Training Course on Advanced Power System Analysis and Optimization

Professional Development Training Course Outline

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

Course Introduction

Introduction

As global energy systems evolve towards smarter, cleaner, and more resilient grids, power system professionals must harness advanced tools and techniques to optimize system performance. Training Course on Advanced Power System Analysis and Optimization provides a high-level, hands-on understanding of how to analyze, simulate, and enhance the reliability, stability, and efficiency of modern power systems using cutting-edge methods and real-time applications. Focused on power flow analysis, system stability, optimal power dispatch, and integration of renewable energy, this course equips engineers and decision-makers with the latest optimization and analysis strategies for modern energy infrastructure.

From load forecasting and state estimation to AI-driven fault detection and smart grid modeling, the course delivers a practical and analytical roadmap to designing, evaluating, and optimizing large-scale power systems. With the global shift to decarbonized grids and increased penetration of distributed energy resources (DERs), the need for accurate, secure, and optimized power system operations is more pressing than ever. This course blends theoretical insight with simulation-based case studies using tools like MATLAB, PSAT, DIgSILENT PowerFactory, and Python, ensuring participants can apply their knowledge to complex real-world challenges.

Programme Curriculum

Training Course on Advanced Power System Analysis and Optimization

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Course Objectives

- Analyze complex power system networks using load flow and fault analysis.
- Apply optimization techniques for efficient power system planning and operation.
- Utilize tools like MATLAB/Simulink and PowerFactory for system simulation and modeling.
- Conduct dynamic and transient stability assessments under contingency conditions.
- Perform economic dispatch and unit commitment using advanced optimization algorithms.
- Integrate and analyze renewable energy systems within power networks.
- Understand and implement smart grid architecture and communication protocols.
- Conduct reliability and contingency analysis using probabilistic methods.
- Employ AI and machine learning algorithms for predictive maintenance and fault detection.
- Implement real-time data analytics and SCADA integration in power systems.
- Optimize voltage stability and reactive power control mechanisms.
- Design resilient systems using microgrid and distributed energy resource (DER) modeling.
- Address cybersecurity threats in power systems with grid protection strategies.

Organizational Benefits

- Improved grid resilience and stability.
- Enhanced staff expertise in modern simulation tools.
- Reduction in operational and energy costs.
- Better integration of renewables and DERs.
- Minimized downtime due to accurate fault analysis.
- Increased system reliability and performance.
- Adoption of smart grid technologies.
- Data-driven decision-making capabilities.
- Proactive approach to cybersecurity and grid protection.
- Competitive advantage through innovation and sustainability.

Target Participants

- Power system engineers and technicians
- Utility and grid operators
- Renewable energy engineers
- Energy consultants and analysts
- SCADA and smart grid professionals
- Researchers and academicians
- Policy makers and regulatory officers

Course Outline

Module 1: Power System Fundamentals

1. Components of power systems
2. One-line diagrams and per unit systems
3. Power system topology
4. Bus classification and modeling
5. Case Study: Kenya National Grid Overview

Module 2: Load Flow Analysis

1. Gauss-Seidel and Newton-Raphson methods
2. Fast Decoupled Load Flow
3. Convergence techniques
4. Modeling of transformers and lines
5. Case Study: Load Flow for Nairobi Urban Distribution

Module 3: Fault Analysis

1. Symmetrical fault analysis
2. Unsymmetrical fault analysis (L-G, L-L, L-L-G)
3. Sequence networks
4. Short-circuit current calculation
5. Case Study: Industrial Fault Simulation

Module 4: Stability Analysis

1. Transient stability
2. Small-signal stability
3. Swing equation and equal area criterion
4. Dynamic modeling of generators
5. Case Study: Wind Power Grid Stability

Module 5: Economic Load Dispatch

1. Cost function modeling
2. Economic dispatch with and without losses
3. Lambda iteration method
4. Quadratic programming approach
5. Case Study: Optimal Dispatch for Renewable-Diesel Hybrid

Module 6: Unit Commitment and Scheduling

1. Constraints in unit commitment
2. Priority list method
3. Dynamic programming
4. Mixed integer programming (MIP)
5. Case Study: Optimal Scheduling for Rural Microgrid

Module 7: Renewable Energy Integration

1. Wind and solar modeling
2. Grid impact of intermittent energy
3. Storage technologies (batteries, hydrogen)
4. Power electronics for renewables
5. Case Study: PV Penetration in Grid-Tied System

Module 8: Power System Protection

1. Types of protection systems
2. Relay coordination and settings
3. Protection zones and breakers
4. Digital relays and IEDs
5. Case Study: Fault Isolation in Transmission System

Module 9: SCADA and Automation

1. SCADA architecture
2. RTUs and communication protocols
3. Automation for substations
4. Real-time monitoring and control
5. Case Study: SCADA for Power Distribution in Nairobi

Module 10: Smart Grid Technologies

1. AMI and demand response
2. Smart meters and IoT
3. Grid communication protocols
4. Big data and smart analytics
5. Case Study: Smart Grid Pilot in Kenya

Module 11: Optimization in Power Systems

1. Linear and non-linear optimization
2. Genetic Algorithms and PSO
3. Optimal power flow (OPF)
4. Multi-objective optimization
5. Case Study: Voltage Profile Optimization

Module 12: Power Quality and Harmonics

1. Power quality indices
2. 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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