Introduction:

This course provides a thorough understanding of the principles behind Digital Power System Relaying and Protection Applications, specifically designed for professionals in electrical power systems. It focuses on the critical aspects of power system protection, ensuring the safe and efficient operation of electrical networks. The course is ideal for engineers, technicians, and managers in the electrical power sector, offering comprehensive insights into power system protection, fault analysis, and network reliability.

The curriculum explores the practical applications of power system projects within electrical engineering, alongside reliability-centered maintenance techniques. Participants will gain an in-depth understanding of the fundamental components involved in maintaining and protecting power systems. The course is structured to support those seeking to enhance their expertise in electrical engineering power systems, whether for professional development or further education.

Power System Projects for Electrical Engineering

Power system projects are central to the field of electrical engineering, involving the design, implementation, and management of electrical networks. This course enables professionals to understand the complexities of these projects, equipping them with the skills to enhance their competencies in this domain.

Targeted Groups

This course is suitable for:

- **Electrical Power System Engineers**
- **Electrical Technicians**
- **Professionals working in substations, power systems, and electrical companies involved in generation, transmission, and distribution**
- **Managers seeking to understand the impact of power factor correction on operational costs**
- **Recent graduates or individuals new to the electrical engineering industry**
- **Professionals looking to further their education in protection relay training, power systems certification, and electrical system training**

Course Objectives

Upon completion of this course, participants will be able to:

- Comprehend the operation and application of power protection devices.
- Understand the various fault types and their effects on electrical power systems.
- Gain insights into control system reliability and perform **Partial Discharge (PD)** analysis.
- Learn about the different types of loads and their impact on the availability of electrical networks.
- Master the core concepts of **Power System Protection**, with a focus on practical applications.

Targeted Competencies

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

- Identify the protection devices required to safeguard power systems.
- Understand relevant standards for protection devices and their settings.
- Conduct function tests for protection devices and analyze **Partial Discharge (PD)**.
- Demonstrate a comprehensive understanding of fault types and fault study methodologies.
- Configure protection relays based on **ANSI (American National Standards Institute)** codes.

Course Content

Unit 1: Voltage Sags and Interruptions

- Defining **power quality** and its core components.
- Quantitative methods for assessing **power quality**.
- The **ITI (CBEMA)** curve and its significance.
- Identifying causes of **voltage sags** and **interruptions**.
- Mitigation strategies for power quality issues.

Unit 2: Transient Voltage Excursions

- The impact of **motor starting**, switching, and traveling wave phenomena.
- Addressing the effects of **capacitor switching**.
- Best practices for **lightning**, **shielding**, and **grounding**.
- Understanding **ferroresonance effects** and mitigation techniques.

Unit 3: Reliability Indices, Effects of Fault Clearing on Power Quality

- Introduction to **IEEE-defined reliability indices**.
- Interpreting **reliability indices** to improve system performance.
- Fault clearing strategies and **reclosing techniques**.
- The philosophy of **fuse saving** and **blowing**.

Unit 4: Insulation Coordination, Arresters, and Steady-State Voltage Regulation

- Basics of **impulse level**, insulation systems, and testing methods.
- Selection and application of **arresters**.
- Working with **load tap changers** and **voltage regulators**.
- Understanding the effects of **steady-state voltage** on system operation.

Unit 5: Harmonics

- Fundamentals and causes of **harmonics** in power systems.
- The relationship between **AC power** and **power factor**.
- Techniques to mitigate the effects of harmonics.
- Using **K-factor transformers** and **harmonic filters** to improve power quality.

Unit 6: Symmetrical Components and Sequence Networks

- Introduction to **power system protection** principles.
- Phasor math and **per-unit** calculations.
- Understanding **symmetrical components** and **sequence network theory**.
- Fault modeling methodologies for power systems.

Unit 7: Electromechanical and Digital Relays, Relay Schemes for Radial Systems, Time-Coordinated Overcurrent Protection

- Principles behind **electromechanical relay** operation.
- Implementation of **microprocessor-based relays**.
- Understanding instantaneous and time overcurrent relay mechanisms.
- The role of **reclosers** and sectionalizers.
- Time-current curves and **device coordination** strategies for effective protection.

Unit 8: Relay Schemes for Networked Systems and Device Protection

- Understanding **distance relays** and **differential relays**.
- Application of **differential relays** for protecting **buses**, **generators**, and **transformers**.

Unit 9: Effect of Protection on Reliability

- Reliability indices and their relationship to fault clearing time.
- Strategies for dealing with **nearby faults** and improving system reliability.
- Implementing **intelligent protective devices** to enhance system performance.

Unit 10: Arc Flash Hazard and a Look to the Future

- Differentiating between **shock hazards** and **burn/blast hazards**.
- Compliance with **IEEE 1584** and **NFPA 70E** standards for arc flash protection.
- The role of **personal protective equipment (PPE)** and **hazard labeling**.

- Future trends in **communication-based overcurrent protection**.
- Innovations in **intelligent sectionalizing** for future protection schemes.

Conclusion: This course offers comprehensive knowledge in the field of Digital Power System Relaying and Protection Applications. It equips professionals with the necessary skills to design, implement, and manage power system protection strategies, ultimately ensuring the safe and efficient operation of electrical power systems. By mastering key components such as protection relays, fault studies, and network reliability, participants will enhance their ability to address the challenges of modern electrical engineering power systems.