peer-to-peer learning and networking.
- Expert-led Q&A sessions.
- Continuous feedback and personalized guidance.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
23 Nov 2026	27 Nov 2026	Online	$1,000
23 Nov 2026	27 Nov 2026	Physical	$1,500
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$4,500
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$6,000

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