



## COURSE OVERVIEW EE0130-4D Maintenance and Troubleshooting of Industrial UPS Systems & Battery Power Supplies

### Course Title

Maintenance and Troubleshooting of Industrial UPS Systems & Battery Power Supplies

### Course Date/Venue

August 12-15, 2024/ Ajman Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

### Course Reference

EE0130-4D

### Course Duration/Credits

Four days/2.4 CEUs/24 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.***

As the theory behind all UPS systems is the same, the course will discuss the UPS system in general regardless of the UPS brand, bearing in mind the tremendous number of UPS manufacturers nowadays. Hence, whatever the brand or manufacturer of your UPS system this course is the right course for you.

The course will cover everything the user and maintainer need to know about UPS and batteries. It enumerates the types and duration of power system disturbances and learn the basic concepts of an Uninterruptible Power System (UPS) including the three general types of UPS's and the three types of static UPS's and discuss the electronic components of a UPS system as well as the proper testing and troubleshooting of these power components including the functions of single phase rectifiers & inverters, three phase rectifiers & inverters including the testing and troubleshooting of these single/three phase rectifiers and inverters.

This course is designed to provide delegates with detailed explanation of the theory of operation and circuit board operation of single-phase systems and review the Silicon Controlled Rectifier (SCR) and Constant Voltage Transformer (CVT) theories related to the general theory of operation of three phase systems including its circuit functions and operation & Printed Circuit Board (PCB) operation.





The concepts of primary and secondary batteries, lead acid batteries and nickel cadmium batteries including the safety and maintenance, testing and troubleshooting of faulty batteries including UPS alignment and maintenance by noting manufacturer's recommendations, making use of appropriate tools and equipment, electrical safety, mechanical requirements of component replacement for UPS systems and the major brands of UPS such as GUTOR, ABB etc will also be discussed during the course.

### **Course Objectives**

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

- Maintain and troubleshoot various types of industrial UPS and batteries in a professional manner
- Enumerate the types and duration of power system disturbances and learn the basic concepts of an Uninterruptible Power System (UPS) including the three general types of UPS's and the three types of static UPS's
- Discuss the electronic components of a UPS system as well as the proper testing and troubleshooting of these power components
- Identify the functions of single phase rectifiers & inverters, three phase rectifiers & inverters including the testing and troubleshooting of these single/three phase rectifiers and inverters
- Give a detailed explanation of the theory of operation and circuit board operation of single phase systems
- Review the Silicon Controlled Rectifier (SCR) and Constant Voltage Transformer (CVT) theories related to the general theory of operation of three phase systems including its circuit functions and operation & Printed Circuit Board (PCB) operation
- Describe industrial UPS covering the essential differences between commercial and industrial UPS systems, EMI/RFI and electrical surge levels, IT applications and industrial applications, environmental considerations, fully electronic, industrial static switch
- Identify industrial UPS and batteries and chargers as well as match UPS service life to the critical process service life
- Discuss inverter technologies in industrial UPS including ferroresonant inverter and PWM inverters
- Carryout the concepts of primary and secondary batteries, lead acid batteries, nickel cadmium and lithium ion batteries including the safety and maintenance, testing and troubleshooting of faulty batteries
- Apply proper UPS alignment and maintenance procedures including battery charger and rectifier operation, battery charger PCB operation and alignment procedures as well as battery safety procedures
- Troubleshoot and maintain UPS systems by noting manufacturer's recommendations, making use of appropriate tools and equipment and observing electrical safety
- Explain the mechanical requirements of component replacement for UPS systems
- Identify the major brands of UPS such as GUTOR, ABB etc.





### 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, sample video clips of the instructor’s actual lectures & practical sessions during the course conveniently saved in a **Tablet PC**.

### Who Should Attend

This course provides an overview of all significant aspects and considerations of industrial UPS system for engineers and other technical staff who are involved in maintenance and troubleshooting of UPS systems and battery power supplies.

### 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.

### Accommodation

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

### Course Fee

**US\$ 4,500** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day



**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: -

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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 **2.4 CEUs** (Continuing Education Units) or **24 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.

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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.







### Course Instructor(s)

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



**Mr. Taiseer Ali, MSc, BSc, is a Senior Electrical & Telecommunications Engineer with over 30 years of extensive experience and academic experience as a University Professor specializing in Power System Protection and Relaying, Power Distribution, HV/LV Equipment, High Voltage Electrical Safety, LV & HV Electrical System, HV Equipments Inspection & Maintenance, HV Switchgear Operation & Maintenance, LV Distribution Switchgear & Equipment, Lock & Tag Out, Circuit Breakers & Switchgears, Portable Cables, Transformers, Gas Insulated Substations (GIS), HV Substation Inspection & Reporting, HV Cable Design, HV Electrical System Commissioning, HV Equipments Inspection & Maintenance, Electrical Signal Analysis (ESA), Electrical Equipment Circuits, Wiring & Testing, Electronic Circuits, Electrostatic Discharge (ESD), Distributed Control System (DCS) Applications & Troubleshooting, SCADA & Industrial Communication, Process Logic Controller (PLC), Load Flow Calculation, Cable Installation, Transformer Maintenance, Electrical Safety, Electrical Drawing, Power Generation & Transmission, Power Distribution & Network, Protection Relays, Electrical Troubleshooting, Earthing, Bonding, Lightning & Surge Protection, UPS & Battery, Instrumentation & Control, Process Control & Instrumentation, Industrial Communication, Flow Measurement, Level Measurement, Temperature & Vibration Measurement, Measurement Instrumentation, Pressure Measurement, Analytical Instrumentation, Calibration & Testing Procedures, Final Control Elements, Control Loops Operation, Control Panels, Power Generation, Power Transformers, Uninterruptible Power Systems (UPS), Battery Chargers, AC & DC Transmission, Distribution Network, Grid Input Assessment, Load Flow, Short Circuit, Smart Grid, Grounding, Electrical Equipment, Electrical Motors & Drives, Power System Harmonics, Electrical Substation Design, Power Cable Testing & Fault Location, Circuit Breakers & Switchgears, Electrical Distribution Design, Installation & Commissioning and HVDC Transmission & Control, Advanced Networking, Datron Maintenance, Cisco Internet, Data Base Access, Advanced Computer, AutoCAD, Standard Radio Devices, Advanced Calibration, Repair and Maintenance of VHF Portable Role, Combat Vehicle Reconnaissance 76mm and Target Engagement Using Simulaser.**

During his career life, Mr. Taiseer has gained his expertise and thorough practical experience through handling challenging positions such as being the **Head of the Command Control & Communication Department, Head of the Academic and Technical Branch, Chief of the Frequency Branch, Commander, Electrical Engineer, Spectrum Management Engineer, Safety Engineer, Engineering Manager, Electrical Engineering Head, Quality Control Department Head, Engineering Supervisor and Lecturer/Instructor** for various companies and universities such as the Yarmouk University, C3 Directorate, JAF C3 Communication Workshops, Jordan Armed Forces Joint Officer and Military Communication College and multi-national companies and institutes.

Mr. Taiseer has a **Master's degree in Industrial Engineering/Engineering Management** and a **Bachelor degree in Electrical/Communication Engineering**. Further, he is a **Certified Instructor/Trainer** and delivered various trainings internally in his previous companies.





**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: Monday, 12<sup>th</sup> of August 2024**

|             |   |
|-------------|---|
| 0730 – 0800 | Registration & Coffee   |
| 0800 – 0815 | Welcome & Introduction  |
| 0815 – 0830 | <b>PRE-TEST</b>   |
| 0830 – 0900 | <b>Introduction</b><br>Overview of course • Why have a UPS  |
| 0900 – 0915 | Break   |
| 0915 – 1100 | <b>Types &amp; Duration of Power System Disturbances</b><br>Sags • Surges and Spikes • Power Quality  |
| 1100 – 1230 | <b>Review of Electronic Components</b><br>Volts/Ohms & Amps • Phase Relationships • Resistors/capacitors/ Inductors/RLC Circuits in Series & Parallel • Diodes/Transistors/Thyristors/SCR's/TRIACs/IGBT's/Op Amps • Testing & Troubleshooting of Power Components |
| 1230 – 1245 | Break   |
| 1245 – 1420 | <b>Introduction to UPS's</b><br>Power Conditioners • Uninterruptible Power Systems • Power Quality Source Alternatives • Power Disturbance Cost Comparisons   |
| 1420 – 1430 | <b>Recap</b><br>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: Tuesday, 13<sup>th</sup> of August 2024**

|             |   |
|-------------|---|
| 0730 – 0830 | <b>Three General Types of UPS's</b><br>Kinetic (Motor Generator Sets) • Flywheel • Static & Components  |
| 0830 - 0930 | <b>Three Types of Static UPS's</b><br>Traditional UPS • Static UPS • Static UPS with Bypass   |
| 0930 – 0945 | Break   |
| 0945 – 1100 | <b>UPS Topologies</b><br>Single Phase Rectifiers • Single Phase Inverters • Three Phase Rectifiers • Three Phase Inverters • Testing & Troubleshooting of Single/Three Phase Rectifiers & Inverters       |
| 1100 – 1230 | <b>Single Phase Systems</b><br>Theory of Operation • Single Phase - Circuit Board Operation • Shorting Board • Sync Board • Oscillator Board • Frequency Detector • Logic Board • Voltage & Current Sense |
| 1230 – 1245 | Break   |
| 1245 – 1420 | <b>Three Phase Systems - General Theory of Operation</b><br>Silicon Controlled Rectifier (SCR) Theory • Constant Voltage Transformer (CVT) Theory   |
| 1420 – 1430 | <b>Recap</b><br>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: Wednesday, 14<sup>th</sup> of August 2024**

|             |  |
|-------------|--|
| 0730 – 0830 | <b>Three Phase Systems - Circuit Functions &amp; Operation</b><br>Inverter • Static Switch • Automatic Transfer Switch • Manual Bypass Switch • General Precautions & Safety • Testing & Maintenance of Each Circuit   |
| 0830 – 0930 | <b>Three Phase System - Printed Circuit Board (PCB) Operation</b><br>Frequency Detector • Logic Board • Disconnect • Noise Suppressor • Voltage & Current Sense • Three Phase Control • Gate Transformer • Frequency Meter • Auto-Retransfer • Crest Factor Interface & Relay Boards   |
| 0930 – 0945 | Break  |
| 0945 – 1100 | <b>Industrial UPSs</b><br>The Essential Differences Between Commercial & Industrial UPS Systems • EMI/RFI & Electrical Surge Levels • IT Applications vs. Industrial Applications • Environmental Considerations • Fully Electronic, Industrial Static Switch • Industrial UPS Batteries & Chargers • Matching UPS Service Life to the Critical Process Service Life |
| 1100 – 1230 | <b>Industrial UPS- Inverter Technologies</b><br>Ferroresonant Inverters • PWM (Pulse-Width-Modulated) Inverters • Sizing an Industrial UPS System for Non-Linear Loads   |
| 1230 – 1245 | Break  |
| 1245 – 1420 | <b>Introduction to Batteries</b><br>Primary Batteries • Secondary Batteries  |
| 1420 – 1430 | <b>Recap</b><br>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: Thursday, 15<sup>th</sup> of August 2024**

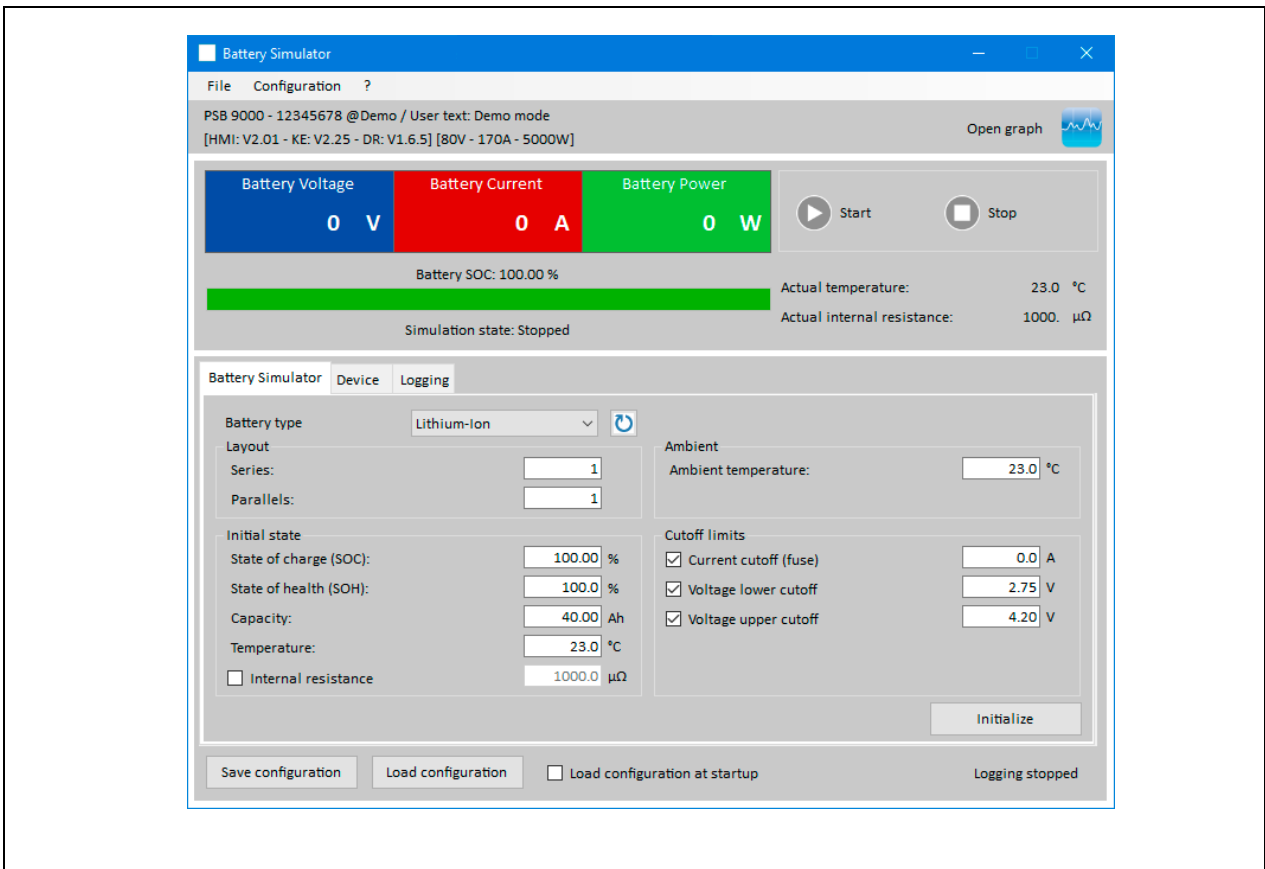
|             |   |
|-------------|---|
| 0730 – 0830 | <b>Lead Acid Batteries</b><br>Chemistry • Different Types • Capacity Factors • S-Curves • Battery Safety & Maintenance • Float & Equalize Voltages • Load Testing • Testing & Troubleshooting of Faulty Batteries           |
| 0830 – 0930 | <b>Nickel Cadmium &amp; Lithium Ion Batteries</b><br>Chemistry • Battery Types • Capacity Factors • Battery Safety & Maintenance • Float & Equalize Voltages • Load Testing • Testing & Troubleshooting of Faulty Batteries |
| 0930 – 0945 | Break   |
| 0945 – 1100 | <b>UPS Alignment &amp; Maintenance Procedures</b><br>Battery Charger & Rectifier Operation • Battery Charger PCB Operation & Alignment Procedures • Battery Safety Procedures   |
| 1100 – 1230 | <b>Troubleshooting &amp; Maintenance of UPS Systems</b><br>Manufacturers Recommendations • Tools & Equipment • Electrical Safety • Mechanical Requirements of Component Replacement   |
| 1230 – 1245 | Break   |
| 1245 – 1345 | <b>Case Studies</b><br>Selection & Sizing • Batteries • UPS's • Batteries & UPS's   |
| 1345 – 1400 | <b>Summary, Course Conclusion, Open Forum &amp; Closure</b>   |
| 1400 – 1415 | <b>POST-TEST</b>  |
| 1415 – 1430 | Presentation of Course Certificates   |
| 1430        | Lunch & End of Course   |





### Simulators (Hands-on Practical Sessions)

Practical session 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 the simulator “Battery simulator”.



### Course Coordinator

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