JUPITER PRIME

Consulting • Training • Advisory

جوبيتر برايم للاستشارات والتدريب

COURSE BROCHURE

# Power System Harmonics Analysis and Filter Design Training Course

14 – 18 December 2026
Dar es Salaam

**jupiterprime.uk**

info@jupiterprime.uk

Registered in the United Kingdom and Saudi Arabia

# Power System Harmonics Analysis and Filter Design Training Course

**Ref:** 2635_100253 **Date:** 14 – 18 December 2026 **Location:** Dar es Salaam **Fees:** 7900 GBP

Power System Harmonics Analysis and Filter Design is a 1-week training course for electrical design, power systems and plant engineers who must trace distortion from variable speed drives, rectifiers and inverter-based generation and specify the right remedy, ending with a harmonic mitigation design note. Non-linear loads now dominate many networks, so unchecked distortion overheats assets and trips equipment. Jupiter Prime Training places harmonic study at the centre of reliable network design.

## Why Power System Harmonics Matter Now

Three forces push harmonics up the engineering agenda. Converter-fed loads such as drives, data centre rectifiers and electric vehicle chargers keep multiplying, while solar and battery inverters add their own switching spectra at the point of connection. Network operators also tighten emission limits in connection agreements. An organisation that models distortion well sizes filters correctly first time; one that ignores it faces resonance, nuisance tripping, capacitor failure and disputes with the network operator. The course rests on harmonic load flow, frequency scanning and impedance modelling methods used across the industry.

## Who Gains Most from Power System Harmonics

- Engineers designing industrial and commercial distribution with converter loads
- Engineers who carry out network studies for new connections and system extensions
- Plant engineers who keep motors, drives and capacitor banks running in process facilities
- Engineers who prepare connection applications for solar, wind and storage plants
- Engineers who commission and test power quality monitoring and correction equipment

Design offices and utility study teams gain most when several members attend together.

## Power System Harmonics Capabilities

Participants move from identifying a distorting source to specifying and checking the device that tames it.

- Calculate current and voltage distortion at the point of common coupling — connection agreement compliance
- Assess parallel and series resonance from frequency scans — capacitor bank placement
- Design single-tuned and high-pass passive filters — equipment ratings and tuning order
- Specify active filters and multi-pulse converter arrangements — choice between mitigation options
- Apply derating factors to transformers and cables — asset loading limits
-

Communicate study findings in a structured design note — project and network operator approval

## Key Power System Harmonics Terms

- Total harmonic distortion — the ratio of the combined harmonic content to the fundamental component, expressed as a percentage of voltage or current.
- Point of common coupling — the network node where a customer's installation meets other users and where emission limits are assessed.
- Parallel resonance — a condition where capacitance and network inductance create very high impedance at one frequency, magnifying harmonic voltages.
- Tuned filter — a series inductor and capacitor branch set near one harmonic order to divert that current away from the network.
- K-factor — a weighting of harmonic currents that indicates the extra heating a transformer must withstand compared with sinusoidal load.
- Frequency scan — a calculation of network driving-point impedance across a range of frequencies to reveal resonant points.

## Power System Harmonics Day by Day

### Day 1: Sources and Spectra of Distortion

- Fourier Series and Harmonic Phase Sequence — Interpreting Waveform Content
- Six-Pulse and Twelve-Pulse Rectifier Spectra — Predicting Characteristic Orders
- Variable Speed Drive Front Ends — Estimating Current Injection at Rated Load
- Inverter-Based Generation Switching Emissions — Planning Renewable Plant Connections
- Interharmonics and Supraharmonics — Recognising Emerging Emission Bands

### Day 2: Measuring and Modelling the Network

- Power Quality Analyser Set-Up and Transducer Accuracy — Trusting Field Results
- Survey Duration and Percentile Statistics — Judging Compliance Against Limits
- Source, Transformer and Cable Impedance Models — Building a Study Case
- Harmonic Load Flow Calculation — Locating Buses With High Distortion
- Emission Allocation Among Connected Customers — Agreeing Fair Limits

### Day 3: Resonance and Frequency Scans

- Driving-Point Impedance Scan — Revealing Parallel Resonant Frequencies
- Power Factor Capacitor Interaction — Avoiding Amplified Harmonic Voltages
- Cable Capacitance in Wind and Solar Collector Systems — Shifting Resonant Points
- Sensitivity to Network Switching States — Testing Worst-Case Configurations
- Detuning Reactors for Capacitor Banks — Selecting Reactor Percentage

## Day 4: Filter Design and Equipment Derating

- Single-Tuned Filter Sizing and Quality Factor — Choosing Tuning Order and Losses
- High-Pass and C-Type Filters — Damping Broadband Distortion
- Active Filters and Active Front-End Drives — Comparing Cost and Response
- Phase-Shifting Transformers and Multi-Pulse Arrangements — Cancelling Low Orders at Source
- Transformer and Cable Derating Calculations — Setting Safe Loading Limits

## Day 5: Practising the Harmonic Mitigation Design Note

- Harmonic Load Flow Review of a Process Plant Case — Confirming Distortion Levels
- Resonance Check With Proposed Capacitor Banks — Verifying Filter Placement
- Filter Rating Verification Under Overvoltage — Confirming Component Stress Margins
- Comparison of Mitigation Options for a Solar Plant — Recommending One Solution
- Harmonic Mitigation Design Note Completion — Presenting Results for Approval

## Applying Power System Harmonics After the Course

- Run a frequency scan on one site with power factor correction capacitors and record any resonance near characteristic orders.
- Review the derating applied to one converter-fed transformer using a harmonic current spectrum taken from a site survey.

## Power System Harmonics Questions FAQ

### What is power system harmonics analysis and why does it matter now?

Power system harmonics analysis is the study of non-sinusoidal currents and voltages and the remedies that limit them. It matters now because drives, rectifiers and inverters form a growing share of load and generation, raising heating, resonance and connection compliance risks.

### Which roles gain most from power system harmonics and filter design training?

Electrical design, network study and plant engineers gain most. You benefit if you specify converter loads, prepare renewable connection studies or maintain capacitor banks.

### How does power system harmonics training differ from a general power quality course?

It goes deeper into one disturbance. A general power quality course spreads time across many disturbance types, while this course concentrates on harmonic spectra, resonance scans, filter sizing and derating.

## What do you bring back from power system harmonics and filter design training?

You bring back a completed harmonic mitigation design note with distortion calculations, a resonance check and a rated filter choice you can adapt to your own site.

## Power System Harmonics: The Way Forward

The harmonic mitigation design note first informs whether a site needs a passive filter, an active filter or a converter change before equipment is ordered. Design engineers, network study teams and plant owners use it to agree ratings and limits. After its first use, revisit the resonance check whenever capacitor banks, cables or new inverter plant alter the network impedance.