COURSE OVERVIEW EE0100

Power System Quality, Harmonics & Interruptions

Course Title

Power System Quality, Harmonics & Interruptions

Course Date/Venue

Session 1: July 06-10, 2025/Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE

Session 2: November 16-20, 2025/Crowne Meeting Room, Crowne Plaza Al Khobar, KSA

Course Reference

EE0100

Course Duration/Credits

Five days/3.0 CEUs/30 PDHs

Course Description

This practical and highly-interactive course includes various practical sessions and exercises. Theory learnt will be applied using our state-of-the-art simulators.

The rapidly increasing installation of electronic equipment such as digital controls, computers and sensitive process control equipment has increased the susceptibility of utility end-users to supply disturbances. In addition, the application of power electronic equipment with its higher energy efficiency and more effective control features has in turn often increased the level of disturbances that might affect end-user equipment.

Both electric utilities and end users of electric power are becoming increasingly concerned about the quality of electric power. The term *power quality* has become one of the most prolific buzzwords in the power industry especially in the second half of the 1990s. It is an umbrella concept for a multitude of individual types of power system disturbances. The issues that fall under this umbrella are not necessarily new. What is new is that engineers are now attempting to deal with these issues using a system approach rather than handling them as individual problems.

This course is designed to provide participants with a comprehensive and up-to-date understanding of the causes of power quality problems and how to prevent them. It discusses every essential aspect of basic power quality and methods used to protect electronic systems. This course will cover all power quality problems including voltage sags, harmonics, transients and light flicker. Delegates will learn analysis fundamentals, instrumentation techniques and methods of improving power quality by both network and plant modifications. Delegates will review the causes of various types of power quality problems in commercial and industrial environments. The effect of these problems on power system components and end-user equipment will also be addressed. Commercially available tools for identifying these problems will be discussed and demonstrated as well as how to interpret their results. Further, delegates will evaluate ground connections and solve many common grounding problems.

Course Objectives

Upon the successful completion of this course, each participant will be able to:-

- Apply and gain an in-depth knowledge on power system quality, harmonics and interruptions
- Discuss the terms and definitions of power quality, power quality evaluation procedure, voltage imbalance, power frequency variations, CBEMA and ITI curves
- Enumerate the different sources of voltage sags and interruptions including the fundamental principles of protection, evaluating the economics of different ride-through alternatives and the utility system fault-clearing issues
- Identify the different sources of transient overvoltages, principles & devices for overvoltage protection, utility system lightning protection and computer tools for transients analysis
- Describe the fundamentals of harmonics including the power system quantities under nonsinusoidal conditions, harmonic indices, harmonic sources from commercial & industrial loads and become aware of the effects of harmonic distortion on capacitors, transformers, motors etc.
- Distinguish the applied harmonics, harmonic distortion evaluations, devices for controlling harmonic distortion and the standards on harmonics
- Explain the significance of long duration voltage variations including the principles of regulating the voltage, devices for voltage regulation and regulating utility voltage with distributed resources
- Employ the principles of power quality benchmarking, illustrate the benchmarking process and give emphasis on power quality contracts, power quality insurance and power quality state estimation
- Enumerate the different distributed generation technologies, power quality issues and interconnection standards related to the distributed generation and power quality
- List the resources, reasons for grounding, typical wiring and grounding problems as well as the solutions to these problems
- Carryout the proper procedure for power quality monitoring, application of intelligent systems and become familiar with the power quality monitoring standards

Exclusive Smart Training Kit - H-STK®

*Participants of this course will receive the exclusive "Haward Smart Training Kit" (**H-STK®**). The **H-STK®** consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.*

Who Should Attend

This course provides an overview of all significant aspects and considerations of power system quality, harmonics and interruptions for managers, electrical engineers, utility specialists and senior electrical technical staff who wish to advise end-users on power quality concerns, those who service large end-users or who wish to understand aspects of network design, construction and maintenance techniques for maximising quality of supply. Personnel working in all areas of power system design who wish to know how the system interacts with the end-user will also gain from this course.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Course Fee

US$ 5,500 per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

- The International Accreditors for Continuing Education and Training (IACET - USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

Course Instructor(s)

This course will be conducted by the following ng instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Mr. Pan Marave, PE, MSc, BEng, is a **Senior Electrical & Instrumentation Engineer** with over **40 years** of extensive experience in **Oil**, **Gas**, **Petrochemical**, **Refinery** & **Power** industries. His expertise includes **Circuit Breaker**, **HV Switchgear Maintenance**, **HV/LV Electrical** Authorisation, Basic **Electricity**, **Electrical & Special Hazards**, **Personnel Protection**, **HV/LV Equipment**, **Motor Controllers**, **Electrical Switching** Practices, **Emergency Planning**, **Safety Management**, Safety Instrumented Systems (**SIS**), Safety Integrity Level (**SIL**), Emergency Shutdown (**ESD**), **DCS**, **SCADA** & **PLC**, **Measurement** (**Flow**, **Temperature**, **Pressure**), **Process Analyzers** & **Analytical Instrumentation**, **Process Control**, **Instrumentation** & **Safeguarding, Process Controller**, **Control Loop & Valve Tuning**, Industrial **Distribution Systems**, Industrial **Control & Control Systems**, **Power Generation & Transmission**, **Electrical Generator & Power Transformers**, Power Systems **Protection & Relaying**, **Earthing**, **Power System Protective Relay**, **Bonding**, **Grounding**, **Lightning & Surge Protection**, Electric Power **Substation** & **Systems**, Electrical Engineering Principles, **Motor Control Circuit**, **Electrical Fault Analysis**, Electrical Networks & Distribution **Cables, Circuit Breakers**, **Switchgears**, **Transformers**, **Hazardous Areas Classification** and **Detailed Engineering Drawings**, **Codes** & **Standards**. Furthermore, he is also well-versed in Microprocessors Structure, Lead Auditor (**ISO 9000:2000**), **ISO 9002**, Quality Assurance, and Projects & Contracts Management.

Presently, Mr. Marave is the **Technical Advisor** of **Chamber of Industry & Commerce** in Greece. Prior to this, he gained his thorough practical experience through several positions as the **Technical Instructor**, **Engineering Manager**, **Electronics & Instruments Head**, **Electrical**, **Electronics & Instruments Maintenance Superintendent**, **Assistant General Technical Manager** and **Engineering Supervisor** of various international companies such as the **Alumil** Mylonas, **Athens Papermill**, **Astropol** and the **Science Technical Education**.

Mr. Marave is a **Registered Professional Engineer** and has **Master** and **Bachelor** degrees in **Electrical Engineering** from the **Polytechnic Institute of New York** and **Pratt Institute of New York** (**USA**) respectively. Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership & Management** (**ILM**) and an active member of the **Technical Chamber** and the Institute of Electrical and Electronics Engineer (**IEEE**) in Greece. He has presented and delivered **numerous international** courses, conferences, trainings and workshops worldwide.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Introduction, Terms & Definitions*** *What is Power Quality? • Power Quality = Voltage Quality • Why Are We Concerned about Power Quality? • The Power Quality Evaluation Procedure • Need for a Consistent Vocabulary • General Classes of Power Quality Problems • Transients • Long-Duration Voltage Variations • Short-Duration Voltage Variations • Voltage Imbalance • Waveform Distortion • Voltage Fluctuation • Power Frequency Variations • Power Quality Terms • Ambiguous Terms • CBEMA and ITI Curves*
0930 – 0945	*Break*
0945 – 1100	***Voltage Sags & Interruptions*** *Sources of Sags and Interruptions • Estimating Voltage Sag Performance • Fundamental Principles of Protection • Solutions at the End-User Level*
1100 – 1230	***Voltage Sags & Interruptions (cont'd)*** *Evaluating the Economics of Different Ride-Through Alternatives • Motor Starting Sags • Utility System Fault-Clearing Issues*
1230 – 1245	*Break*
1245 – 1420	***Transient Overvoltages*** *Sources of Transient Overvoltages • Principles of Overvoltage Protection • Devices for Overvoltage Protection • Utility Capacitor-Switching Transients*
1420 - 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day One*

Day 2

0730 – 0930	***Transient Overvoltages (cont'd)*** *Utility System Lightning Protection • Managing Ferroresonance • Switching Transient Problems with Loads • Computer Tools for Transients Analysis*
0930 – 0945	*Break*
0945 - 1100	***Fundamentals of Harmonics*** *Harmonics Distortion • Voltage versus Current Distortion • Harmonics versus Transients • Power System Quantities under Nonsinusoidal Conditions*
1100 – 1230	***Fundamentals of Harmonics (cont'd)*** *Harmonic Indices • Harmonic Sources from Commercial Loads • Harmonic Sources from Industrial Loads*
1230 – 1245	*Break*

1245 – 1420	***Fundamentals of Harmonics (cont'd)*** *Locating Harmonic Sources • System Response Characteristics • Effects of Harmonic Distortion • Interharmonics*
1420 - 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Two*

Day 3

0730 – 0930	***Applied Harmonics*** *Harmonic Distortion Evaluations • Principles for Controlling Harmonics • Where to Control Harmonics • Harmonic Studies*
0930 – 0945	*Break*
0945 – 1100	***Applied Harmonics (cont'd)*** *Devices for Controlling Harmonic Distortion • Harmonic Filter Design: A Case Study • Case Studies • Standards on Harmonics*
1100 – 1230	***Long Duration Voltage Variations*** *Principles of Regulating the Voltage • Devices for Voltage Regulation • Utility Voltage Regulator Application • Capacitors for Voltage Regulation*
1230 – 1245	*Break*
1245– 1420	***Long Duration Voltage Variations (cont'd)*** *End-User Capacitor Application • Regulating Utility Voltage with Distributed Resources • Flicker*
1420 - 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Three*

Day 4

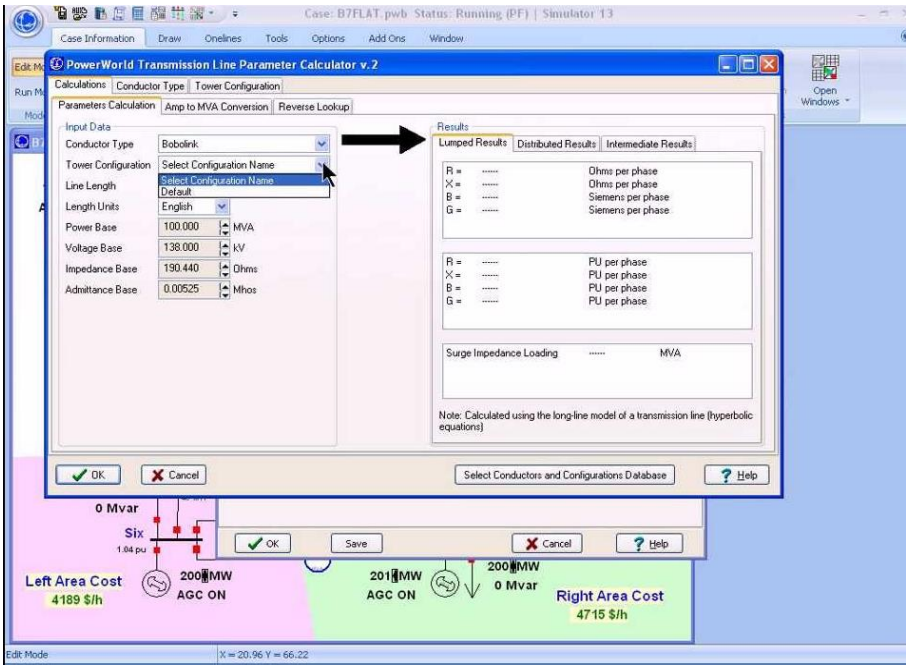
0730 - 0830	***Power Quality Benchmarking*** *Introduction • Benchmarking Process • RMS Voltage Variation Indices • Harmonics Indices*
0830 - 0930	***Power Quality Benchmarking (cont'd)*** *Power Quality Contracts • Power Quality Insurance • Power Quality State Estimation • Including Power Quality in Distribution Planning*
0930 - 0945	*Break*
0945 - 1230	***Distributed Generation & Power Quality*** *Resurgence of DG • DG Technologies • Interface to the Utility System • Power Quality Issues*
1230 - 1245	*Break*
1245 - 1420	***Distributed Generation & Power Quality (cont'd)*** *Operating Conflicts • DG on Low-Voltage Distribution Networks • Siting DG • Interconnection Standards*
1420 - 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Four*

Day 5

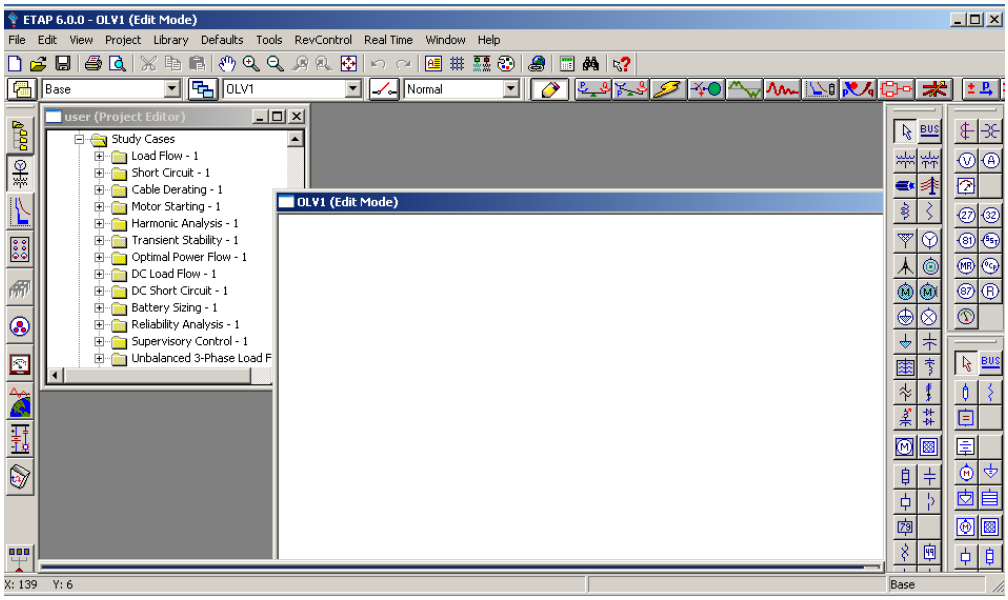
0730 - 0830	***Wiring & Grounding*** *Resources • Definitions • Reasons for Grounding*
0830 - 0930	***Wiring & Grounding (cont'd)*** *Typical Wiring and Grounding Problems • Solutions to Wiring and Grounding Problems*
0930 - 0945	*Break*
0945 - 1230	***Power Quality Monitoring*** *Monitoring Considerations • Historical Perspective of Power Quality Monitoring Equipment • Power Quality Measurement Equipment*
1230 - 1245	*Break*
1245 - 1345	***Power Quality Monitoring (cont'd)*** *Assessment of Power Quality Measurement Data • Application of Intelligent Systems • Power Quality Monitoring Standards*
1345 - 1400	***Course Conclusion*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course*
1400 - 1415	***POST-TEST***
1415 - 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Simulators (Hands-on Practical Sessions)

Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using our state-of-the-art simulators "Power World" and "ETAP software".



Power World Simulator



ETAP Software Simulator

Course Coordinator

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