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Course Name

Harmonics in power systems: causes, effects and elimination methods

Sector Name

Electrical Engineering

Document Type

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Harmonics in power systems: causes, effects and elimination methods

Course Introduction

Understanding Harmonics in Power Systems: Causes, Effects and Elimination Methods is essential for maintaining high Power Quality in modern electrical infrastructures. As industries shift toward Variable Frequency Drives (VFDs), UPS systems, and LED lighting, the prevalence of Non-linear Loads has introduced significant distortion into the sine wave. This course provides a comprehensive technical breakdown of how Harmonic Currents and Voltage Distortion degrade system performance and how to implement effective Harmonic Mitigation strategies.

In this program, we analyze the root causes of Harmonic Distortion, ranging from Rectifiers and Inverters to saturated Transformers. You will learn to calculate Total Harmonic Distortion (THD) and understand the severe effects on equipment, such as Transformer Overheating, Neutral Conductor Loading, and nuisance tripping of Circuit Breakers. By mastering Elimination Methods—including Passive Harmonic Filters, Active Power Filters (APF), and Multi-pulse Converters—you will ensure compliance with global standards like IEEE 519 and protect sensitive electronic components from premature failure

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Target Audience

✓ Circuits Engineer

✓ Design Engineer

✓ Electrical Controls Engineer

✓ Electrical Design Engineer

✓ Electrical Engineer

✓ Electrical Project Engineer

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Learning Objectives

✓ Sources of harmonics and AC drive types

✓ Line notching, inter-harmonics

✓ The relationship between harmonic currents and power factors

✓ Harmonics' effects on the complete range of equipment

✓ Resonance in AC drives and PFC equipment

✓ PWM, DC, AC load commutated inverter and AC cycloconverters

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Course Outline

✓ DAY 01

Introduction to Power Quality

- ✓ The power source
- ✓ Delivery of power
- ✓ The load
- ✓ Three-phase model
- ✓ Voltage and Current Disruptions
- ✓ Classifying interruptions, sags, and swells
- ✓ Power interruptions
- ✓ Undervoltage, overvoltage, sags, swells, and flicker
- ✓ Transients
- ✓ Noise
- ✓ CBEMA (ITIC) curve
- ✓ Power line conditioners
- ✓ Power

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Course Outline

✓ Day 02

Power Factor

- ✓ Impedance, resistance, and reactance
- ✓ Ohm’s law with complex impedances
- ✓ ELI the Ice Man
- ✓ Complex power
- ✓ Power factor
- ✓ Cost of low power factor
- ✓ Sources of harmonics and AC drive types
- ✓ PWM, DC, AC load commutated inverter and AC cycloconverters
- ✓ Question and answer session.
- ✓ Effect of equipment loading on harmonic currents and total harmonic current distortion.
- ✓ Effect of source kVA, impedance, and sub-transient reactance (Xd”) on harmonics
- ✓ Illustrating Examples using SOLV software.

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Course Outline

✓ Day 03

Harmonics

- ✓ Distortions due to semiconductors
- ✓ Skin effect
- ✓ Harmonic problems involving transformers
- ✓ Harmonic problems specific to three-phase systems
- ✓ Variable frequency drives
- ✓ THD and TDD
- ✓ Crest factor
- ✓ Displacement power factor
- ✓ Interharmonics
- ✓ Harmonic filters

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Course Outline

✓ Day 04

Harmonic mitigation techniques (for three-wire and four 3-phase distribution systems and for standard 3-phase systems) – including neutral current eliminators

- ✓ Reactors (AC line and DC bus), commutation reactors, special reactors (Lineator wide spectrum and duplex reactors),
- ✓ Passive L-C filters, phase shifting (multi-pulse), phase staggering (quasi-multi-pulse), active filters, hybrid active/passive filters, and active front ends (sinusoidal rectifiers).
- ✓ Question and answer session.
- ✓ Understanding harmonic recommendation IEEE 519 (1992).

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Course Outline

✓ Day 05

Simple harmonic calculation summary

- ✓ Example of harmonic calculation software (SOLV) and sample calculations.
- ✓ Harmonic survey techniques and safety issues.
- ✓ Local site measurements using harmonic measurement equipment
- ✓ Information required from vendors (e.g., drive suppliers) to solve harmonics problems
- ✓ Question and answer session.
- ✓ Conclusion

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Confirmed Sessions

FROM	TO	DURATION	FEES	LOCATION
Jan. 17, 2027	Jan. 21, 2027	5 days	4250.00 $	KSA , Riyadh
April 19, 2027	April 23, 2027	5 days	5950.00 $	switzerland , Geneva
Aug. 17, 2026	Aug. 21, 2026	5 days	4250.00 $	UAE , Dubai
Sept. 21, 2026	Sept. 25, 2026	5 days	4250.00 $	UAE , Abu Dhabi

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