Training Course on Power Quality, Harmonics Mitigation and Reactive Power Management

Professional Development Training Course Outline

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

Course Introduction

In today's dynamic electrical landscape, ensuring **power quality** is paramount for operational efficiency, equipment longevity, and regulatory compliance. This comprehensive training course delves into the critical aspects of **harmonics mitigation** and **reactive power management**, equipping participants with the knowledge and skills to identify, analyze, and resolve power quality issues. By understanding the sources and impacts of harmonic distortion and implementing effective reactive power compensation techniques, organizations can significantly reduce energy losses, minimize equipment downtime, and improve overall system reliability. This course offers a blend of theoretical foundations and practical applications, empowering attendees to contribute directly to a more stable and efficient electrical infrastructure.

This intensive program is structured to provide a thorough understanding of power quality principles, focusing on the detrimental effects of **harmonic distortion** on electrical systems and the importance of proactive **reactive power management**. Participants will learn about various **harmonics mitigation techniques**, including passive and active filters, and gain practical insights into the selection and implementation of **power factor correction** strategies. The training will also cover relevant industry standards and best practices, enabling organizations to optimize their power systems, reduce operational costs, and enhance the performance of sensitive electronic equipment. Mastering these concepts is crucial for maintaining a reliable and cost-effective electrical network in modern industrial and commercial environments.

Programme Curriculum

Training Course on Power Quality, Harmonics Mitigation & Reactive Power Management

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Course Duration

10 days

Course Objectives

1. **Define Power Quality:** Understand the fundamental principles and importance of power quality in modern electrical systems.
2. **Identify Power Quality Issues:** Recognize common power quality disturbances such as voltage sags, swells, transients, and interruptions.
3. **Analyze Harmonic Distortion:** Comprehend the sources, characteristics, and effects of **harmonic distortion** on electrical equipment and networks.
4. **Apply Harmonic Measurement Techniques:** Learn how to use power quality analyzers to measure and assess harmonic content in electrical systems.
5. **Implement Passive Harmonic Filters:** Design and apply **passive harmonic filters** for effective **harmonic mitigation**.
6. **Utilize Active Harmonic Filters:** Understand the principles and applications of **active harmonic filters** in dynamic power quality improvement.
7. **Explain Reactive Power:** Grasp the concept of **reactive power**, its impact on power factor, and system efficiency.
8. **Calculate Power Factor:** Learn to calculate **power factor** and its significance in electrical energy consumption.
9. **Apply Power Factor Correction:** Implement various **power factor correction** methods using capacitors and other compensation techniques.
10. **Manage Reactive Power in Industrial Loads:** Understand the specific challenges of **reactive power management** in industrial applications with motor drives and other inductive loads.
11. **Comply with Power Quality Standards:** Familiarize with relevant IEEE, IEC, and other industry **power quality standards** and regulations.
12. **Troubleshoot Power Quality Problems:** Develop effective strategies for diagnosing and resolving common **power quality problems**.

13. **Optimize Energy Efficiency:** Understand how effective power quality management contributes to overall **energy efficiency** and cost reduction.

Organizational Benefits

- **Reduced Operational Costs:** Minimize energy losses and penalties associated with poor power factor and harmonic distortion.
- **Increased Equipment Lifespan:** Mitigate the damaging effects of harmonics on sensitive electronic equipment, extending their operational life.
- **Improved System Reliability:** Enhance the stability and reliability of the electrical infrastructure, reducing downtime and production losses.
- **Enhanced Energy Efficiency:** Optimize power utilization and reduce overall energy consumption.
- **Compliance with Regulations:** Meet relevant power quality standards and avoid potential penalties.
- **Safer Operations:** Reduce the risk of equipment overheating and failures caused by harmonic currents.
- **Better Power System Performance:** Ensure optimal performance of electrical equipment and processes.
- **Reduced Maintenance Costs:** Lower maintenance requirements due to fewer equipment failures related to power quality issues.

Target Audience

1. Electrical Engineers
2. Maintenance Engineers
3. Facility Managers
4. Plant Engineers
5. Energy Managers
6. Electrical Technicians
7. Power System Operators
8. Consulting Engineers

Course Outline

Module 1: Fundamentals of Power Quality

- Introduction to Power Quality: Definition, Importance, and Impacts
- Types of Power Quality Disturbances: Transients, Voltage Variations, Waveform Distortion
- Ideal vs. Non-Ideal Power Systems
- Power System Components and Their Influence on Power Quality
- Overview of Power Quality Standards and Regulations

Module 2: Understanding Harmonics

- Introduction to Harmonic Distortion: Definition and Causes
- Non-Linear Loads and Harmonic Generation
- Odd and Even Harmonics, Triplen Harmonics
- Effects of Harmonics on Equipment: Overheating, Malfunctions, Reduced Lifespan
- Harmonic Current and Voltage Distortion

Module 3: Harmonic Analysis and Measurement

- Introduction to Harmonic Analysis Techniques
- Using Power Quality Analyzers for Harmonic Measurement
- Interpreting Harmonic Data and Spectrum Analysis
- Total Harmonic Distortion (THD) and Total Demand Distortion (TDD)
- Identifying Harmonic Sources in Electrical Systems

Module 4: Passive Harmonic Filters

- Principles of Passive Filters: Inductors, Capacitors, Resistors
- Types of Passive Filters: Single-Tuned, High-Pass, Band-Pass
- Design Considerations for Passive Harmonic Filters
- Placement and Application of Passive Filters
- Limitations of Passive Harmonic Filters

Module 5: Active Harmonic Filters

- Principles of Active Filters: Current Injection, Voltage Compensation
- Types of Active Filters: Shunt, Series, Hybrid
- Control Strategies for Active Harmonic Filters
- Advantages and Disadvantages of Active Filters Compared to Passive Filters
- Applications of Active Harmonic Filters in Industrial and Commercial Settings

Module 6: Reactive Power and Power Factor

- Understanding Active, Reactive, and Apparent Power
- The Concept of Power Factor and Its Significance
- Effects of Low Power Factor: Increased Losses, Voltage Drop, Reduced Capacity
- Power Factor in Inductive and Capacitive Circuits
- Power Factor Penalties and Utility Tariffs

Module 7: Power Factor Correction Techniques

- Capacitor Banks for Power Factor Correction: Fixed and Switched
- Automatic Power Factor Correction (APFC) Systems
- Synchronous Condensers for Reactive Power Compensation
- Static VAR Compensators (SVCs)
- Placement and Sizing of Power Factor Correction Equipment

Module 8: Reactive Power Management in Industrial Loads

- Reactive Power Requirements of Electric Motors
- Impact of Variable Speed Drives (VFDs) on Reactive Power
- Power Factor Correction for Motor Loads
- Compensation Strategies for Welding Machines and Other Intermittent Loads
- Dynamic Reactive Power Compensation

Module 9: Power Quality Standards and Compliance

- Overview of IEEE 519 Standard for Harmonic Control in Electric Power Systems
- IEC 61000 Series Standards for Power Quality
- National and Local Power Quality Regulations
- Compliance Measurement and Reporting
- Impact of Renewable Energy Sources on Power Quality Standards

Module 10: Power Quality Monitoring and Assessment

- Establishing a Power Quality Monitoring Program
- Selecting Appropriate Monitoring Equipment
- Data Logging and Analysis Techniques
- Identifying Trends and Anomalies in Power Quality Data
- Developing Power Quality Improvement Strategies Based on Monitoring Results

Module 11: Troubleshooting Power Quality Problems

- Systematic Approach to Power Quality Problem Solving
- Identifying Symptoms and Root Causes of Common Issues
- Using Measurement Data for Diagnosis
- Implementing Corrective Actions and Verifying Effectiveness
- Case Studies of Power Quality Problem Resolution

Module 12: Power Quality in Smart Grids and Renewable Energy Systems

- Impact of Distributed Generation on Power Quality
- Challenges and Solutions for Integrating Renewable Energy Sources
- Power Quality Issues in Smart Grid Environments
- Active Management of Power Quality in Future Power Systems
- Role of Energy Storage in Enhancing Power Quality

Module 13: Economic Aspects of Power Quality

- Cost of Poor Power Quality: Direct and Indirect Costs
- Return on Investment (ROI) for Power Quality Improvement Measures
- Life Cycle Cost Analysis of Power Quality Solutions
- Energy Savings and Reduced Utility Bills
- Economic Benefits of Enhanced Equipment Reliability

Module 14: Best Practices for Power Quality Management

- Developing a Comprehensive Power Quality Management Plan
- Implementing Preventative Measures
- Regular Audits and Assessments
- Training and Awareness Programs for Personnel
- Collaboration with Utilities and Other Stakeholders

Module 15: Future Trends in Power Quality

- Advancements in Power Electronic Technologies
- Emerging Standards and Regulations
- Impact of Increasing Penetration of Electric Vehicles
- Role of Artificial Intelligence and Machine Learning in Power Quality Management
- Sustainable Solutions for Power Quality Improvement

Training Methodology

This training course will employ a blended learning approach, combining:

- **Interactive Lectures:** Engaging presentations with real-world examples and case studies to explain theoretical concepts.

- **Practical Demonstrations:** Hands-on demonstrations using power quality analyzers and simulation tools.
- **Group Discussions:** Facilitated discussions to encourage peer-to-peer learning and knowledge sharing.
- **Case Study Analysis:** In-depth examination of real-world power quality problems and their solutions.
- **Problem-Solving Exercises:** Practical exercises to reinforce understanding and application of concepts.

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

Start Date	End Date	Location	Price
23 Nov 2026	04 Dec 2026	Physical	$3,000
23 Nov 2026	04 Dec 2026	Physical	$6,000
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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