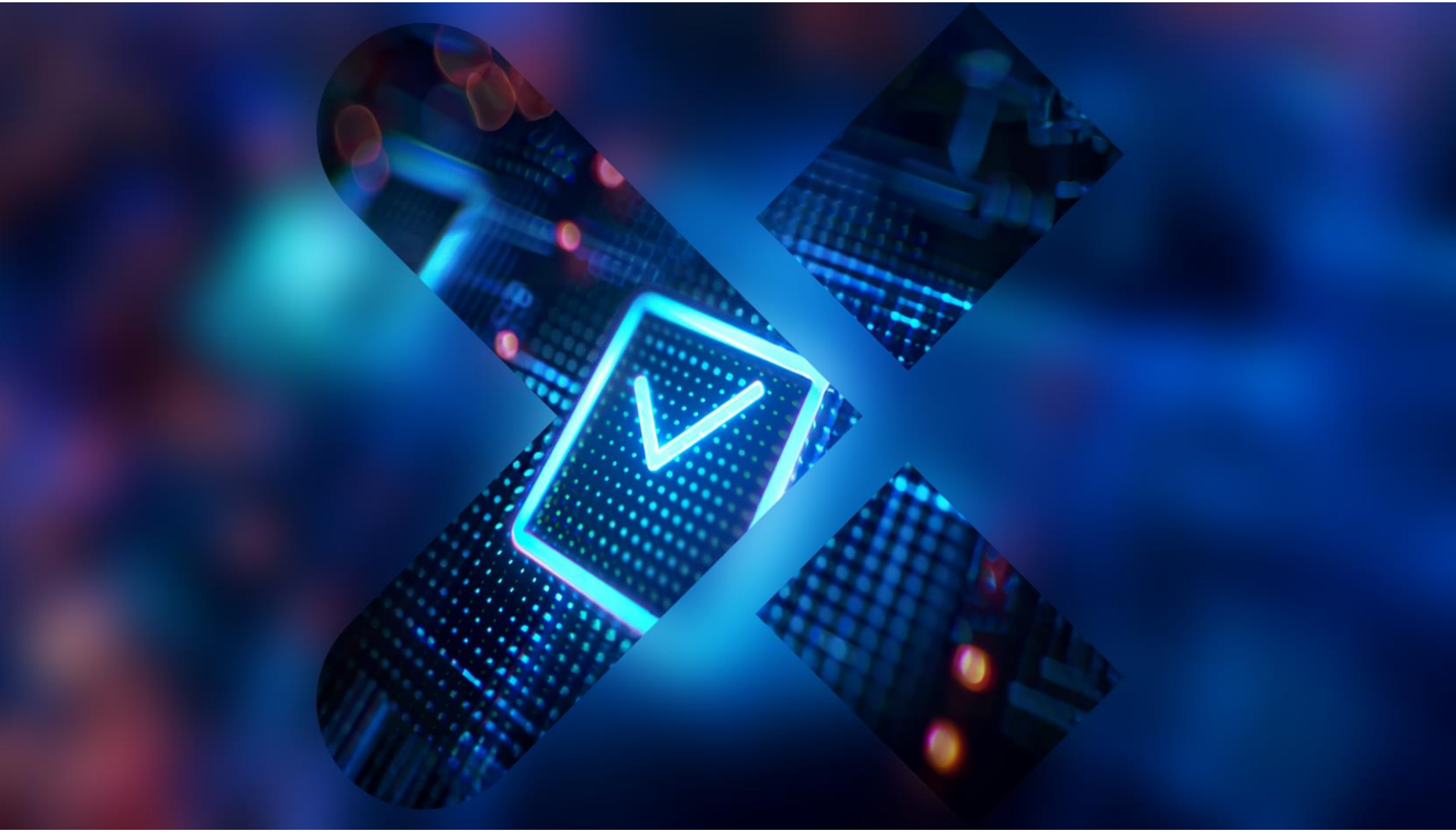

2025

GRID SOFTWARE UNIVERSITY – GSW-U

# Course Catalog

*COURSES OFFERED BY PTI ACADEMY & GSW-U*

Document: GSW-U-PTI-Course-Descriptions

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# Contents

# 1. Power Transmission Course Descriptions

This Course Catalogue has everything for your customer to get started with Power Transmission.

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# 1.1 Fundamentals of Overhead Transmission Line Design (HV-OVHDLN)

**Description**

The Fundamentals of Overhead Transmission Line Design course provides participants with a fundamental understanding of the electrical and mechanical design of AC 69-765 kV transmission lines. Upon completion of this course, participants will understand how transmission lines are designed and how they fit into an integrated power system design.

General Information

| | |
|---|---|
| Course Code | PTEC_500 |
| Delivery Method | Remote, On-Site |
| Duration | 4.5 Days |
| Language | English |
| CEUs | 2.7 |
| PDHs | 27 |

**Target Audience**

The structure of the course is intended for engineers needing an overview of the important aspects and applications of transmission lines.

Roles: Power system engineers

**Prerequisites**

None

**Content**

Explore:

- Overhead line design, including components, ROW, major considerations and constraints
- Typical tasks related to overhead line planning, design and construction
- Considerations in appropriate route selection, environmental licensing and impact mitigation
- NESC loading and strength design criteria
- NERC overhead line related standards
- Conductors including steady-state, transient and dynamic thermal ratings, technical-economical selection, and bundling
- Catenary conditions, variations and calculations
- Electric field characterization, sources, management and mitigation
- Corona effects, including audible noise, radio and TV interference
- Magnetic field sources, formulas, management and mitigation
- Electromagnetic compatibility between OHTL and nearby facilities
- Basic concepts of structures and foundations
- Materials and design specifications of insulators, hardware and accessories
- Voltage stresses (steady state, temporary and transient over voltages)
- Insulation coordination methods, characteristics and requirements
- Overhead line electrical parameters, including line series impedance and line shunt admittance
- Thermal uprating and voltage upgrading, including techniques and economic feasibility analysis.

## 1.2 Overhead Transmission Line Asset Management (HV-OVHDMO)

**Description**

Overhead Transmission Line Asset Management provides participants with a fundamental understanding of the commissioning, maintenance and operations techniques that are a vital part of any overhead transmission line (OHTL) asset management program. Upon completion of this course, participants will better understand the fundamentals of OHTL asset management methods and tools, and be able to apply this knowledge to their asset management procedures.

General Information

| | |
|---|---|
| Course Code | PTEC_550 |
| Delivery Method | Remote, On-Site |
| Duration | 4.5 Days |
| Language | English |
| CEUs | 2.7 |
| PDHs | 27 |

**Target Audience**

Designed for electrical technicians and engineers, this course covers concepts that are of special importance to those working in the field.

Roles: Power system engineers

**Prerequisites**

None

**Content**

Upon completion of this course, participants will better understand the fundamentals of OHTL asset management methods and tools and be able to apply this knowledge to their asset management procedures.

Explore:

- Pre-operation (commissioning) inspections
- Asset management methodology, including performance measurement, data collection, software tools and reliability centered maintenance (RCM)
- Corrosion and corrosion protection
- Asset management of overhead line components, including degradation and failure modes, inspection techniques, condition assessment and maintenance actions
- Maintenance, including preventative, corrective, live-line and new technologies for OHTL
- Options for increasing the utilization of OHTL, such as uprating, upgrading, refurbishment and life extension
- OHTL thermal ratings establishment and monitoring
- Causes of conductor vibration and mitigation options
- Lightning performance improvement on OHTL, including insulation coordination, line surge arresters and grounding systems.

# 2. Power Distribution Course Descriptions

This Course Catalogue has everything for your customer to get started with power distribution.

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## 2.1 Introduction to Power System Studies & Power Circuit Analysis (PE_DISTENG)

**Description**

Introduction to Distribution System and Power Circuit Analysis The Introduction to Distribution Systems and Power Circuit Analysis course provides engineers with a fundamental understanding of the distribution systems and power system analysis. This is a great course for anyone who needs to better understand distribution system components, and the power circuit analysis techniques applicable to the identification of the distribution system limits and performance under normal and emergency conditions.

Upon completion of this course, the participant will have the ability to analyze common power circuit problems and will have a stronger understanding of distribution system problems and equipment applications.

**General Information**

| | |
|---|---|
| Course Code | PDEC_500 |
| Delivery Method | Remote, On-Site |
| Duration | 3 Days |
| Language | English |
| CEUs | 1.8 |
| PDHs | 18 |

**Target Audience**

System operators and planning engineers who are new to the software or require re-familiarization with PSS®ODMS will greatly benefit from this course.
Roles: Power system engineers

**Prerequisites**

A background in electric power systems is not required. It is assumed that participants have college level geometry, trigonometry, matrix algebra, and physics.

**Content**

PDEC 500 course participants will:

- Understand the structure and operation of the electric power system as a whole
- Learn about electric customer classifications based on load categories
- Understand the modeling of electrical loads in power system studies
- Learn to interpret one-line diagrams, identify components depicted, and describe their functions
- Get acquainted with the concepts of active and reactive power and their impact on power system operations
- Understand the most common distribution system configurations, their operation, and design considerations
- Learn to identify power distribution system equipment, such as transformers, voltage regulators and reclosers
- Understand the fundamental concepts of power quality, identify the main causes of power quality issues, and discuss related standards
- Understand how electric utilities measure reliability and explain the use of reliability indices, such as SAIFI, MAIFI, CAIFI, SAIDI and CAIDI
- Understand capacitor applications, placement of capacitor banks, power factor correction with capacitors, and loss reduction due to capacitor application
- Perform calculations including: Ohm's and Kirchoff's laws; loop and nodal analysis; series and parallel circuits; Thevenin and Norton equivalents; star-delta and delta-star conversions; DC and AC circuits; active, reactive and apparent power; power factor; resistive, inductive and capacitive circuits; three-phase power systems; balanced and unbalanced networks; fault calculations; and the per unit system.

## 2.2 Introduction to Distribution Systems

**Description**

This course provides an introduction to the electric power distribution system. Common distribution system configurations, equipment used and operational issues such as power quality and PF control will be discussed.

Upon completion, the students will have an in-depth understanding of the major components and configurations that make up the distribution system.

**General Information**

| | |
|---|---|
| Course Code | PDEC_501 |
| Delivery Method | Remote, On-Site |
| Duration | 3 Days |
| Language | English |
| CEUs | 1.8 |
| PDHs | 18 |

**Target Audience**

System operators and planning engineers who are new to the software or require re-familiarization with PSS®ODMS will greatly benefit from this course.

Roles: Power system engineers

**Prerequisites**

None.

**Content**

The following topics will be covered:

- Theory: distribution system layouts, grounding basics (concepts, grounding methods, grounding-related issues), distribution feeders (loading classes, voltage levels, conductor arrangements), distribution secondary systems (voltages, configurations, three-phase connections)
- Equipment: feeder equipment, conductor and cables, ratings
- Operation: voltage control (voltage regulation, voltage drop), power factor control (shunt capacitors, optimal placement, applications, loss reduction)
- Problems & Consequences: power quality (concept, power quality concerns, standards, solutions, voltage flicker and notching, electrical noise, voltage unbalance)

## 2.3 Understanding System Losses for Utility Management

**Description**

This course provides transmission and distribution planning engineers, rate design engineers from utilities, and regulatory commissioners with methods for effectively modeling, analyzing, allocating and reducing losses.

**General Information**

| | |
|---|---|
| Course Code | PDEC_563 |
| Delivery Method | Remote, On-Site |
| Duration | 3 Days |
| Language | English |
| CEUs | 1.8 |
| PDHs | 18 |

**Target Audience**

Transmission and distribution planning engineers, rate design engineers from utilities, and regulatory commissioners

Roles: Power system engineers

**Prerequisites**

None.

**Content**

Topics include loss evaluation techniques, methods for simplifying the loss calculation, principal causes of losses (transformers and lines) and program requirements to reduce them effectively.

# 2.4 Distribution Transformers - Grounding & Protection

**Description**

To successfully deploy a smarter grid, it is essential to understand the fundamentals of what exists in today's system. The Distribution Transformers, Grounding and Protection course discusses the practical aspects of transformer applications. This course is designed for electric utility engineers and technicians involved in distribution planning, engineering, standards, protection, and operation of the distribution system. It is also valuable to engineers involved in consulting and the design of industrial and commercial power systems.

Upon completion of this course, participants will have a better understanding of the important aspects and contemporary applications of Distribution Transformers, Grounding and Protection.

**General Information**

| | |
|---|---|
| Course Code | PDEC_540 |
| Delivery Method | Remote, On-Site |
| Duration | 3 Days |
| Language | English |
| CEUs | 1.8 |
| PDHs | 18 |

**Target Audience**

Transmission and distribution planning engineers, rate design engineers from utilities, and regulatory commissioners
Roles: Power system engineers

**Prerequisites**

The course requires no specialized background in distribution engineering, but does presume a general understanding of the distribution system.

**Content**

PDEC 540 course participants will gain a better understanding of the power distribution system including:

- A detailed technical look into multiple transformer configurations
- Distribution grounding practices and their applications under both normal and faulted conditions
- Distribution protection and protection system design

# 2.5 Understanding System Losses for Utility Management

**Description**

This course provides transmission and distribution planning engineers, rate design engineers from utilities, and regulatory commissioners with methods for effectively modeling, analyzing, allocating and reducing losses. Topics include loss evaluation techniques, methods for simplifying the loss calculation, principal causes of losses (transformers and lines) and program requirements to reduce them effectively.

**General Information**

| | |
|---|---|
| Course Code | PDEC_563 |
| Delivery Method | Remote, On-Site |
| Duration | 3 Days |
| Language | English |
| CEUs | 1.8 |
| PDHs | 18 |

**Target Audience**

Transmission and distribution planning engineers, rate design engineers from utilities, and regulatory commissioners

Roles: Power system engineers

**Prerequisites**

The course presumes a general understanding of distribution system and cost analysis. It is beneficial to engineers or individuals involved in system planning, line design, equipment specification, electric utilities financial/rate departments, and members of engineering, operations and construction departments.

**Content**

In PDEC 563 Understanding System Losses for Utility Management participants will:

- Understand the nature of electric system losses and how these losses impact power system operation
- Learn how electric losses have a financial impact on consumers, network users and power companies
- Explore the concept of active and reactive power and how they relate to system frequency, voltage and losses
- Recognize the typical data required for loss calculations
- Understand methodology of loss calculations
- Determine losses in transmission, transformer, primary and secondary distribution losses and electric meters

# 2.6 Substation Engineering (PE-SUBENG)

**Description**

The objective of the Substation Engineering course is to provide participants with a basic understanding of the electrical engineering design fundamentals for new substations or for expansions of existing stations. Upon completion of this course, participants will have a fundamental understanding of substation design, which is a must for engineers and technicians working in the power system.

**General Information**

| | |
|---|---|
| Course Code | PDEC_591 |
| Delivery Method | Remote, On-Site |
| Duration | 3 Days |
| Language | English |
| CEUs | 1.8 |
| PDHs | 18 |

**Target Audience**

This course is intended for engineers in the first few years of substation engineering and design, and for managers or seasoned designers who want an overview of the complete substation engineering and design process.
Roles: Power system engineers

**Prerequisites**

None (see Target Audience above)

**Content**

PDEC 591 course participants will:

- Investigate general substation design considerations, including major substation components, system and space requirements, and switching arrangements
- Explore considerations in the design process, including security of supply, operational flexibility, environmental considerations, etc.
- Understand the types of substations, their general layouts, configurations, and applications
- Discuss reactive power fundamentals and their relation to substation design
- Explore grounding methodology, considerations, grid design, studies required, and preliminary engineering
- Discuss bus design, including electrical clearances and bracing
- Review FACTS devices and explore their implementation in the overall power system design
- Understand the effect of lightning on utility systems
- Discuss surge arrester selection in the insulation coordination process
- Understand the general principles of protection schemes, i.e., how protective systems are designed to minimize equipment damage and service disruption resulting from system disturbances
- Recognize inspection and testing requirements for substation equipment and develop appropriate procedures
- Compare the features of gas insulated to air insulated substation installations
- Discuss HVDC substations, equipment, components, and operation.

# 2.7 Distributed Generation & Energy Storage Applications (REN-STORAG)

**Description**

Distributed generation (DG) is becoming a key component of current and future energy strategy in the US and throughout the world. The Distributed Generation and Energy Storage Applications course focuses on DG technologies, the power system impacts of DG, DG interconnection requirements and issues/solutions that must be addressed to integrate DG onto the electric power system.

Upon completion of the course, participants will have a general understanding of DG and energy storage technologies, interconnection issues and methods for identifying problems that may arise and solutions that can be applied.

**General Information**

| | |
|---|---|
| Course Code | PDEC_620 |
| Delivery Method | Remote, On-Site |
| Duration | 2 Days |
| Language | English |
| CEUs | 1.2 |
| PDHs | 12 |

**Target Audience**

This course is recommended for engineers, planners, and managers who wish to understand how to apply the appropriate DG technologies to the power system.
Roles: Power system engineers

**Prerequisites**

No previous experience in DG is required, although a basic understanding of power distribution systems is recommended.

**Content**

The PDEC 620 course covers:

- Key interconnection problems that must be addressed, related to system control, voltage regulation, fault protection, islanding protection, service restoration, and grounding
- Various DG technologies and applications in detail, including internal combustion engine generators, small combustion turbine generators, fuel cells, renewable sources, and dispatch capable energy storage devices
- Comparison of performance aspects of power converters: inverter, synchronous generator and induction generator types
- Power system impacts, including voltage regulation, flicker, power quality, reliability, fault levels, and power losses
- System interconnection and impacts, including protective relaying and controls, grounding and transformer connections, power quality issues, and interconnection standards (such as IEEE 1547).

## 2.8 Low Voltage Networks - Theory and Practical Applications (NET-LV)

**Description**

Most major cities throughout the country have low-voltage network systems in the downtown commercial areas, supplying important loads requiring highly reliable service. Many network systems have been in service for more than 60 years, and the engineers familiar with these have retired. An understanding of the fundamentals of network system design, protection and operation is required by engineers and technicians involved with secondary networks for the first time.

The Low-voltage Networks – Theory and Practical Applications course teaches the design, operation, and protection practices used for both dedicated feeder grid and spot network systems, and for non-dedicated feeder spot network systems.

**General Information**

| | |
|---|---|
| Course Code | PDEC_630 |
| Delivery Method | Remote, On-Site |
| Duration | 3 Days |
| Language | English |
| CEUs | 1.8 |
| PDHs | 18 |

**Target Audience**

Engineers and technicians involved with secondary networks
Roles: Power system engineers

**Prerequisites**

The course participants should have an engineering degree, an electrical technology background or practical experience with low-voltage networks.

**Content**

In PDEC 630, participants will explore:

- Fundamentals of low-voltage network system design and operation
- Basic components of a low-voltage network, including substation and primary feeders, and network unit
- Identification of parameters significantly affecting network voltages
- Minimum loading required for forward power flows
- Power flows during normal conditions and faults
- Cable limiter types, functions and time-current
- Closed transition switching/generation on spot networks and network-relay testing
- 480-volt spot network protection
- Protector relaying and coordination for primary feeder faults
- Primary system grounding schemes.

# 2.9 Distribution Automation for the Smart Grid (SG-DISAUTO)

#### Description

Government and regulatory bodies are pressuring power utilities to improve power supply reliability while maintaining voltage level of the system within limits. Distribution Automation is one of the smart grid applications that can enable reliability improvement while accounting for voltage control. The Distribution Automation course provides participants with a practical understanding of system, equipment, economic and communication aspects of Distribution Automation applications.

#### General Information

| | |
|---|---|
| Course Code | PDEC_655 |
| Delivery Method | Remote, On-Site |
| Duration | 4.5 Days |
| Language | English |
| CEUs | 2.7 |
| PDHs | 27 |

#### Target Audience

Recommended for engineers, planners, and managers who wish to understand how to implement a DA application.
Roles: Power system engineers

#### Prerequisites

No previous experience in Distribution Automation is required, although a basic understanding of power distribution systems is recommended.

#### Content

In PDEC 630, participants will:

- Review the current system including distribution system topologies, equipment, electrical fundamentals, reliability, peak load, losses, and distributed power generation
- Discuss distribution system concerns currently facing utilities, including reliability, power quality, and increasing distributed generation penetration
- Learn the market drivers of the smart grid
- Discuss an overview of smart grid applications, including smart meters, substation automation, distribution automation (DA), distributed generation, and microgrids
- Explore DA applications, including volt/var control and optimization (CVR, IVVC), intelligent line switching (FDIR, ONR), and transformer monitoring and diagnostics
- Review distribution system equipment in use today and discover the next generation of smart equipment
- Discuss IT enterprise management systems (SCADA, DMS, MDMS, EAM), evolution in IT architecture, development of standards and the importance of cyber security
- Understand DA communication basics (data paths, packet switching, protocols, etc.), DA architecture, and communication mediums
- Explore DA economics, including utility economics, and financial incentives for smart grid deployment.

# 2.10 Microgrids: Understanding design, Operation, and Implementation

**Description**

This course provides a comprehensive exploration of microgrids, covering their key concepts, operations, and unique features compared to traditional and digital grids.

By the end of the course, learners will have a solid foundation in microgrid fundamentals, enabling them to understand their operation, advantages, challenges, and broader context. Whether an energy professional, policymaker, or interested in sustainable energy systems, this course equips learners with the necessary knowledge to navigate the world of microgrids effectively.

**General Information**

| | |
|---|---|
| Course Code | PDEC_850 |
| Delivery Method | Remote, On-Site |
| Duration | ½ Days |
| Language | English |
| CEUs | 0.4 |
| PDHs | 4 |

**Target Audience**

Energy professional, policymaker, or interested in sustainable energy systems
Roles: Power system engineers

**Prerequisites**

No previous experience in Distribution Automation is required, although a basic understanding of power distribution systems is recommended.

**Content**

The course begins by defining microgrids and examining their components, structure, and architecture. It then analyzes the pros and cons of microgrids from various perspectives, including energy efficiency, reliability, resilience, and control. The operational considerations of microgrids, such as energy generation, storage, distribution, renewable energy sources, and control systems, are discussed. The integration of microgrids with the larger power grid and the regulatory and financial considerations associated with microgrids are also addressed.

# 3. Power Engineering

This Course Catalogue has everything for your customer to get started with power engineering.

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# 3.1 Power Management for Power System Engineers

**Description**

Project teams face challenges such as aggressive deadlines, scope creep, communication breakdowns and financial constraints. It takes solid project management skills and knowledge to successfully manage these challenges and achieve project success.

This course discusses and examines tools used in the project management process for scheduling and controlling the types of projects a power system engineer would encounter.

**General Information**

| | |
|---|---|
| Course Code | PSEC_515 |
| Delivery Method | Remote, On-Site |
| Duration | 2 Days |
| Language | English |
| CEUs | 1.2 |
| PDHs | 12 |

**Target Audience**

Project teams

Roles: Power system engineers

**Prerequisites**

None

**Content**

This course discusses and examines tools used in the project management process for scheduling and controlling the types of projects a power system engineer would encounter.

# 3.2 Power System Studies for Transmission Scale Renewable Generation and Energy Storage

**Description**

The primary objective of this course is to provide an overview of the technical challenges and benefits of integrating large amounts of renewable generation (wind and solar) and energy storage into the transmission system, along with the power system studies that need to be conducted.

Upon completion of this course, participants will have a deep understanding of the latest renewable generation and energy storage technologies, their capabilities and limitations and methods to assess their impacts on the transmission system.

**General Information**

| | |
|---|---|
| Course Code | PSEC_535 |
| Delivery Method | Remote, On-Site |
| Duration | 3.5 Days |
| Language | English |
| CEUs | 2.0 |
| PDHs | 20 |

**Target Audience**

Project teams

Roles: Power system engineers

**Prerequisites**

The course requires no specialized background in power system engineering, but does presume a general understanding of the power and transmission systems.

**Content**

PSEC 535 course participants will:

- Understand the technical considerations for integrating large amounts of renewable generation into the transmission system
- Learn about renewable generation and energy storage technologies and their technical capabilities
- Understand interconnection requirements
- Learn about ride through capabilities and reactive power control
- Study ramp rate limitations of renewable generation and the benefits of combining with energy storage to provide dispatchable power
- Learn how modern controllers can provide load following and ancillary services for frequency and voltage control
- Review simulations and modeling of steady state, dynamic studies, including disturbance selection
- Study stability results and discuss remedies
- Understand market and operational impacts of renewable generation and energy storage integration

# 3.3 Power System Dynamics Introduction - Theory

**Description**

Understand the dynamic models of power system components and the classical control techniques to determine system transient and small signal stability. The Power System Dynamics – Introduction course explores both theory and practice for modeling major power system components, such as synchronous machines, excitation systems, governors and loads, and provides examples using PSS®E.

Upon completion of this course, participants will have an understanding of dynamic effects encountered in operation of the power system and expansion planning analysis.

**General Information**

| | |
|---|---|
| Course Code | PSEC_600 |
| Delivery Method | Remote, On-Site |
| Duration | 4.5 Days |
| Language | English |
| CEUs | 2.7 |
| PDHs | 27 |

**Target Audience**

Electricity distribution and industry engineers

Roles: Power system engineers

**Prerequisites**

Participants should have a degree in electrical engineering and be familiar with load flow and stability topics.

**Content**

Topics covered in PSEC 600 include:

- Modeling synchronous machines for stability studies
- Understanding the synchronous machine model development procedure
- Modeling DC, AC and static excitation systems
- Examining the characteristics of prime movers and developing models that can be used in power system studies
- Exploring the characteristics of load models such as constant power (MVA) load, polynomial load, exponential load, etc.
- Modeling of induction motors
- Studying the transient behavior of synchronous machines due to electrical and mechanical phenomena
- Exploring the factors affecting small signal stability
- Understanding the design, structure and use of power system stabilizers (PSS)

# 3.4 Power System Scheduling and Operation

**Description**

This course introduces the topics of economic dispatch and generation scheduling. A logical sequence of generation scheduling problems is examined, and new solution techniques discussed. Power generation characteristics, economic dispatch and methods of solution, transmission losses, unit commitment, scheduling of limited energy resources, hydro-thermal coordination, current interchange practices in U.S. utilities and pools, and techniques for analyzing power system security are addressed.

**General Information**

| | |
|---|---|
| Course Code | PSEC_635 |
| Delivery Method | Remote, On-Site |
| Duration | 3 Days |
| Language | English |
| CEUs | 1.8 |
| PDHs | 18 |

**Target Audience**

Electricity distribution and industry engineers

Roles: Power system engineers

**Prerequisites**

The course requires no specialized background in power system engineering, but does presume a general understanding of the power and transmission systems.

**Content**

Topics covered in PSEC 635 include:

- Characteristics of generating units
- Economic dispatch
- Unit commitment of thermal units
- Market operations and scheduling
- Distributed System Platform (DSP)
- Interconnections and interface flows
- FERC & NERC requirements i.e. FERC order 1000
- Power system security (N-1, N-2 & N-1-1)
- Power system generation control
- Power system state estimation
- Planning vs operation

# 3.5 Protective Relaying Fundamentals

**Description**

Protective devices serve to increase system performance and play a crucial role in minimizing equipment damage and customer outages that can result from short circuits and other abnormal power system operating conditions. Protective relays and other protective devices are vital in maintaining reliability in today's electric power systems.

Protective Relaying - Fundamentals is designed for engineers interested in deepening their practical understanding of the protective devices and systems commonly used in generation, transmission, sub-transmission and distribution systems.

Upon completion of this course, engineers working in all areas of power system planning, operations, testing and construction will be able to relate the operation of the protective system to their particular area of responsibility.

**General Information**

| | |
|---|---|
| Course Code | PSEC_640 |
| Delivery Method | Remote, On-Site |
| Duration | 3 Days |
| Language | English |
| CEUs | 1.8 |
| PDHs | 18 |

**Target Audience**

Electricity distribution and industry engineers

Roles: Power system engineers

**Prerequisites**

Participants should understand the fundamentals of power system engineering and basic mathematical skills, such as trigonometry, complex numbers, matrix algebra and applied calculus.

**Content**

Topics covered in PSEC 640 include:

- Characteristics of a protection system and general principals of protection schemes
- Objectives of selecting and applying a protective relaying scheme
- Equipment damage as a result of system disturbances
- Relay input sources (CTs and PTs)
- Principles of protection (timeovercurrent, differential and distance)
- Elements of distribution system protection, including relays, reclosers, fuses and sectionalizers
- Elements of transmission line protection, including overcurrent and distance relays
- Advantages and disadvantages of bus protection methods
- Components of optimal transformer protection
- Multiple aspects of generator protection
- Out-of-step relaying for a generator and transmission system
- Inputs for a coordination study

# 3.6 Economic Transmission Planning

**Description**

Today's transmission system is challenged with renewable energy integration, competing interests of investors, consumers and environmental advocates, and the increasing role information technology plays in the delivery of electric energy. The growth in behind-the-meter solutions from demand response to on-site generation, and the emergence of alternative networks, such as microgrids, means that the transmission system's reliability function has become more complex, and the economic evaluation of competing projects, less straightforward.

The primary objective of this course is to teach fundamental and advanced economic concepts as an integral component of transmission planning and project evaluation. The objective is to instill in transmission planners the economic and transmission concepts that will allow for best in class project planning and analysis.

Upon completion of this course, participants will be able to apply these concepts for short, intermediate and long-term planning studies and to judge the relative merits of competing transmission projects.

**General Information**

| | |
|---|---|
| Course Code | PSEC_720 |
| Delivery Method | Remote, On-Site |
| Duration | 2 Days |
| Language | English |
| CEUs | 1.2 |
| PDHs | 12 |

**Target Audience**

Electricity distribution and industry engineers
Roles: Power system engineers

**Prerequisites**

The course requires no specialized background in power system engineering, but does presume a general understanding of transmission systems and basic economics.

**Content**

Topics covered in PSEC 720 include:

- Understand the fundamentals of economic transmission planning such as project capital costs and their time value, costs-benefits based on production cost, and how to measure the societal costs and benefits
- Learn how revenue requirements is used as a calculation method to compare different transmission alternatives on an equivalent base (first year present value)
- Understand energy market concepts including: scarcity, surplus, supply demand curve, day-ahead market, real-time market, firm transmission rights, reliability vs. economics
- Learn about production cost modeling (software agnostic) including the input data requirements such as generator and transmission data and outputs such as production costs, emissions and market prices
- Review comparative approaches and best practices
- Understand societal costs-benefits and metrics
- Learn about economic criteria required to evaluate transmission projects i.e. comparative system costs with and without project and thresholds as defined by specific regions
- Learn how to identify opportunities to build market efficiency projects i.e. evaluating multiple projects vs a single project to the same end
- Understand how to account for uncertainties such as: reserves, regulation, spinning and non-spinning, black start, transmission out-ages, generation and load forecasts, generation volatility, fuel cost volatility and emissions

# 3.7 Advanced Transmission Analysis and Planning Study Techniques

**Description**

Just as transient stability studies shook up the transmission planning industry back in the 1920s and 30s, new requirements to ensure safe and reliable system operation are now increasing the number and variety of studies being performed.

In this course participants will gain practical knowledge in performing advanced studies such as: black start, NERC compliance (CIP-014 and PRC-006), sub-synchronous resonance, and voltage stability.

Through completion of this course, participants will gain a thorough understanding of requirements for these advanced studies, as well as basic knowledge in performing these studies utilizing PSS®E.

**General Information**

| | |
|---|---|
| Course Code | PSEC_740 |
| Delivery Method | Remote, On-Site |
| Duration | 2.5 Days |
| Language | English |
| CEUs | 1.5 |
| PDHs | 15 |

**Target Audience**

Electricity distribution and industry engineers

Roles: Power system engineers

**Prerequisites**

Participants should understand the fundamentals of power system engineering and basic mathematical skills, such as trigonometry, complex numbers, matrix algebra and applied calculus.

**Content**

In this course participants will gain practical knowledge in performing advanced studies such as: black start, NERC compliance (CIP-014 and PRC-006), sub-synchronous resonance, and voltage stability.

# 3.8 Advanced Distribution Analysis and Planning Study Techniques

**Description**

Only a few years ago performing simple peak load and minimum load steady state studies, along with simple protection studies were sufficient to plan the distribution system. However, with new technologies integrating into the distribution system such as distributed generation, energy storage, distribution automation etc., increasingly complex studies are required.

In this course students will learn from our expert instructors who perform these complex studies on a daily basis. Upon completion of this course, participants will be armed with the knowledge to perform these studies and better positioned to cope with an ever increasingly complex distribution system.

**General Information**

| | |
|---|---|
| Course Code | PSEC_750 |
| Delivery Method | Remote, On-Site |
| Duration | 2.5 Days |
| Language | English |
| CEUs | 1.5 |
| PDHs | 15 |

**Target Audience**

Electricity distribution and industry engineers

Roles: Power system engineers

**Prerequisites**

Participants should understand the fundamentals of power system engineering and basic mathematical skills, such as trigonometry, complex numbers, matrix algebra and applied calculus.

**Content**

In this course students will learn from our expert instructors who perform these complex studies on a daily basis. Upon completion of this course, participants will be armed with the knowledge to perform these studies and better positioned to cope with an ever increasingly complex distribution system.

## 3.9 Advanced Distribution Analysis and Planning Study Techniques

**Description**

Only a few years ago performing simple peak load and minimum load steady state studies, along with simple protection studies were sufficient to plan the distribution system. However, with new technologies integrating into the distribution system such as distributed generation, energy storage, distribution automation etc., increasingly complex studies are required.

In this course students will learn from our expert instructors who perform these complex studies on a daily basis. Upon completion of this course, participants will be armed with the knowledge to perform these studies and better positioned to cope with an ever increasingly complex distribution system.

**General Information**

| | |
|---|---|
| Course Code | PSEC_750 |
| Delivery Method | Remote, On-Site |
| Duration | 2.5 Days |
| Language | English |
| CEUs | 1.5 |
| PDHs | 15 |

**Target Audience**

Electricity distribution and industry engineers

Roles: Power system engineers

**Prerequisites**

Participants should understand the fundamentals of power system engineering and basic mathematical skills, such as trigonometry, complex numbers, matrix algebra and applied calculus.

**Content**

In this course students will learn from our expert instructors who perform these complex studies on a daily basis. Upon completion of this course, participants will be armed with the knowledge to perform these studies and better positioned to cope with an ever increasingly complex distribution system.

## 3.10 Emerging Technologies in Renewable Energy

**Description**

As US energy markets enter into an era of "Clean Energy Transition", renewable energy will play a significant role in the realization of this outcome. This course examines the development of existing and emerging renewable technologies, providing an overview of each and an in-depth discussion of the key technologies that are driving this transition.

**General Information**

| | |
|---|---|
| Course Code | EBA_500 |
| Delivery Method | Remote, On-Site |
| Duration | 4 Days |
| Language | English |
| CEUs | 1.6 |
| PDHs | 16 |

**Target Audience**

Electricity distribution and industry engineers

Roles: Power system engineers

**Prerequisites**

None.

**Content**

Topics covered in EBA_500 include:

- Overview and History of Renewable Energy in the US and Globally
- Focus Topics: Wind, Solar, Storage (battery and Natural Gas} Electric Vehicles
- The e-mobility revolution and its impact today and in the future on utility systems
- Off-shore wind generation and its impact

## 3.11 Transmission Scale Renewable Generation

**Description**

Understanding the role of renewable energy in the power supply portfolio is critical when developing a reliable and feasible power system, which meets Renewable Portfolio Standards and reduces the utility's carbon footprint. Utility executives need an appreciation of the planning and operational impacts of integrating renewable generation into the transmission system and an understanding of renewable energy policies to sustain and grow this largely unharnessed energy source.

Upon completion of this course, participants will have a deep understanding of the latest renewable generation and energy storage technologies, their capabilities and limitations and methods to assess their impacts on the transmission system.

**General Information**

| | |
|---|---|
| Course Code | EBA_600 |
| Delivery Method | Remote, On-Site |
| Duration | 3 Days |
| Language | English |
| CEUs | 1.2 |
| PDHs | 12 |

**Target Audience**

Electricity distribution and industry engineers

Roles: Power system engineers

**Prerequisites**

None.

**Content**

The primary objective of this course is to provide an overview of the technical challenges and benefits of integrating large amounts of renewable generation (wind and solar) and energy storage into the transmission system, along with the power system studies that need to be conducted.

# 4. Power Technology Certification Program

**Program Details**

**Overview**

The Power Technology Certificate Program is a comprehensive program of study focusing on topics related to power systems and transmission planning, design, and operation. Through a series of courses, this program introduces transmission design concepts, power flow, insulation coordination, economic considerations, reliability, dynamics and system stability, generation dynamics, and power system scheduling and operations for today's power system network.

**Goals and Objectives**

The program is aimed at enhancing decision-making skills and developing problem-solving skills of the participants. Upon completion of this program, participants will demonstrate a deeper knowledge of power system transmission and distribution technology, enabling them to become significant contributors in planning, design, and operation departments. Specific learning objectives include improving participants' fundamental knowledge of electrical engineering theory, equipment applications, and considerations for system and equipment reliability.

**Audience**

The courses offered in this program are derived from content and materials presented at Siemens PTI Academy Transmission and Distribution – North America (Siemens PTI Academy). Designed for engineers and delivered at the graduate level, the courses have been tailored to incorporate concepts specific to your company's systems and operations. It is recommended that the students enrolling in this program have previous knowledge of transmission system design, planning, and operation, or possess an engineering degree to be able to successfully complete this program.

**Program Management**

Siemens PTI Academy will assign staff to work directly with your company's Subject Matter Experts (SMEs) and program participants to facilitate the delivery of the program. Program management services are designed to enhance the participants' learning experience, to foster learning, and to ensure quality and consistency throughout the program. These services include coordinating course schedules, delivering content, managing instructors, overseeing program materials, coordinating with SMEs, tracking and reporting on participants' attendance, giving assignments and quizzes, keeping a track of your records, and maintaining the Siemens Learning Management System (LMS) allowing program participants' to access learning materials and assignment submissions.

**Program Structure**

The Power Technology Certificate Program spans twenty-two months. Each course is delivered in a series of weekly sessions following the approved program schedule. The program consists of nineteen (19) courses, making in total sixty-four (64) sessions in total.

Participants who successfully complete all courses in the program will be considered for certification. Additionally, participants may be eligible for continuing education units or partial credit transfer based on their participation or successful completion of individual courses. Participants who have previously completed parts of the program may rejoin and complete the program later; however, they must finish all incomplete coursework, including newly added course material, to earn certification.

**Instructors**

All courses provided through Siemens PTI Academy are taught by Siemens PTI consultants and industry experts with vast experience in engineering. Our instructors are well known for their contributions in their respective engineering disciplines and hold stature in related IEEE committees. In addition to their technical expertise, our instructors have a proven track record of successful transfer of knowledge and concepts to their students.

**Subject Matter Experts (SME)**

As part of this comprehensive program, instructors welcome and encourage the participation of your company's Subject Matter Experts (SMEs). Siemens PTI Academy will coordinate with each assigned SME to review relevant materials and facilitate presentations to participants for each course. SMEs will provide technical or practical applications of the material tailored to your company's systems, practices, or policies. For each SME participating in the Power Technology Certificate Program, Siemens PTI Academy will document and confirm professional development hours (PDHs). SMEs may use this documentation to apply for or maintain their professional licensures or certifications.

**Program Schedule and Logistics**

The Power Technology Certificate Program consists of a series of courses delivered in weekly half-day sessions, accompanied by assignments. Students will take quizzes at the end of each course or when a specific course is finished. Participants will receive a program schedule detailing course dates, locations, room assignments, and session times at the beginning of the program. The schedule will also indicate holidays and dates when classes will not be held. An instructional break is traditionally scheduled for July and August, during which no classes will be held unless there is a specific request. Classes will not be scheduled during breaks or holidays unless necessary. In the event of emergency, such as storm aftermaths, Siemens PTI Academy will collaborate with your company to adjust the schedule as effectively as possible. For the 2024-2026 Power Technology Certificate Program, classes will be conducted Online on Wednesdays. Each session will last four (4) hours, from 1:00 pm to 5:30pm, including a 30-minute break.

**Documentation**

Electronic course notes will be available at the Siemens Learning Management System (LMS). Participants can download copies of the electronic course notes from their student accounts on the LMS and annotate the PDFs during course sessions. Additionally, video recordings of all sessions will be available to students on the LMS. Siemens PTI Academy will also provide participants with the latest electronic edition of the 'Siemens Power System Engineering Guide.'

**Reference Material**

The following book will be incorporated into the training as reference material, 'Standard Handbook for Electrical Engineers, Seventeenth Edition' by Surya Santoso and H. Wayne Beaty.

**Records Management**

Siemens PTI Academy will provide your company’s management team with a report on participants' attendance, assignment completion, progress, and exam results at the conclusion of each course and at the end of the program. Siemens PTI Academy will maintain electronic records on our secure LMS. In addition to facilitating assessment management and providing participants access to documentation, this system will enable timely reporting of relevant information to your program managers, individual participants, or authorized parties such as colleges.

**Participant Assessment**

An assessment of a participants' progress will be based on the completion of homework assignments and quiz grades. Assessments are integral to the learning process as they provide participants with feedback, foster learning, and serve as a mechanism for evaluating knowledge transfer. Students should allocate time outside of the classroom to study course materials, complete assignments, and take quizzes. Instructions for homework assignments and quizzes will be communicated by the instructor and posted on the Siemens LMS. All completed assignments and quizzes must be accessed and submitted via the LMS by the assigned due date unless otherwise specified. Assignments will be collected and reviewed for completeness and accuracy. Quizzes, graded numerically, are given either at the conclusion of a course or when a specific topic is finished.

**Siemens Certification**

Participants who successfully complete the program will receive the Certificate in Power Technology from Siemens Power Academy. Successful completion is determined through ongoing evaluation of attendance, assignment completion, and quiz results. A minimum of 80% attendance is required, and participants must achieve a cumulative score of 80% or higher in all courses to qualify for the Certificate in Power Technology, associated CEU hours, and eligibility to submit a transcript for credit transfer to colleges.

**Continuing Education Units**

Courses offered by Siemens PTI Academy are eligible for Continuing Education Units (CEUs) and Professional Development Hours (PDHs). Upon request, Siemens PTI Academy will provide documentation indicating the number of CEUs or PDHs awarded based on instructional hours completed.

**Professional Licensed Engineers**

A Continuing Education Unit (CEU) is a nationally recognized unit for recording participation in professional development and noncredit educational programs, typically representing 10 hours of participation. Professional Development Hours (PDHs) are used by Professional Licensed Engineers (PEs) to meet licensure requirements, with one PDH earned per hour of instruction. Participants are responsible for maintaining records of courses taken to support licensure.

**Graduate-Level Transfer Credit**

In collaboration with select colleges, the Power Technology Certificate Program offers nine (9) graduate-level credits towards a Master of Science in Electrical Engineering. Siemens PTI Academy will prepare and submit an official transcript to the college upon request from either the college or the participant. Successful transfer of credits requires meeting program requirements for attendance and achieving a cumulative grade of 80% (B) or better. Credit transfer eligibility is determined by the institution granting the degree.

## 4.1 Course 1 – Overview of Power Systems (Generation, Transmission and Distribution)

Session 1 (4 hrs.) – The course will introduce the power system to the students at a high level, establishing a solid foundation for the more detailed topics that come later in the program.
The following topics will be covered:

- Introduction of the power systems
- Voltage levels
- System operation overview
- Equipment overview: generators, transformers, switchgear, OH lines, underground cables, substations

## 4.2 Course 2 – Power Systems Analysis

Sessions 2-3 (8 hrs.) – This course reviews the fundamental methods used in the steady-state analysis of AC circuits as applied to power system networks. Upon completion, the students will be equipped with the mathematical tools necessary to comprehend more complex subjects that will follow.
The following topics will be covered:

- Basic math used in power system analysis
- Voltage, current, impedance, power
- AC Circuits, RMS values, complex power
- Three-phase systems, per unit system, one-line diagrams, power flow

## 4.3 Course 3 – Power Flow Analysis

Sessions 4-7 (16 hrs.) – This course covers steady-state power flow analysis methods beginning with the steady-state power angle relationship on transmission lines and continuing with methods of solution of load flow problems in large networks. The course also includes applications of multi-winding single- and three-phase transformers, as well as phase angle regulators in the steady-state analysis of power systems. Upon completion, students will understand how to analyze the power system and how the simulation tools are used in the industry.
The following topics will be covered:

- Power system networks
- Generator and load models
- Transformer models
- Line models
- Power flow solution methods (overview)
- Power flow applications
- Transfer limit analysis

Distribution to Bulk Generation

## 4.4 Course 4 – Introduction to Distribution Systems

Sessions 8-10 (12 hrs.) – This course provides an introduction to the electric power distribution system, covering planning, design considerations, operations and maintenance (O&M), and common problems. Upon completion, students will gain a deeper understanding of the system that complements the transmission system.
The following topics will be covered:

- Theory: system configurations (Public Service Enterprise Group),power quality, voltage regulation, loading classes, voltage levels, conductor arrangements, grounding, secondary systems, protection distributed resources
- Equipment: transformers, isolation devices, overhead lines, underground cables, voltage control devices, protection devices, grounding equipment (impedance, zigzag), pertinent standards, network equipment and distributed generation
- Operation & Maintenance: preventative maintenance, corrective maintenance, network operation, SCADA/ DMS monitoring and control, distribution automation
- Problems & Consequences: contingencies, common modes of failure (using your company examples), system restoration, storm hardening

## 4.5 Course 5 – Substations

Sessions 11-15 (20 hrs.) – This course provides a general understanding of transmission cable systems, focusing on practical aspects related to design, installation, and maintenance. Additionally, common problems and failures are discussed. In this course, students will gain knowledge that can be directly applied in their roles and day-to-day tasks in the company.
The following topics will be covered:

- Theory: Transformers, FACTS, voltage control devices, protective relaying, isolation, grounding, configurations (ring bus, breaker-and-a-half)
- Equipment: Design requirements, ratings, and calculations (your company’s schematics and diagrams), AIS, GIS, transformers, switchgear, reactive power devices, FAT (your company test data), protection relays, communications (networks and mediums), ancillary system (battery backup), pertinent standards
- Operation & Maintenance: Asset management, corrective and preventative maintenance, commissioning, reenergization and periodic (trending) testing (your company data), interlocking, transformer testing, SF6 gas handling, SCADA, monitoring and control, pertinent standards and MAXIMO along with other tools used to maximize maintenance efficiency and reduce costs
- Problems & Consequences: Contingencies, reliability indices and calculations, common modes of failure (using your company’s examples), system restoration, storm hardening and impact on the distribution system.

## 4.6 Course 6 – Electrical Maintenance and Safety *NEW

Sessions 16 -17 (8 hrs.) – The Electrical Safety course is designed to provide an understanding of electrical systems and the theory behind equipment and systems. This training will enhance your company's students' comprehension of electrical areas related to operating transmission and distribution substation equipment. The training integrates a combination of classroom instruction and practical applications. The goal of the electrical maintenance and safety course is to provide an understanding of how to work safely in de-energized electrical systems.

The following topics will be covered:

- Generator and Motor Fundamentals
  - DC motor theory
  - AC motor theory
  - How electrical fundamentals affect generator construction
  - Generator output and system interactions
- Electrical Systems Fundamentals
  - Battery
  - Transformer
  - Circuit protection
- Electrical Safety
  - Hazards/Boundaries
  - PPE (including the classification of gloves)
  - Qualified vs non-qualified
  - LOTO
  - Grounding
- Electrical Maintenance
  - Transformers
  - Switchboards/Switchgear
  - Generator Breaker
  - Circuit Breakers
  - Motors
  - Motor Controllers
  - Battery
  - Auxiliary System

## 4.7 Course 7 – Transmission Lines

Sessions 18-22 (20 hrs.) – This course offers a comprehensive study of the electrical theory and practical operation of overhead transmission lines. It covers the fundamental physics of electric and magnetic fields, exploring their connection to the calculation of line equivalent electrical parameters and models. The course also delves into transmission line design, equipment, maintenance, monitoring, and typical failures in detail.

The following topics will be addressed:

- Theory: Transmission line impedance and admittance, transmission line modeling and power flow, line design overview, conductors, line thermal rating, electric and magnetic field, Corona effect.
- Equipment: Line surge arresters, insulators, tower configurations, grounding, pertinent standards.
- Operation & Maintenance: Corrective and preventative maintenance, loading and dynamic ratings, audible noise, radio and TV interference, environmental and health effects of electric and magnetic fields, management, pertinent standards.
- Problems & Consequences: Weather impacts, effects of overloading, common modes of failure (using your company examples), dielectric integrity, system restoration, storm hardening.

## 4.8 Course 8 – Underground Cables

Sessions 23-27 (20 hrs.) – This course is aimed at imparting a general understanding of transmission cable systems, emphasizing practical aspects such as design, installation, and maintenance. It will also address common problems and failures. This course is essential for students, as it equips them with vital knowledge directly applicable to their daily roles within the company.

The following topics will be addressed:

- Theory: Transmission cable systems, an overview of design considerations and calculations, determining rating requirements and ampacity, soil and backfill criteria, circuit uprating, installation design and field considerations, magnetic fields
- Equipment: Cable system materials and components, basics of cable installation, NESC standards, ampacity, pipe-type cables, GIL, cable type selection
- Operation & Maintenance: Common operation and maintenance practices, loading, cooling systems (i.e., pressurizing and PFT leak detection) and pertinent standards
- Problems & Consequences: Corrosion effects, common modes of failure (using your company examples), dielectric integrity (cable breakdown), system restoration, storm hardening.

## 4.9 Course 9 – Substation Site Visit

Session 28 (4 hrs.) – This course will involve a site visit to a your selected company substation and coordinated by the relevant SME of your company. Students will come to the substation and participate in a guided tour following your company's safety practices and under your company's insurance policies.
The substation visit will cover the following highlights:

- View equipment discussed in courses 1-7 i.e. transformers, switchgear, secondary equipment, under ground cable joints, overhead line gantries/droppers and terminations, outgoing feeders.
- Your company schematics and substation drawings will be provided to the students and used by the instructor to showcase equipment and to provide an overview of the substation.
- Siemens bears no responsibility to your company's employees. The Siemens instructor will abide by your company's safety policy

## 4.10 Course 10 – Electromagnetic Transients & Insulation Coordination

Sessions 29-36 (32 hrs.) – Courses 2 and 3 focus on steady state analysis, while this course delves into transient analysis, exploring the time responses from first and second-order circuits. Alongside theory, the course addresses the effects of electromagnetic transients on power system equipment, emphasizing operational and maintenance strategies for mitigation and restoration.
The following topics will be addressed:

- Theory: Time functions and transients, Sine and Cosine transients, traveling waves, EMTP traveling wave results, lightning surges, transients in lumped parameter circuits fundamentals of traveling waves (single phase, multi-phase traveling waves), lightning surges on transmission lines, impulse overvoltage's (terminals)
- Equipment: Modern insulation coordination, voltage stresses, steady state and transient capacitor switching, ferro resonance-induced failures in high voltage transformers by air break switch operations, power circuit interruption devices, circuit breaker recover voltage calculation method and breaker transient recovery voltages, self-restoring insulation, evolution of high voltage insulators, standards and requirements, effects of excitation on surge stresses, factors affecting transformer insulation strength, impulse tests on normal frequency excited transformers (history, physics, decline and fall), memo on impulse behavior of transformer windings, and dielectric tests and standards for transformers, Power circuit interruption devices, high-voltage switchgear for substations, line clearances, overhead power lines, surge arresters, transmission line arresters, protection of distribution equipment and secondary systems
- Operation & Maintenance: A review of your company's operating procedures and test reports will be carried out
- Problems & Consequences: Transient recovery voltage failures of two 15 kV indoor oil-less circuit breakers and impacts. Probabilistic methods, tests and division of risks by governor action, action of AGC to accomplish frequency.

## 4.11 Course 11 – Electrical Machine Dynamics, System Stability and Control

Session 37-44 (32 hrs.) –This course introduces the concept of stability, focusing on the electrical behavior of synchronous and induction machines and their associated controllers. It includes discussions and demonstrations of simulations and modeling using PSS®E. The course explains the operation of power systems to ensure stability, covering available tools and techniques. Additionally, it reviews the consequences and solutions when power systems become unstable, presenting historical events that led to instability for analysis and discussion.

The following topics will be addressed:

- Theory: Concept of stability, steady-state, dynamic and transient forms of instability
- Equipment & Modeling: Synchronous and induction machine basics, stability-excitation systems, power system stabilizers, series capacitors, static VAR controls, braking resistors and high-speed reclosing, machine models, block diagrams, physical analogies
- Operation: Dynamic performance of interconnected synchronous machines and control areas, frequency control-line control and economic dispatch, role of AGC, governor characteristics, load frequency control, operator action, voltage regulator characteristics and re-synchronization
- Problems & Consequences: Response of interconnected systems to major disturbances, case history which describes power plant response

Power System Operation & Finances

## 4.12 Course 12 – Cyber Security *NEW

Session 45 (4 h) – Power grids are essential infrastructures that are continually increasing in complexity with the development of new technologies. Millions of new intelligent, connected electronic devices are integrated into the system each year, making the grid vulnerable to cyberattacks. This course introduces cybersecurity concepts, covering fundamentals from security risks for distributed energy systems to cybersecurity industry standards.
The following topics will be addressed:

- Cyber Security Overview/Concepts
- Cyber Security Regulations & Standards
  - Security Risks
  - Hardening Operating System Platforms
  - Securing the System Logs
  - Disabling and Restricting Services
  - Validate OS installation
- Hardening Relational Databases (i.e., Oracle)
  - Username/Password Management
- User Access Control
  - Special User Accounts
  - OS User Access Features
- Network Security
  - Network Applications (ssh, ftp, rsh ...)
  - Server Network Connections (middleware security)
  - SCADA Network Connections
  - Network-based and Host-based Firewalls
- User Interface Access Controls
  - Role-Based Access Controls
- Security Patch Management

## 4.13 Course 13 – Introduction to Microgrids *NEW

Sessions 46-47 (8 hrs.) – Microgrids are essentially scaled down versions of the traditional centralized electric grid. Similar to the bulk power grid, microgrids generate, distribute, and regulate energy to their loads. Microgrids uniquely have the capability to operate either connected to the main grid or independently as islanded systems. The increasing global interest in microgrids stems from their potential to enhance grid reliability. This course emphasizes the need for greater resilience, leveraging the significant cost reduction of renewable resources and battery energy storage. It offers students a robust opportunity to redesign their power systems, thereby creating a more resilient grid.
The following topics will be addressed:

- What are microgrids
  - Types of microgrids – behind the meter, front of the meter, islands etc.
- Why microgrids
- How a microgrid is different than main grid
- How microgrids are operated (operational needs)
- Challenges in microgrid
- Microgrid control systems

  - What control systems are applied to microgrids
  - Brief history of automation and how the microgrid is combining automation and power system control etc.
- Introduction to Microgrids Management Systems (MGMS)

## 4.14 Course 14 – SCADA and EMS Basic Training *NEW

Sessions 48-49 (8 hrs.) – This course provides a broad SCADA-EMS overview and a comprehensive understanding of the use case within an electrical utility
The following topics will be addressed:

- Overview
- SCADA Solution Overview
  - Components of a SCADA and EMS
  - Supervisory Control and Data Acquisition (SCADA)
  - Energy Management Systems (EMS)
  - Power Applications (PA)
  - Forecast & Scheduling Applications
  - Transmission Network Applications (TNA)
  - Operator Training Simulator (OTS)
  - Distribution Management Systems (DMS)
- Communication
- Data and Displays
- EMS Building Blocks
- Operator Training Simulator
- Use Case Examples

## 4.15 Course 15 – Power System Reliability

Sessions 50-52 (12 hrs.) – This course introduces probability and statistical methods useful in planning and design functions through practical applications to power system problems. Techniques for calculating reliability and availability of components are applied to generation, transmission, and distribution system problems to determine overall system performance to be expected from various combinations of equipment. Problems involved in load forecasting and techniques of preparing load models are examined. The fundamental requirements for adequate service are discussed.
The following topics will be addressed:

- Basic concepts and methods
- Probability Risk Analysis (PRA)
- Bulk transmission system reliability assessment
- Forced outage model
- Generation system reliability
- Local area reliability
- Sub-transmission and substation reliability
- Must-run generation for reliability
- Hands-on exercises

## 4.16 Course 16 – Power Grid, Grid Blackouts and Protective Relaying

Session 53 (4 hrs.) – The Power Grid, Grid Blackout, and Protective Relaying course is designed to provide an understanding of grid dynamics and protective relays. The training will enhance your company's students' understanding of electrical areas related to operating the grid. The training combines classroom instruction and practical examples.
The following topics will be addressed:

- Introduction to Course overview Definitions and nomenclature
    - Safety precautions
    - Electrical schematic reading
- Protection Fundamentals
    - Theory and operations
    - Circuit protection
    - Breakers and fuses
    - Selective tripping
- Grid Dynamics and Theory
    - Relay schemes
    - Scenario US Blackout 2003
    - Lessons Learned US Blackout 2003
    - Scenario UK Blackout 2019
    - Lessons Learned UK Blackout 2019

## 4.17 Course 17 – Power System Scheduling and Operation

Session 54-57 (20 hrs.) – The course focuses on generation scheduling problems and discusses new solution techniques. Topics covered include power generation characteristics, economic dispatch methods and solutions, transmission losses, unit commitment, scheduling of limited energy resources, hydro-thermal coordination, current interchange practices in the U.S. utilities and pools, and techniques for analyzing power system security.
The following topics will be addressed:

- Characteristics of generating units
- Economic dispatch
- Unit commitment of thermal units
- Market operations and scheduling
- Distributed System Platform (DSP)
- Interconnections and interface flows
- FERC & NERC requirements i.e. FERC order 1000
- Power system security (N-1, N-2 & N-1-1)
- Power system generation control
- Power system state estimation
- Planning vs operation

## 4.18 Course 18 – Production Cost Analysis

Sessions 58-60 (12 hrs.) – A power system is engineered to meet system demand, losses, and to maintain generation reserves efficiently. Energy production and supply aim for minimal cost and environmental impact. In the day-ahead market, system price is established through the matching of generator offers with user bids at each node, creating a supply-demand equilibrium price. This course introduces day-ahead and real-time market concepts, and explores the regulatory frameworks and deregulation of electric markets, highlighting their impacts on the electricity value chain.

The following topics will be addressed:

- The law of supply and demand
- Roles and players: the financial grid organization chart – suppliers, customers, market participants and the economic drivers
- Security Constrained economic Dispatch
- Unit Commitment
- LMP Pricing model
- Supply Curves
- Congestion and Shadow Prices
- Transmission congestion
- Generation curtailment
- Ancillary Services
- Energy Market

# 4.19 Course 19 – Utility Economics

Sessions 61-64 (16 hrs.) – This course introduces the financial and economic aspects of the electric utility and demonstrates their relevance to engineering decisions. It covers essential accounting concepts, financial structures, depreciation computations, and other operating expenses. Cash flow, financing system growth, and the effect of income taxes on economic choices are discussed. The course also covers basic methods for making engineering economic decisions, including present value calculations and techniques involving corporate model simulations.

The following topics will be addressed:

- Basic utility accounting and financial concepts
- Financial data
- Time value of money
- Utility economic and financial evaluations
- Basis for utility financing (PURPA, PUHCA)
- Revenue requirements, and rate cases
- Mortality, O&M, capital, retirements, recovery and taxes
- Strategic and least cost planning
- Economic evaluations in a competitive environment
- Annual carrying charges

# 4.20 Expert Seminars

In this series of seminars, world-renowned experts present trendy topics to your company, discussing state-of-the-art technology, its applications, and lessons learned from around the globe.

Topic 1 - Offshore Wind Generation

Topic 2 - The e-mobility revolution and its impact today and in the future of the electric utilities

Topic 3 - Distributed Energy Resources (DER) emerging technologies

- Battery Storage
- Hydrogen

Topic 4 - Decarbonization: The path to achieve carbon neutrality

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