Training Course on Transmission, Distribution Operation and Design Calculations

Professional Development Training Course Outline

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

Course Introduction

The **Transmission & Distribution (T&D) Operation & Design Calculations** training course offers a comprehensive understanding of the critical infrastructure that delivers electrical power from generation sources to end-users. This program delves into the fundamental principles, operational aspects, and intricate design considerations involved in both high-voltage transmission networks and lower-voltage distribution systems. Participants will gain practical insights into system parameters, equipment functionality (including transformers, switchgears, and protection systems), and the analytical techniques required for effective operation and robust design. Mastering these concepts is crucial for ensuring grid stability, minimizing losses, and facilitating the reliable delivery of electricity to meet growing energy demands.

This intensive course equips professionals with the essential knowledge and skills to analyze, operate, and design efficient and safe power delivery systems. Through a blend of theoretical learning and practical application, attendees will explore load flow analysis, protection coordination, voltage regulation, and the impact of emerging technologies on the grid. The curriculum emphasizes the use of industry-standard calculations, diagrams, and software tools to solve real-world problems in **power system operation**, **electrical grid design**, and **transmission and distribution infrastructure**. By understanding the complexities of these interconnected systems, participants can contribute significantly to enhancing the reliability, security, and sustainability of the modern power network.

Programme Curriculum

Training Course on Transmission & Distribution Operation & Design Calculations

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Course Duration

10 days

Course Objectives

1. To grasp the basic theories and principles governing electrical power systems, including AC/DC circuits, power factor, and complex power.
2. To learn how to model and analyze the electrical characteristics of transmission lines, such as resistance, inductance, and capacitance.
3. To gain in-depth knowledge of power and distribution transformers, including their construction, operation, cooling methods, and voltage control techniques.
4. To understand the functionality, types, ratings, and applications of various switchgear and circuit breakers used in T&D systems.
5. To develop the ability to perform load flow studies under different operating scenarios and interpret the results for system optimization.
6. To learn how to design and coordinate protection systems, including relays, fuses, and circuit breakers, to ensure system safety and reliability.
7. To understand and apply different methods for maintaining voltage stability within acceptable limits in T&D networks.
8. To gain insights into the concepts of steady-state and transient stability and the factors affecting the stability of power systems.
9. To learn the principles and practices involved in designing efficient and reliable distribution networks, considering load characteristics and voltage levels.
10. To comprehend the importance of proper earthing and grounding in ensuring the safety and protection of electrical systems and personnel.
11. To learn how to analyze different types of faults in power systems and calculate fault currents for protection system design.
12. To gain an understanding of the emerging technologies and concepts associated with smart grids and their impact on T&D systems.
13. To become familiar with the software and tools commonly used for power system analysis, design, and simulation.

Organizational Benefits

- Improved System Reliability.
- Enhanced Operational Efficiency.
- Reduced Maintenance Costs.
- Increased Safety.
- Better Asset Management
- Compliance with Regulations.
- Enhanced Problem-Solving Capabilities.
- Innovation and Adaptability
- Improved Team Performance
- Attracting and Retaining Talent.

Target Audience

1. Electrical Engineers.
2. Transmission & Distribution Engineers
3. Substation Engineers & Technicians.
4. Protection & Control Engineers.
5. System Operators.
6. Maintenance Engineers & Technicians.
7. Project Engineers & Managers
8. Technical Managers & Supervisors.

Course Outline

Module 1: Fundamentals of Power Systems

- Basic Electrical Concepts: Voltage, Current, Resistance, Power, Energy
- AC and DC Systems: Characteristics and Applications
- Single-Phase and Three-Phase Power: Generation, Transmission, Distribution
- Power Factor: Definition, Effects, and Improvement Techniques
- Complex Power and Power Triangle

Module 2: Transmission Line Parameters

- Conductor Properties and Types
- Resistance, Inductance, and Capacitance of Transmission Lines
- Modeling of Short, Medium, and Long Transmission Lines
- Surge Impedance and Propagation Constant
- Voltage Regulation and Transmission Efficiency

Module 3: Power Transformers

- Transformer Principles of Operation and Construction
- Types of Transformers: Power vs. Distribution
- Transformer Connections: Star, Delta, Zig-Zag
- Transformer Cooling Methods and Insulation
- Voltage and Tap Changing Mechanisms

Module 4: Distribution Transformers

- Single-Phase and Three-Phase Distribution Transformers
- Transformer Loading and Losses

- Parallel Operation of Transformers
- Transformer Protection and Maintenance
- Smart Distribution Transformers

Module 5: Switchgear and Circuit Breakers

- Types of Switchgear: Low, Medium, and High Voltage
- Circuit Breaker Principles and Operating Mechanisms
- Types of Circuit Breakers: Air, Oil, Vacuum, SF6
- Circuit Breaker Ratings and Selection Criteria
- Switchgear Maintenance and Testing

Module 6: Load Flow Analysis

- Bus Admittance Matrix Formulation
- Gauss-Seidel and Newton-Raphson Methods
- Load Flow Studies for Different Operating Conditions
- Interpretation of Load Flow Results
- Power Flow Control Techniques

Module 7: Power System Protection

- Principles of Power System Protection
- Protective Relays: Types and Characteristics
- Current and Voltage Transformers for Protection
- Protection Zones and Coordination
- Digital and Numerical Relays

Module 8: Overcurrent and Earth Fault Protection

- Time-Current Characteristics of Overcurrent Relays
- Definite Time and Inverse Time Relays
- Earth Fault Protection Schemes
- Directional Overcurrent Relays
- Coordination of Overcurrent and Earth Fault Protection

Module 9: Transformer Protection

- Differential Protection of Transformers
- Restricted Earth Fault Protection
- Buchholz Relay and Other Transformer Protection Devices
- Transformer Inrush Current and ??? Mitigation
- Protection of Autotransformers

Module 10: Transmission Line Protection

- Distance Protection Schemes
- Pilot Wire and Carrier Current Protection
- Differential Protection of Transmission Lines
- Automatic Reclosing and Synchro-Check
- Traveling Wave Protection

Module 11: Voltage Regulation

- Importance of Voltage Regulation
- Methods of Voltage Control: Tap-Changing Transformers, Voltage Regulators, SVCs
- Reactive Power Compensation Techniques
- Power System Stability and Voltage Collapse
- FACTS Devices for Voltage Control

Module 12: Power System Stability

- Steady-State Stability and Power Transfer Limits
- Transient Stability and Swing Equation
- Factors Affecting Power System Stability
- Methods for Improving Stability
- Small Signal Stability Analysis

Module 13: Distribution System Design and Operation

- Distribution System Configurations: Radial, Loop, Network
- Voltage Levels and Load Characteristics in Distribution Systems
- Distribution Substation Design and Location
- Power Quality Issues in Distribution Systems
- Distributed Generation and its Impact on Distribution Networks

Module 14: Earthing and Grounding

- Importance of Earthing and Grounding for Safety
- Types of Earthing Systems: TN, TT, IT
- Equipment Grounding and System Grounding
- Ground Fault Protection Techniques
- Standards and Regulations for Earthing

Module 15: Smart Grid Technologies and Applications

- Overview of Smart Grid Concepts and Benefits
- Advanced Metering Infrastructure (AMI)
- Demand Response and Load Management
- Integration of Renewable Energy Sources
- Communication Technologies for Smart Grids

Training Methodology

- **Interactive Lectures**: Engaging presentations covering the fundamental concepts, principles, and theories of transmission and distribution systems.
- **Case Studies**: Analysis of real-world scenarios and challenges in T&D operation and design to foster critical thinking and problem-solving skills.
- **Hands-on Exercises**: Practical exercises and calculation sessions using industry-standard formulas and techniques.
- **Software Simulations**: Utilization of power system analysis software to simulate various operating conditions and design scenarios.
- **Group Discussions**: Facilitated discussions to encourage the exchange of ideas, experiences, and best practices among participants.
- **Visual Aids**: Use of diagrams, schematics, and multimedia presentations to enhance understanding of complex concepts.

- **Quizzes & Assessments**: Regular assessments to gauge participant comprehension and identify areas requiring further attention.
- **Practical Demonstrations**: Where feasible, demonstrations of equipment and operational procedures will be included.

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

Start Date	End Date	Location	Price
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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