

**COURSE OVERVIEW EE0229**  
**PS-EIA-PDT-101 Power and Distribution Transformers**  
**(E-Learning Module)**

**Course Title**

PS-EIA-PDT-101 Power and Distribution Transformers (E-Learning Module)

**Course Reference**

EE0229

**Course Format & Compatibility**

SCORM 1.2. Compatible with IE11, MS-Edge, Google Chrome, Windows, Linux, Unix, Android, IOS, iPadOS, macOS, iPhone, iPad & HarmonyOS (Huawei)

**Course Duration**

30 online contact hours  
(3.0 CEUs/30 PDHs)



**Course Description**



This E-Learning course is designed to provide participants with a detailed and up-to-date overview of power and distribution transformers. It covers the magnetic field, magnets, names of poles and various shapes of magnets; the magnetic force, attraction, repulsion, magnetic and electric fields; the electric charges, magnetism difference and electromagnetism; the making of an electromagnet; the wire in a coil, iron core, AC electricity, strength of electromagnetic field, unit, current, turns of coil, distance and effect of iron core; the electromagnetic induction and self and mutual inductance; and the direction of current and the three-phase system, star connection, vector diagram, delta connection, Y-connected load,  $\Delta$ -connected load and Y- $\Delta$  equivalence.

During this course, participants will learn the power in three-phase circuits, three wire system, three-phase bases and three-phase power measurement; the transformer theory, purpose and scope; the types of transformers, transformer applications, magnetic circuit, core material, winding, current and voltage ratios; the laws of transformer, principle of operation of a transformer, reflected impedance and transformer equivalent circuit; the transformer construction, core configurations, three-phase transformer cores assembly and corner jointing of limbs with yokes; and the core and shell form construction, transformer windings, power transformer cooling and sealing systems.

### **Course Objectives**

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

- Apply and gain an in-depth knowledge on power and distribution transformers
- Recognize magnetic field, magnets, names of poles and various shapes of magnets
- Discuss, magnetic force, attraction, repulsion, magnetic and electric fields, electric charges and magnetism difference and electromagnetism
- Make an electromagnet and explain how electromagnetism works
- Describe wire in a coil, iron core, AC electricity, strength of electromagnetic field, unit, current, turns of coil, distance and effect of iron core
- Recognize electromagnetic induction and self and mutual inductance
- Determine direction of current including the three-phase system, star connection, vector diagram, delta connection, Y-connected load,  $\Delta$ -connected load and Y- $\Delta$  equivalence
- Describe power in three-phase circuits, three wire system and three-phase bases as well as carryout three-phase power measurement
- Explain transformer theory, purpose and scope as well as identify the types of transformers, transformer applications, magnetic circuit, core material, winding, current and voltage ratios
- Discuss the laws of transformer, principle of operation of a transformer, reflected impedance and transformer equivalent circuit
- Carryout transformer construction, core configurations, three-phase transformer cores assembly and corner jointing of limbs with yokes
- Describe core and shell form construction, transformer windings, power transformer cooling and sealing systems

### **Who Should Attend**

This course provides an overview of all significant aspects and considerations of power and distribution transformer for electrical power managers, engineers, superintendents, supervisors, foremen and those who are involved in the design, engineering, operation, maintenance and control of the electric power system or those who are interested in obtaining a working knowledge of the modern electric power system.

### **Training Methodology**

This Trainee-centered course includes the following training methodologies:-

- Talking presentation Slides (ppt with audio)
- Simulation & Animation
- Exercises
- Videos
- Case Studies
- Gamification (learning through games)
- Quizzes, Pre-test & Post-test


Every section/module of the course ends up with a Quiz which must be passed by the trainee in order to move to the next section/module. A Post-test at the end of the course must be passed in order to get the online accredited certificate.

### Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course.

### Certificate Accreditations


Certificates are accredited by the following international accreditation organizations: -

-  USA International Association for Continuing Education and Training (IACET)

Haward Technology is an Authorized Training Provider by the International Association 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 1-2013 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 1-2013 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 Association 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.

-  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 Fee

As per proposal

## Course Contents

- Introduction & Basics
- Introduction
- Magnetic Field
- Magnets
- Names of poles
- Various shapes
- Cutting a magnet
- Magnetic Force
- Attraction
- Repulsion
- Magnetic and Electric Fields
- Electric charges and magnetism different
- In conclusion
- Electromagnetism
- Questions you may have include
- Making an Electromagnet
- Turn on and off
- How Electromagnetism Works
- Wire in a coil
- Iron core
- Using AC electricity
- Strength of Electromagnetic Field
- Unit
- Current
- Turns of coil
- Distance
- Effect of iron core
- Conclusion
- Electromagnetic Induction
- Induced E.M.F
- Inductor

- Self-Inductance
- Mutual Inductance
- Direction of current
- Three Phase System
- Star Connection (Y)
- Vector Diagram
- Delta Connection (D)
- Y-connected Load
- $\Delta$ -connected Load
- Y- $\Delta$  Equivalence
- Three Phase Circuit
- Power in three-phase circuits
- Introduction and Basics
- Three Phase Power Measurement
- Three wire system
- Per Unit Values
- 9-per-Unit Values
- Defining Bases
- Three phase bases
- Example
- Transformers in Per Unit Calculations
- Course Recap
- Transformer Theory
- Purpose
- Scope
- Types of Transformers.
- Transformer Applications
- Magnetic Circuit
- Core Material
- Winding, Current and Voltage Ratios
- Example
- Laws of Transformer
- Principle of Operation of a Transformer

- Example
- Reflected Impedance
- Transformer Equivalent Circuit
- Course Recap
- Transformer Construction
- Introduction
- Core Material
- Core Configurations
- Core Sheets
- Core Cross Sectional Area
- Core Assembly
- Three-Phase Transformer Cores Assembly
- Single-Phase Transformer Cores
- Corner Jointing of Limbs with Yokes
- Oil Ducts
- Core form Construction
- Shell form Construction
- Transformer Windings
- Course Recap
- Power Transformer Cooling and Sealing Systems
- Introduction
- Cooling Arrangement
- ONAN Type Cooling (Oil to Air - OA)
- ONAF Type Cooling (Oil to Air OA/ Forced Air FA)
- OFAF Type Cooling (Forced Oil AIR FOA)
- OFWF Type Cooling
- Forced Directed Oil Cooling
- Gas Insulated Transformer (GIS )
- Layout Example of a Gas Insulated Substation
- Comparison
- Temperature Gauges
- Transformer Oil Temperature Gauge
- Winding Temperature Gauge

- Oil Level Gauge
- Thermal Time Constant of Power Transformer
- Course Recap
- Transformer Performance and OLTC & ALTC Tap Changers
- Nameplate Data
- Transformer Parameters
- Determining the Circuit Parameters from Tests
- Percentage Impedance
- Calculations of % Regulation Using % Impedance
- Three Phase Transformer
- Y-Y Connection of Transformers
- $\square$  -  $\square$  Connection of Transformers
- $\square$ -Y and Y- $\square$  Connection of Transformers
- Terminal Marking
- Vector Group
- Scott Connection
- Auto-Transformer
- Transformer Tap Changer
- Types of Tap Changers
- Connections of Tapping Windings
- Location of On-Load Tap Changer
- Diverter Switch Contact Life
- Automatic Control of Tap Changers
- What is Line Drop Compensation (LCD)?
- Automatic Control of Tap Changers
- Transformer Power Factor pf and Harmonics
- Introduction
- Causes of Low Power Factors
- Known Loads Power Factors
- Annual Power Factor Penalty
- Unfavorable Effects of Low Power Factor loads
- Capacitor Price Simple Payback
- Power Factor Improvement



- Power Factor Improvement for Power Transformer
- Transformer Reactance
- Capacitor Sizes Required to Compensate the No-load Reactive Power of Transformers
- Voltage Rise
- Harmonics
- Waveform
- Course Recap
- Transformer Protection
- Transformer Faults
- Protection Against External Faults
- Differential Relays
- Biased Differential Relays
- Restricted Earth Fault Protection
- Over Current Protection
- Gas Operated (Buchholz) Relay
- Construction
- Operation
- Sudden Pressure Relay
- The Internal Fault Detector (IFD)
- Explosion Vents
- Temperature Indicator
- Tank Earth Protection
- Do It Yourself
- Oil Testing
- Definitions
- Viscosity
- Flash Point
- Dielectric Strength
- Loss Tangent/Dielectric Dissipation Factor (DDF)
- Pour Point
- Fire Point
- Power Factor
- Furans





- Neutralization Number
- Density
- Functions of Transformer Oil
- Transformer Oil Properties
- Transformer Oil Standards
- Hydrocarbon Compounds in Transformer Oil
- Moisture Problems
- Where Does the Water Come From?
- Moisture in Transformer Insulation
- Cellulose Degradation
- Oil Dielectric Strength Test
- Relative Water Content Test
- Physical & Chemical Tests (Polar Characteristics of Oil)
- Transformer Dissolved Gas-in-oil Analysis (DGA)
- Ratio Methods for Dissolved Gas in Oil Result Interpretation
- Overview of IEC Ratio Method
- Threshold Values
- Troubleshooting Chart
- Oil Color Test
- Insulating Oil Sampling Procedure
- Location of Oil Sampling
- Cases for Oil Sampling
- Oil Purification and Dehydration
- Oil Aging
- Preventive Maintenance Procedures for Transformer Oil
- Course Recap
- Transformer Testing
- Abnormal Operating Conditions of Power Transformer
- Reasons for Transformer Testing
- Transformer Performance Assurance
- Classification of Transformer Tests
- Transformer Routine Tests
- Special Tests

- Winding Resistance Test
- DC Voltampere Method
- Bridge Method
- Application
- Polarity Test
- Ratiometer Test
- Ratiometer Transformer
- No-Load Losses Test
- Test Requirements
- Measurement of No-Load Losses
- Measurement of Excitation Current
- Measuring Circuitry for Three Phase Transformers
- Load Losses Test
- Percent Impedance Voltage Measurement
- Leakage Reactance Measurement
- Efficiency Test
- Winding Insulation Resistance Test
- Winding Insulation Capacitance & Dissipation Factor (TAN  $\delta$ ) Test
- Oil Pressure Test
- Temperature Rise Test
- Transformer Arrival: Handling, Inspection and Pre-Commissioning
- Course Recap
- Transformer Diagnostics, And Monitoring
- Safety
- Fire Safety
- Visual Inspection
- Transformer Diagnostics
- Infrared
- IR for Transformer Tanks
- IR Transformer Cabinet Terminal Block Connections
- Doble Tests on Insulation
- High Voltage Insulator Coating
- Ultrasonic & Sonic Fault Detection

- Core Insulation Resistance
- Transformer Operating History
- Transformer Monitoring
- Transformer Status Monitoring System
- Gas-in-Oil Monitoring Unit
- Moisture Monitoring Sensor
- LTC Operation Monitoring Sensor
- Transformer Maintenance Management
- Maintenance Activities
- Transformer Maintenance Categories
- Transformer Maintenance Schedules
- Do It Yourself