

DAY 1

Transmission System Design Considerations

- AC Transmission
- Grid Network Features
- Transmission Security
- Building-up Impedance Models
- Complex Power Definitions
- Power Factor
- Power Factor Compensation (PFC) Techniques
- Shunt Reactor Compensation
- Minimum Clearance Distances
- Line Voltage Drop
- Electrical Loads Types and Behaviour
- Single Wire Earth Return (SWER)
- Balanced 3-phase System
- Unbalanced 3-phase Systems
- Symmetrical Components
- Sequence Networks
- Wye-connected & Delta-connected Loads
- Voltage Regulation
- Power Angle & Power Transfer
- Steady State Stability Limit
- Transmission Line Terms (*span, sag, cross arm, clearance*)
- Transmission Line Surge Impedance and Propagation
- Overhead Line Conductors (*AAC, AAAC, ACSR*)
- Bundles Conductors
- Overhead Line Insulators
- Line Supporting Structure (*wood & concrete poles, towers*)
- Power Transfer Capability, Current Carrying Capacity
- Transmission Line Loadability

DAY 2

Transformers & Switchgears

- Transformer Theory
- Transformer Construction
- Transformer Cooling
- Transformer Voltage Control
- Power Transformers vs. Distribution Transformers
- Transformer Installation
- Transformer Fire Protection
- Air Blast Circuit Breakers
- Bulk Oil & Minimum Oil Circuit Breakers
- SF6 Circuit Breakers
- Vacuum Circuit Breakers
- Circuit Breaker Ratings
- Auto-reclosers
- Switchgear Options
- Outdoor & Indoor MV Switchgear
- MV Switchgear Panel Configurations & Auxiliary Devices
- MV Switchgear Ratings
- LV Molded Case Circuit Breaker (MCCB)
- LV Miniature Circuit Breaker (MCB)

DAY 3

Distribution System Design Considerations

- Load Models
- Typical Characteristics of An Industrial Distribution System
- Distribution System Types and Components
- Electrical Safety & Power Security
- Voltage Classification
- Multiple Voltage Levels in Power Distribution
- Distribution Configurations and Redundancy
- Distribution Expandability
- Distribution System Planning
- Electricity Demand & Future Growth
- Equipment Sizing / Ratings
- HV Power Cables Types & Sizing
- Selection of Appropriate Equipment
- System Studies & Software Packages

- Embedded (in-plant) Generation
- Parallel Operation of Utility with Embedded Generation
- Integrating Embedded Generation with Plant Distribution

DAY 4

Power System Analysis Techniques and Calculations

- Transmission Line Self and Mutual Inductances
- Transmission Line Transposition
- Transmission Line Modeling (*short, medium, long*)
- Transmission Line ABCD Parameters
- Lossless Line
- Complex Power Flow (*single-phase analysis*)
- Complex Power Flow (*3-phase analysis*)
- Bus Admittance Matrix (*Ybus*)
- Bus Impedance Matrix (*Zbus*)
- Power Flow Terms and Equations
- Geometric Mean Distance (GMD)
- Geometric Mean Radius (GMR)
- Swing (slack) Bus, Load (PQ) Bus, Voltage Controlled (PV) Bus
- Network Nodal Analysis
- Iterative Solutions to Linear Equations
- Gauss-Seidel Iterative Solution
- Newton-Raphson Iterative Solution

DAY 5

Power System Protection, Stability, and Switching

- Protection Objectives
- Protection Sensitivity, Stability, and Reliability
- Main & Backup Protection
- Symmetrical & Asymmetrical Faults
- Power System Stability
- Impacts of Electric Faults
- Fuse Protection
- Circuit Breaker Protection
- Relay Protection (*types, functions, construction, technology*)

- Trip Circuit Supervision (TCS)
- Per Unit (PU) System
- Fault Calculations
- Protection Zones & Overlap
- Short Circuit Capacity (SCC)
- Balanced 3-phase Fault
- Unbalanced Single-Phase-to-Ground Fault
- Unbalanced Phase-to-Phase Fault
- Unbalanced Phase-to-Phase-to-Ground Fault
- Fault Indicator
- Overcurrent Protection
- Earth Fault Protection
- Lightning Protection