Advanced Catalysis for Chemical Processes 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

Catalysis is at the heart of modern chemical manufacturing, enabling process intensification, energy efficiency, sustainable production, carbon reduction, reaction selectivity, and operational excellence across the chemical, petrochemical, refining, and pharmaceutical industries. As global industries pursue net-zero emissions, green chemistry, digital transformation, circular economy strategies, and advanced process optimization, catalytic technologies have become indispensable tools for achieving higher productivity, improved product quality, and reduced environmental impact. Understanding advanced catalytic mechanisms, catalyst design, reactor integration, and performance optimization is critical for engineers and scientists seeking competitive advantage in modern processing facilities.

Advanced Catalysis for Chemical Processes Training Course provides participants with in-depth knowledge of heterogeneous catalysis, homogeneous catalysis, biocatalysis, catalyst characterization, catalyst deactivation, reaction engineering, AI-driven catalyst development, and industrial catalyst optimization. Through practical examples, industrial case studies, and hands-on analytical methodologies, participants will gain the expertise required to enhance catalytic performance, maximize conversion efficiency, improve selectivity, and support sustainable chemical manufacturing operations.

Programme Curriculum

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Course Objectives

Upon completion of this course, participants will be able to:

1. Understand advanced **catalytic reaction mechanisms** and kinetics.
2. Evaluate **heterogeneous, homogeneous, and biocatalytic systems**.
3. Optimize catalyst performance using **process intensification techniques**.
4. Analyze catalyst activity, selectivity, and stability parameters.
5. Apply **advanced catalyst characterization technologies**.
6. Assess catalyst deactivation and regeneration strategies.
7. Design catalytic reactors for industrial applications.
8. Integrate **green chemistry and sustainable catalysis principles**.
9. Utilize **AI-assisted catalyst development and digital optimization tools**.
10. Improve process economics through catalyst lifecycle management.
11. Implement catalytic solutions for emissions reduction and decarbonization.
12. Troubleshoot catalyst-related operational challenges.
13. Develop advanced catalytic process improvement programs.

Target Audience

1. Chemical Engineers
2. Process Engineers
3. Production Engineers
4. Research and Development Scientists
5. Petrochemical Specialists
6. Refinery Operations Personnel
7. Process Technology Managers
8. Catalyst Development and Technical Service Professionals

Course Modules

Module 1: Fundamentals of Catalysis

- Principles of catalytic reactions
- Catalytic reaction pathways
- Thermodynamics and kinetics

- Catalytic cycle concepts
- Industrial applications overview
- **Case Study:** Performance comparison of catalytic versus non-catalytic processes.

Module 2: Catalytic Reaction Engineering

- Reaction rate theories
- Surface reaction mechanisms
- Mass transfer limitations
- Heat transfer effects
- Reactor performance analysis
- **Case Study:** Optimization of catalytic reactor productivity.

Module 3: Heterogeneous Catalysis

- Solid catalyst fundamentals
- Active sites and surface chemistry
- Adsorption and desorption phenomena
- Industrial catalyst systems
- Catalyst support materials
- **Case Study:** Fluid catalytic cracking catalyst performance enhancement.

Module 4: Homogeneous Catalysis

- Molecular catalyst design
- Organometallic catalysts
- Catalyst-solvent interactions
- Selectivity enhancement techniques
- Industrial homogeneous processes
- **Case Study:** Hydroformylation process optimization.

Module 5: Biocatalysis and Enzyme Catalysis

- Enzyme reaction mechanisms
- Immobilized enzyme technologies
- Bioreactor integration
- Industrial biotechnology applications
- Sustainable biocatalytic processes
- **Case Study:** Enzyme-assisted specialty chemical production.

Module 6: Catalyst Synthesis and Development

- Catalyst preparation methods
- Nanocatalyst development
- Catalyst formulation techniques
- Material selection strategies
- Scale-up considerations
- **Case Study:** Development of high-performance nanocatalysts.

Module 7: Catalyst Characterization Techniques

- Surface area analysis

- XRD and crystallography
- Spectroscopic methods
- Electron microscopy
- Thermal analysis techniques
- **Case Study:** Diagnosing catalyst performance loss.

Module 8: Catalyst Deactivation and Regeneration

- Fouling mechanisms
- Poisoning effects
- Sintering and thermal degradation
- Regeneration technologies
- Lifecycle management
- **Case Study:** Refinery catalyst regeneration program.

Module 9: Advanced Catalytic Reactor Design

- Fixed-bed reactors
- Fluidized-bed reactors
- Slurry reactors
- Structured reactors
- Reactor modeling techniques
- **Case Study:** Reactor redesign for conversion improvement.

Module 10: Catalysis in Petrochemical and Refining Processes

- Catalytic cracking
- Hydroprocessing technologies
- Reforming processes
- Alkylation reactions
- Product quality optimization
- **Case Study:** Refinery yield maximization through catalyst optimization.

Module 11: Green and Sustainable Catalysis

- Green chemistry principles
- Waste minimization strategies
- Renewable feedstock utilization
- Low-carbon technologies
- Circular economy applications
- **Case Study:** Sustainable catalyst implementation project.

Module 12: Emerging Catalytic Technologies

- Photocatalysis
- Electrocatalysis
- Plasma catalysis
- Carbon capture catalysis
- Hydrogen economy applications
- **Case Study:** Catalytic technologies for green hydrogen production.

Module 13: Digitalization and AI in Catalysis

- Data-driven catalyst development
- Machine learning applications
- Predictive catalyst modeling
- Digital twins
- Process optimization platforms
- **Case Study:** AI-driven catalyst performance prediction.

Module 14: Process Optimization and Troubleshooting

- Root cause analysis
- Performance benchmarking
- Process monitoring systems
- Optimization methodologies
- Operational excellence practices
- **Case Study:** Troubleshooting catalyst activity decline.

Module 15: Industrial Applications and Future Trends

- Specialty chemical production
- Pharmaceutical catalysis
- Energy transition technologies
- Carbon-neutral manufacturing
- Future catalyst innovations
- **Case Study:** Next-generation catalyst deployment 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

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