Introduction:

This comprehensive training course provides an in-depth exploration of electrical power system analysis and design. Combining theoretical understanding with practical application, participants will learn methods such as phasors, per-unit systems, and symmetrical components through clear, practical examples.

Instead of focusing on abstract mathematical procedures, this course emphasizes realistic modeling and analysis, offering insights into the behavior and analysis of power systems under normal and contingency conditions. By the end, participants will gain a solid understanding of power system behavior and the skills needed to analyze and design modern electrical power systems effectively.

Professional Power Systems Integration

Modern power engineers must understand the integration and application of advanced power system analysis tools. This course highlights how professional power systems function and equips participants with the tools to enhance grid reliability, blending theoretical expertise with applied techniques.

Targeted Groups

This course is ideal for:

- Engineers and technicians new to the power industry.
- Intermediate-level professionals working in planning, design, or operations of power systems.
- Practitioners in power generation, transmission, distribution, or utilization.
- Professionals integrating renewable energy resources into the power grid.
- Individuals focused on modernizing and optimizing power system performance.

Course Objectives

By the end of the course, participants will be able to:

1. Perform three-phase power system calculations using phasor analysis and the per-unit system.
2. Model critical power system components, including transmission lines, transformers, generators, and loads.
3. Conduct power flow analysis and understand the fundamentals of power system operation.

4. Apply symmetrical component theory and sequence networks to analyze short-circuit faults.
5. Comprehend and apply the equal-area criterion for transient stability analysis.

Targeted Competencies

Participants will develop expertise in:

- Phasor and per-unit analysis for three-phase power systems.
- Modeling of transmission lines, transformers, generators, and loads.
- Conducting power flow and system operation analysis.
- Short circuit and symmetrical component analysis.
- Transient stability evaluation and analysis.

Course Content

Unit 1: Math Review and System Modeling

- Transitioning between time and phasor domains.
- Phasor mathematics and per-unit calculations.
- Basic three-phase power calculation techniques.
- Parameter computation for transmission lines.
- Modeling power system components such as transformers, generators, and loads.

Unit 2: Power Flow Analysis

- Understanding AC power components.
- Building Ybus and Zbus matrices.
- Formulating and solving power flow equations.
- Using software tools for simulations.
- Interpreting power flow analysis results.

Unit 3: Generation Control, Economic Dispatch, and Unbalanced System Analysis

- Load and generation dynamics, including Area Control Error (ACE).
- Frequency bias and its role in system stability.
- Principles of economic dispatch.
- System behavior under network contingencies.
- Analyzing unbalanced power systems and introducing symmetrical components.

Unit 4: Symmetrical Components and Sequence Networks

- Development and application of symmetrical components.
- Sequence current behaviors and transformer analysis.
- Modeling sequence impedances for accurate system representation.
- Constructing sequence networks for fault and harmonic analysis.

Unit 5: Short Circuit Calculations and Transient Stability

- Using sequence networks to model and analyze faults.
- Calculating short circuit and open circuit currents.
- Evaluating fault currents versus arc flash hazard energy.
- Exploring power system dynamics.
- Applying the equal-area criterion for transient stability analysis.

Conclusion

This **Electrical Power System Analysis and Design Training Course** prepares participants to tackle the challenges of modern power systems. By bridging the gap between theoretical knowledge and real-world applications, attendees will be empowered to design, analyze, and optimize electrical power systems for enhanced reliability, safety, and efficiency.