COURSE OVERVIEW EE0007
Transformer Operation, Maintenance, Diagnosis, Testing & Lifetime Extension



Course Title
Transformer Operation, Maintenance, Diagnosis, Testing & Lifetime Extension

Course Date/Venue
Session 1: May 02-06, 2027/Meeting Plus 9, City Centre Rotana Doha Hotel, Doha, Qatar
Session 2: October 03-07, 2027/Meeting Plus 9, City Centre Rotana Doha Hotel, Doha, Qatar

Course Reference
EE0007

Course Duration/Credits
Five days/3.0 CEUs/30 PDHs

Course Description







This practical and highly-interactive course includes real-life case studies and exercises where participants will be engaged in a series of interactive small groups and class workshops.

The high efficiency and reliability of power transformers have contributed to the domination of power networks since the beginning of the last century. Transformers play also a key role in the interconnection of power systems at different voltage levels. Without transformers, it would simply not be possible to use electric power in many of the ways it is used today. Consequently, transformers occupy prominent positions in the electric power system, being the vital links between power generating stations and points of electric power utilization.

This course is designed to provide delegates a detailed and up-to-date overview of transformer operation, maintenance, diagnosis, testing and lifetime extension. It covers the power transformer fundamentals including the main electric parameters and laws, magnetism and electromagnetism, Lenz and Faradays Laws, circuits, star and delta connections, theory, the role of transformers in power systems, standards, regulations and voltages as well as the various types and construction of transformers.

Further, the course will also discuss the special transformers, transformer components, materials, cooling of transformers, transformer performance, electrical parameters and transformer faults; the power transformer failure and faults; the proper power transformer protection, operation and factory acceptance test (FAT); the transformer installation, testing and commissioning; and the transformer maintenance, routine inspections, diagnostic analysis, life expectancy and extension.

During this interactive course, participants will learn the methods of insulating system and lifetime extension in transformer diagnostic; the insulation system composition, transformer oil types, thermal effects and energy losses; the heat transformer modes, insulation systems oxidation and degradation, corrosive sulphur effect and insulation system aging factors; the aging measurement, electrical diagnosis of insulation system, gas diagnostic analysis and chemical diagnostic analysis; and the physical diagnostics analysis, estimation diagnostic analysis, transformer lifetime extension and remaining life assessment (RLA).

Course Objectives/Outcomes & Benefits for the Participants

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

- Apply and gain systematic techniques and methodologies of transformer operation, maintenance, diagnosis, testing and lifetime extension
- Operate, maintain, troubleshoot and test power transformers in a professional manner
- Discuss the power transformer fundamentals covering the main electric parameters and laws, magnetism and electromagnetism, Lenz and Faradays Laws, circuits, star and delta connections, theory, the role of transformers in power systems, standards, regulations and voltages
- Identify the various types and construction of transformers
- Describe special transformers as well as enumerate transformer components and materials
- Determine cooling of transformers, transformer performance and electrical parameters
- Recognize power transformer failure and faults as well as employ proper power transformer protection, operation and factory acceptance test (FAT)
- Install, test and commission transformer efficiently
- Carryout transformer maintenance, routine inspections, diagnostic analysis, life expectancy and extension
- Apply the methods of insulating system and lifetime extension in transformer diagnostic
- Discuss the insulation system composition, transformer oil types, thermal effects and energy losses
- Identify the heat transformer modes, insulation systems oxidation and degradation, corrosive sulphur effect and insulation system aging factors
- Carryout aging measurement, electrical diagnosis of insulation system, gas diagnostic analysis and chemical diagnostic analysis
- Perform physical diagnostics analysis, estimation diagnostic analysis, transformer lifetime extension and remaining life assessment (RLA)

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 transformer operation, maintenance, diagnosis, testing and lifetime extension for engineers and other technical staff who need a sound understanding of power transformer operation, maintenance, troubleshooting or testing.

Training Methodology

Our courses employ an interactive, learner-centred methodology that integrates theoretical knowledge with practical application. The training is delivered through a suitable combination of some or all of the following methods, selected according to the course content and learning objectives:

- Instructor-led presentations and facilitated discussions
- Practical workshops and participant presentations
- Hands-on exercises and real-world case studies
- Equipment demonstrations and technical drawings
- Hardware- and software-based simulations
- Gamification & Role Play in soft-skills courses only
- Virtual Reality (VR) and Augmented Reality (AR)
- Instructional videos and other relevant training resources

This blended approach encourages active participation, strengthens practical skills and supports the effective application of acquired knowledge in the workplace.

Learning Design & Customization

This course can be customized to the exact requirements of clients. Haward Technology is so proud of our huge capabilities in tailoring our courses to the training needs of our valued clients.

Course Fee

US$ 6,000 per Delegate. This rate includes Participants Pack (Folder, Manual, Hand-outs, etc.), 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

Haward's 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**. Haward's certificates are internationally recognized and accredited by the British Accreditation Council (BAC). 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 instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:



Mr. Ahmed Hayajneh is a **Senior Electrical Engineer** with **20 years** of experience in **Oil**, **Gas**, **Petrochemical**, **Refinery** & **Power** industries. His expertise widely covers in the areas of **HV/MV** Cable Splicing, Jointing, Inspection & Termination, **HV/LV** Equipment, **High Voltage Electrical Safety**, **LV & HV Electrical** System, **HV** Equipment Inspection & Maintenance, **HV Switchgear** Operation & Maintenance, **LV Distribution Switchgear & Equipment**, LV/MV Electrical Safety (**11 KV, 415 & 220 Voltage**), **Power System Equipment**, **Power Cable** Standard and Testing, **Cables & Wiring**, **Overhead Transmission Lines**, **Transmission Network** Maintenance, **Electrical Forecasting** Techniques, **Inspection Reporting** Techniques, **Electrical Substation** Design & Planning, **Electrical Drawings** & **Schematics**, **Fault Detection** Analysis, **Distribution Networks** & **Load Forecasting**, **Power Generation**, **Electrical Power** System, **Electrical** Installations & Utilities, **Electrical Distribution Systems & Control Circuits**, **Electrical Drawings**, **Relay Logic Circuits**, Troubleshooting **Transformers**, **System Grounding**, **Circuit Breakers**, **Protection Devices & Technology**, **Protection Relay**, **Transformers**, **Generators**, **Power Transformers**, **Motors**, **Substations**, **Switchgears & Distribution**, **Power System** Analysis, **Electrical Equipment** Control Systems, **Transformer Maintenance & Testing**, **Electrical Substation & Design**, **Power Quality** Studies & Load Criteria, **Substation Earthing System**, **Electrical Equipment** Maintenance, **Electrical Safety**, **Electrical Protection**, **Batteries**, **Chargers & UPS**, **Electrical Submersible Pumps** (**ESP**), **Power Supply** Substations, Area Classification, Safety Management System, Permit to Work & Issuing Authority, Emergency **Diesel Generator**, **Variable Frequency Drives** (VFD), **PLC & SCADA** for Automation & Process Control, **Automation Solutions & Techniques**, **Automating Process Equipment**, **DCS** Automated Process Control Systems, High & Low Voltage **Electrical Safety**, **Electrical Inspection** & Testing, **Electrical Control** & Monitoring System, **Electric Power System**, Intensive Overhead **Transmission** Line (OHTL), **Generator** Maintenance & Troubleshooting, **Transmission** Line Networks, **Distribution** Engineering, HVDC **Transmission** & Control, **Substation** Maintenance Techniques and **Overhead Power Line** Construction & Patrolling.

Mr. Ahmed gained his expertise and experience through several positions as a **Senior Electrical Project Engineer**, **Senior Electrical Engineer**, **Site Electrical Engineer** and **Senior Instructor/Trainer** for various companies such as United Electro-Mechanical International Company, AL OSAIS Contracting Co., ASTRACO, Saudi Service for Electro Mechanic Work Co. (S.S.E.M), Dubai Electricity & Water Authority (DEWA) and Saudi Electricity Company (SEC).

Mr. Ahmed has a **Bachelor's** degree in **Electrical Engineering**. Further, he is a **Certified Instructor/Trainer** and has delivered various trainings, seminars, conferences, workshops and courses globally.

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	***Power Transformer Fundamentals*** *Main Electric Parameters & Laws ● Magnetism & Electromagnetism ● Lenz & Faraday's Laws*
0930 – 0945	*Break*
0945 -1115	***Power Transformer Fundamentals (cont'd)*** *Single & Three-phase Circuits (3 & 4 Wires) ● Star (Y) & Delta (Δ) Connections ● Basic Transformer's Theory ● The Role of Transformers in Power Systems ● Standards & Regulations ● Standard Voltages*
1115 - 1230	***Types & Construction of Transformers*** *Oil-filled Transformers with Expansion Tanks ● Oil-filled Sealed Transformers ● Dry Transformers ● Gas Insulated Transformers (GIT) ● Two & Three Windings Transformers ● Applications*
1230 - 1245	*Break*
1245 – 1420	***Special Transformers*** *Single Phase Transformers ● Autotransformers ● Arc Furnace Transformers ● Rectifier Transformers ● Zig-Zag & Grounding Transformers ● Instrument Transformers*
1420 – 1430	***Recap***
1430	*Lunch & End of Day One*

Day 2

0730 – 0930	***Transformer Components & Materials*** *Steel Core ● Copper & Aluminium Windings ● Insulation Materials ● Expansion Tank & Radiators ● Expansion Tank & Radiators ● Bushings ● Cooling System ● Tap Changers ● Built-on Protections ● Accessories*
0930 – 0945	*Break*
0945 – 1100	***Cooling of Transformers*** *Heat Dissipation & Load ● Environment & Cooling of Transformers ● Cooling Fluids ● Types of Cooling Systems & Notations (ONAN; ONAF; OFAF; OFWF; AN; GIT) ● Types of Cooling Systems & Notations (ONAN; ONAF; OFAF; OFWF; AN; GIT) (cont'd) ● Rated Power & Cooling System*
1100 - 1230	***Transformer Performance & Electrical Parameters*** *Rated Power ● Rated Voltages & Ratio ● Rated Frequency Losses & Efficiency ● Impedance Voltage Drop*
1230 - 1245	*Break*
1245 - 1420	***Transformer Performance & Electrical Parameters (cont'd)*** *Vector Group ● Voltage Regulation (On-load Tap Changers & Off-load Tap Changers)*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Two*

Day 3

0730 – 0930	***Power Transformer Failure & Faults*** *Causes of Failure ● Oil & Insulation Faults ● Windings Faults ● Overloads & Overheating ● Assessing Risk Failure ● Preparing a Risk Based Transformer Management Program*
0930 – 0945	*Break*
0945 – 1100	***Power Transformer Protection*** *Built-on Protections ● Differential Protection ● Overcurrent Protection ● Restricted Earth Fault Protection ● Overload Protection*
1100 – 1230	***Transformer Operation*** *Inrush Currents & Harmonics ● Parallel of Transformers ● Power Factor ● Power Factor (cont'd) ● Lightning & Switching Overvoltages ● Surge Arresters ● Fire Protection*
1230 – 1245	*Break*
1245 - 1420	***Factory Acceptance Tests (FAT)*** *Type Tests ● Routine Tests ● Routine Tests ● Special Tests ● Oil Testing*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Three*

Day 4

0730 - 0930	***Transformer Installation, Testing & Commissioning*** *General Layout ● Floor Mounted Transformers ● Pad Mounted Transformers ● Pole Mounted Transformers ● Oil Retention Basin*
0930 – 0945	*Break*
0945 – 1100	***Transformer Installation, Testing & Commissioning (cont'd)*** *Neutral Grounding ● Earthing & Bonding ● Transportation & Handling ● Site Acceptance Tests (SAT)*
1100 - 1230	***Transformer Maintenance, Routine Inspections & Diagnostic Analysis*** *Establishing a Preventive Maintenance & Inspection Program ● Safety ● Visual Inspection ● Insulation Resistance (Oil & Solid) ● Insulation Power Factor (PF) ● Oil Analysis & Samples ● Windings*
1230 - 1245	*Break*
1245 – 1420	***Transformer Maintenance, Routine Inspections & Diagnostic Analysis (cont'd)*** *Windings ● Tank & Conservator ● On-load Tap Changer ● Bushings ● Cooling System ● Accessories & Auxiliary Equipments ● Infrared Thermography ● Schedule of Preventive Maintenance Actions & Inspections ● Procedures*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Four*

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Day 5

0730 – 0830	***Transformer Life Expectancy*** *Mean Time Between Failures (MTBF) ● Insulation System Aging Factors*
0830 - 0930	***Transformer Life Expectancy (cont'd)*** *Oil ● Paper ● Bushings*
0930 – 0945	*Break*
0945 – 1100	***Transformer Diagnostic: Methods of Insulating System & Lifetime Extension*** *Insulation System Composition ● Transformer Oil Types ● Thermal Effects ● Energy Losses*

1100 - 1230	***Transformer Diagnostic: Methods of Insulating System & Lifetime Extension (cont'd)*** *Modes of Heat Transfer ● Oxidation & Degradation of Insulation Systems ● Corrosive Sulphur Effect ● Insulation System Aging Factors*
1230 – 1245	*Break*
1245 – 1315	***Transformer Diagnostic: Methods of Insulating System & Lifetime Extension (cont'd)*** *Aging Measurement ● Electrical Diagnosis of Insulation System ● Gas Diagnostic Analysis ● Chemical Diagnostic Analysis*
1315 - 1345	***Transformer Diagnostic: Methods of Insulating System & Lifetime Extension (cont'd)*** *Physical Diagnostics Analysis ● Estimation Diagnostic Analysis ● Transformer Lifetime Extension ● Remaining Life Assessment (RLA)*
1345 – 1400	***Course Conclusion***
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Practical Sessions

This practical and highly-interactive course includes real-life case studies and exercises:-



Course Coordinator

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