Advanced Reaction Engineering Training Course

Professional Development Training Course Outline

Category	General Training	**Duration**	10 Days
Base Fee	$3,000 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

Advanced Reaction Engineering is a critical discipline that drives innovation, sustainability, and operational excellence across modern chemical and process industries. As organizations pursue process intensification, digital transformation, decarbonization, advanced catalysis, reactor optimization, Industry 4.0 integration, AI-driven process analytics, energy efficiency, carbon capture technologies, green chemistry, and sustainable manufacturing, reaction engineering has become a strategic competency for maximizing productivity and profitability. Advanced Reaction Engineering Training Course provides participants with advanced methodologies for analyzing, designing, optimizing, troubleshooting, and scaling chemical reaction systems while ensuring process safety and environmental compliance.

The program combines theoretical principles with practical industrial applications, focusing on reaction kinetics, catalytic reactor design, computational modeling, CFD-assisted reactor analysis, process simulation, machine learning applications, advanced process control, multiphase reactor systems, renewable energy processes, hydrogen technologies, and circular economy initiatives. Through real-world case studies and industry best practices, participants will develop the expertise required to improve reactor performance, enhance product quality, reduce operating costs, and support sustainable industrial growth.

Programme Curriculum

Advanced Reaction Engineering Training Course

Introduction

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Course Duration

10 Days

Course Objectives

By the end of this training, participants will be able to:

1. Master advanced reaction kinetics and mechanistic modeling techniques.
2. Optimize industrial reactor performance using data-driven methodologies.
3. Apply AI and machine learning tools in reaction engineering analysis.
4. Design catalytic reactors for enhanced conversion and selectivity.
5. Improve process efficiency through reactor optimization strategies.
6. Evaluate multiphase reaction systems and transport phenomena.
7. Utilize computational fluid dynamics (CFD) for reactor design.
8. Analyze reaction networks and complex reaction pathways.
9. Implement advanced process control for reactor operations.
10. Perform reactor scale-up and technology transfer effectively.
11. Integrate sustainability and green chemistry principles into reactor design.
12. Conduct reaction hazard assessments and process safety studies.
13. Develop digital twin models for real-time reactor monitoring.

Target Audience

1. Chemical Engineers
2. Process Engineers
3. Production Engineers
4. Research and Development Scientists
5. Petrochemical Engineers
6. Plant Operations Managers
7. Process Safety Specialists
8. Technical Consultants and Project Engineers

Course Modules

Module 1: Fundamentals of Advanced Reaction Engineering

- Reaction engineering principles
- Reaction stoichiometry review
- Kinetic modeling approaches
- Thermodynamic relationships

- Industrial applications overview
- **Case Study:** Performance evaluation of a petrochemical reactor system.

Module 2: Advanced Chemical Kinetics

- Elementary and complex reactions
- Rate law development
- Mechanistic reaction pathways
- Parameter estimation methods
- Kinetic data interpretation
- **Case Study:** Kinetic modeling for specialty chemical production.

Module 3: Catalytic Reaction Engineering

- Catalyst properties and characterization
- Heterogeneous catalysis
- Homogeneous catalysis
- Catalyst deactivation mechanisms
- Catalyst regeneration strategies
- **Case Study:** Refinery catalyst performance optimization.

Module 4: Reactor Design and Selection

- Batch reactor design
- Continuous stirred tank reactors
- Plug flow reactors
- Packed bed reactors
- Reactor selection criteria
- **Case Study:** Reactor selection for chemical plant expansion.

Module 5: Multiphase Reactor Systems

- Gas-liquid reactors
- Gas-solid reactors
- Liquid-solid reactors
- Three-phase reactors
- Industrial reactor applications
- **Case Study:** Slurry reactor optimization project.

Module 6: Transport Phenomena in Reactors

- Mass transfer fundamentals
- Heat transfer analysis
- Momentum transfer effects
- Diffusion limitations
- Transport-reaction interactions
- **Case Study:** Heat transfer bottleneck investigation.

Module 7: Computational Reaction Engineering

- Process simulation techniques
- Numerical modeling

- Reactor simulation software
- Model validation
- Sensitivity analysis
- **Case Study:** Digital reactor simulation and optimization.

Module 8: CFD Applications in Reactor Design

- CFD fundamentals
- Flow pattern analysis
- Mixing behavior studies
- Turbulence modeling
- Reactor geometry optimization
- **Case Study:** CFD-based reactor redesign.

Module 9: Advanced Process Control

- Process dynamics
- Model predictive control
- Real-time optimization
- Instrumentation requirements
- Performance monitoring
- **Case Study:** APC implementation in continuous reactors.

Module 10: Reactor Scale-Up and Commercialization

- Laboratory-scale studies
- Pilot plant evaluation
- Scale-up methodologies
- Commercial deployment challenges
- Technology transfer
- **Case Study:** Scale-up of a catalytic process.

Module 11: Process Intensification Technologies

- Microreactor technologies
- High-performance reactors
- Compact process systems
- Intensified mixing concepts
- Energy-efficient designs
- **Case Study:** Process intensification in specialty chemicals.

Module 12: Sustainable and Green Reaction Engineering

- Green chemistry principles
- Carbon footprint reduction
- Renewable feedstocks
- Circular economy concepts
- Waste minimization
- **Case Study:** Sustainable reactor design project.

Module 13: Safety and Risk Management

- Reaction hazard analysis
- Thermal runaway prevention
- HAZOP applications
- Inherently safer design
- Emergency response planning
- **Case Study:** Investigation of reactor safety incidents.

Module 14: Digital Transformation and Industry 4.0

- Smart reactor technologies
- Industrial IoT applications
- Digital twins
- Big data analytics
- Predictive maintenance
- **Case Study:** Smart manufacturing implementation.

Module 15: Emerging Technologies and Future Trends

- Hydrogen production technologies
- Carbon capture utilization
- AI-assisted reactor optimization
- Advanced materials applications
- Future industrial innovations
- **Case Study:** Net-zero chemical manufacturing strategy.

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	04 Dec 2026	Online	$2,000
23 Nov 2026	04 Dec 2026	Physical	$3,000
23 Nov 2026	04 Dec 2026	Physical	$6,000
23 Nov 2026	04 Dec 2026	Physical	$6,000
23 Nov 2026	04 Dec 2026	Physical	$12,000
23 Nov 2026	04 Dec 2026	Physical	$9,000
23 Nov 2026	04 Dec 2026	Physical	$12,000
23 Nov 2026	04 Dec 2026	Physical	$12,000

Ready to enroll or request a customized program? Book online or contact us:

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