Electrochemical 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

Electrochemical Reactor Systems are at the forefront of modern green energy transition, industrial decarbonization, and advanced process engineering. These systems play a critical role in applications such as hydrogen production, fuel cells, electrochemical CO? reduction, wastewater treatment, battery energy systems, and chemical synthesis optimization. As industries shift toward net-zero emissions, electrochemical reactors are becoming essential for scalable, energy-efficient, and sustainable production technologies.

Electrochemical Reactor Systems Training Course provides a comprehensive foundation and advanced understanding of electrochemical engineering principles, reactor design optimization, electrode kinetics, and process integration. Participants will gain hands-on insight into industrial electrochemical systems, performance modeling, scale-up strategies, and real-world case studies aligned with global standards in clean energy technologies, chemical process intensification, and electrochemical innovation ecosystems

Programme Curriculum

Electrochemical Reactor Systems Training Course

Introduction

Electrochemical Reactor Systems are at the forefront of modern green energy transition, industrial decarbonization, and advanced process engineering. These systems play a critical role in applications such as hydrogen production, fuel cells, electrochemical CO? reduction, wastewater treatment, battery energy systems, and chemical synthesis optimization. As industries shift toward net-zero emissions, electrochemical reactors are becoming essential for scalable, energy-efficient, and sustainable production technologies.

Electrochemical Reactor Systems Training Course provides a comprehensive foundation and advanced understanding of electrochemical engineering principles, reactor design optimization, electrode kinetics, and process integration. Participants will gain hands-on insight into industrial electrochemical systems, performance

modeling, scale-up strategies, and real-world case studies aligned with global standards in clean energy technologies, chemical process intensification, and electrochemical innovation ecosystems.

Course Duration

5 days

Course Objective

1. Understand electrochemical reactor design principles and system configurations
2. Master electrode kinetics and reaction mechanisms in industrial applications
3. Analyze mass transfer and charge transfer limitations in electrochemical systems
4. Apply electrochemical modeling and simulation tools for process optimization
5. Evaluate hydrogen production via water electrolysis technologies (PEM, Alkaline, SOEC)
6. Assess fuel cell performance and degradation mechanisms
7. Develop skills in CO? electroreduction and carbon capture utilization (CCU)
8. Optimize industrial electrochemical process efficiency and energy consumption
9. Implement scale-up strategies for pilot and industrial reactor systems
10. Investigate advanced electrode materials and nanostructured catalysts
11. Improve wastewater treatment using electrochemical oxidation and reduction methods
12. Integrate renewable energy systems with electrochemical reactors
13. Strengthen expertise in sustainable chemical manufacturing and green process engineering

Target Audience

1. Chemical & Process Engineers
2. Mechanical Engineers in Energy Systems
3. Electrochemical & Materials Scientists
4. Renewable Energy Engineers
5. Industrial R&D Professionals
6. Environmental Engineers & Sustainability Experts
7. Graduate Students in Chemical/Electrical Engineering
8. Energy Policy & Clean Technology Consultants

Course Modules

Module 1: Fundamentals of Electrochemical Engineering

- Electrochemical thermodynamics and kinetics
- Faradaic and non-Faradaic processes
- Electrode-electrolyte interface behavior
- Nernst equation applications in reactor systems
- Basic reactor configurations
- **Case Study:** Industrial chlorine-alkali electrolysis process optimization

Module 2: Electrochemical Reactor Design & Configurations

- Reactor geometries and flow dynamics
- Bipolar and monopolar reactor systems
- Membrane and separator technologies
- Current distribution and scaling effects
- Reactor safety and operational stability

- **Case Study:** PEM electrolyzer design for hydrogen production plants

Module 3: Electrode Kinetics & Reaction Mechanisms

- Butler-Volmer equation and Tafel analysis
- Activation, concentration, and ohmic losses
- Catalyst surface engineering
- Reaction pathway optimization
- Electrochemical impedance spectroscopy (EIS)
- **Case Study:** Nickel-based electrodes in alkaline water electrolysis

Module 4: Mass Transfer & Transport Phenomena

- Diffusion, convection, and migration processes
- Limiting current density concepts
- Boundary layer effects in reactors
- Porous electrode transport modeling
- Multi-phase electrochemical systems
- **Case Study:** Copper electrorefining in hydrometallurgy industry

Module 5: Hydrogen Production & Fuel Cell Systems

- PEM, alkaline, and solid oxide electrolysis systems
- Hydrogen storage and compression integration
- Fuel cell architectures and efficiency analysis
- Degradation mechanisms and lifecycle performance
- Grid integration of hydrogen systems
- **Case Study:** Large-scale green hydrogen plant in Europe

Module 6: CO? Reduction & Environmental Applications

- Electrochemical CO? conversion pathways
- Carbon capture and utilization (CCU) systems
- Waste-to-chemical transformation
- Electro-oxidation in wastewater treatment
- Environmental compliance and sustainability metrics
- **Case Study:** CO?-to-methanol pilot electrochemical reactor

Module 7: Industrial Scale-Up & Process Integration

- Lab-to-pilot-to-industrial scale transition
- Energy efficiency optimization strategies
- Process intensification techniques
- Reactor modularization and system integration
- Techno-economic analysis (TEA)
- **Case Study:** Industrial electrochemical chlorine production facility scale-up

Module 8: Advanced Materials & Future Innovations

- Nanostructured catalysts and electrode materials
- Solid electrolytes and membrane advancements
- AI-driven reactor optimization

- Smart monitoring and digital twin systems
- Emerging electrochemical technologies
- **Case Study:** AI-optimized electrochemical reactor for battery recycling

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

Start Date	End Date	Location	Price
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

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

Register Online Now

Email: info@fineskilltrainingcenter.com | Website: www.fineskilltrainingcenter.com