TABLE OF CONTENTS

1. ARTECHE, Cluster of Knowledge | 4

2. Technical training | 4

3. Programmed open courses | 5
   › Webinars
   › In-person

4. Closed courses with predefined programs. Modularity to the service of our customers | 7
   › Measurement and instrument transformers
   › Substation automation systems
   › Power quality systems and distribution automation

5. Remarks | 22
1. ARTECHE, Cluster of Knowledge

Knowledge is the key to making effective decisions and minimizing risks.

ARTECHE makes available to its clients the knowledge and years of experience in qualification and training services, both theoretical and practical, in different areas of product and application.

With local presence in over 120 countries and its own centers in more than 8, ARTECHE offers a wide spectrum of training modules, which can be combined to meet the specific needs of each situation and each professional.

2. Technical training

ARTECHE offers different types of training in different languages to meet each need:

› **Programmed Open Courses**, with a theoretical and practical scope, taught in our facilities, with access to laboratories and real equipment testing, and sharing experiences with the trainers and all the registered participants.

› **Closed Courses with Predefined Programs**, taught both, in our own facilities and also of our clients; Modular theoretical and/or practical contents, which can be mixed and combined depending on the different profiles of attendees.

› **Closed Courses with Customized Programs**, in order to deepen and professionalize aspects of greater relevance and interest for human teams, proposing ad-hoc topics and adapting them so they can be taught in any modality, at the client’s house or at the factory.

From general concepts to specific knowledge of products and applications, always with the goal that participants can use this learning to improve their daily operations, whether in the field of technical specification, engineering, network operating, asset management...
3. Programmed open courses
3. Programmed Open Courses

WEBINARS:
Currently focused on 3 knowledge areas:

› Operation, Maintenance and Commissioning of Measurement and Instrument Transformers.
› Substation automation system - SAS. System maintenance. Configuration tools. 61850 Communications.
› Reactive Power Compensation Systems.

During the webinar, support tools for the delivery of each course will be analyzed and used.

The dates and programs for 2019 will be announced through our communication channels and commercial networks.

IN-PERSON:
ARTECHE will organize, in its Mungía (Spain) facilities, open courses with closed predefined program, in theoretical/practical model, available to everyone who wish to participate.

The dates and programs for 2019 will be announced through our communication channels and commercial networks.
4. Closed courses with predefined programs. Modularity at the service of our customers.
MEASUREMENT AND INSTRUMENT TRANSFORMERS
Measurement and Instrument Transformers

INSTRUMENT TRANSFORMER THEORY.
INTRODUCTION:

➤ Goal: To get familiar with the basic characteristics and generalities of a measurement and instrument transformer.
➤ Aimed at: Novice engineers and technicians who are just getting started in the electricity sector, who are not yet familiar with measuring equipment and who want to acquire a basic knowledge of the assets of the electrical installations.
➤ Modality: Theoretical.
➤ General program:
  1. What are they and what are they for
  2. Classification
  3. Connection of transformers to the network
  4. Requirements
  5. Current transformer with measurement function
  6. Current transformer with protection function
  7. Voltage transformer with measurement and protection function
➤ Module duration: 5h.
➤ Available languages: SP-EN-PT (*)
➤ Reference: T2A

INSTRUMENT TRANSFORMER THEORY.
APPROACH:

➤ Goal: To broaden the knowledge on the particular characteristics of a measurement and instrument transformer.
➤ Aimed at: Novice engineers and technicians who are starting in the electrical sector, with low familiarization in measurement equipment and who want to have a better knowledge of the assets of the electrical installations.
➤ Observations: Complementary module of reference T2A.
➤ Modality: Theoretical.
➤ General program:
  1. Why are they used and where can they be found?
  2. Transformer components
  3. Internal insulation technologies
  4. External insulation technologies
  5. Tests
  6. Aging
  7. Maintenance
  8. Costs
➤ Module duration: 16h.
➤ Available languages: SP-EN-PT (*)
➤ Reference: T2B
FACTORS THAT INFLUENCE THE COST/SPECIFY MEASUREMENT TRANSFORMERS:

› **Goal:** Analyze the particular technical characteristics and variants that influence the cost of a measurement and instrument transformer.
› **Aimed at:** Engineers and technicians with knowledge of instrument transformers, who need to have a specific knowledge of the impacts on the sizing of assets of electrical installations.
› **Modality:** Theoretical.
› **General program:**
  1. Measurement transformers
  2. Types of transformers
  3. Insulation and construction technologies
  4. Basic characteristics
  5. Main variants influencing the cost
› **Module duration:** 5h.
› **Available languages:** SP-EN-PT (*)
› **Reference:** T2K

HV/MV INSULATION:

› **Goal:** Examine the particular characteristics of technical parameters in a measurement and instrument transformer.
› **Aimed at:** Engineers and technicians with knowledge of instrument transformers, who require specific knowledge of the technical parameters of the assets of the electrical installations.
› **Modality:** Theoretical.
› **General program:**
  1. What are they and why are they used for?
  2. Classification
  3. Requirements
  4. Insulation technologies
› **Module duration:** 5h.
› **Available languages:** SP-EN-PT (*)
› **Reference:** T2H

HARMONICS MEASUREMENT - STATE OF THE ART:

› **Goal:** Approach the particular characteristics of technical parameters in a measurement and instrument transformer.
› **Aimed at:** Engineers and technicians with knowledge of instrument transformers, who require specific knowledge of the technical parameters of the assets of the electrical installations.
› **Modality:** Theoretical.
› **General program:**
  1. What are harmonics
  2. Which are their effects
  3. Harmonic measurement requirements
  4. Behavior of measurement transformers and other solutions against harmonics
› **Module duration:** 5h.
› **Available languages:** SP-EN (*)
› **Reference:** T2M
Measurement and Instrument Transformers

COURSE OF OPERATION, PREDICTIVE/PREVENTIVE MAINTENANCE AND COMMISSIONING OF MEASUREMENT TRANSFORMERS.

› **Goal:** To deepen the particular characteristics for the operation, commissioning and maintenance of a measurement and instrument transformer.

› **Aimed at:** Senior operation and maintenance engineers and technicians, with a high degree of familiarity in measurement equipment, knowledge of instrument transformers, and requiring action and greater knowledge of the assets of electrical installations.

› **Modality:** Theoretical.

› **General program:**
  1. Characteristics of the transformers
  2. Current transformers
  3. Inductive voltage transformers
  4. Capacitive voltage transformers
  5. Special care
  6. Less common types of transformers
  7. Maintenance and diagnosis goal
  8. Factors affecting the performance of the transformer
  9. Reliability and safety of measurement transformers
  10. Aging of the insulator
  11. Problems during handling and transportation
  12. Maintenance
  13. Technical instructions: transport, storage, handling, installation, maintenance, recommendations and environment
  14. Commissioning

› **Module duration:** 16h.

› **Available languages:** SP-EN (*)

› **Reference:** T2U

INDUCTIVE VOLTAGE TRANSFORMERS.

› **Goal:** Deepen the specific technical characteristics of a type of measurement and instrument transformer.

› **Aimed at:** Engineers and technicians with basic or general knowledge about instrument transformers, who need to get familiar with specific parameters of these assets of the electrical installations.

› **Modality:** Theoretical.

› **General program:**
  1. Why are they used and where can they be found?
  2. Inductive voltage transformer components
  3. Insulation technologies
  4. Internal insulation technologies
  5. External insulation technologies
  6. Tests and regulation
  7. Aging
  8. Parameters of definition and cost
  9. Measurement function and voltage protection
  10. Maintenance

› **Module duration:** 8h.

› **Available languages:** SP-EN (*)

› **Reference:** T2R
Measurement and Instrument Transformers

CAPACITOR VOLTAGE TRANSFORMERS.

› **Goal:** Deepen the specific technical characteristics of a type of measurement and instrument transformer.
› **Aimed at:** Engineers and technicians with basic or general knowledge about instrument transformers, who need to get familiar with specific parameters of these assets of the electrical installations.
› **Modality:** Theoretical.
› **General program:**
  1. Why are they used and where can they be found?
  2. Transformer components
  3. Insulation technologies
  4. Internal insulation technologies
  5. External insulation technologies
  6. Tests and regulation
  7. Aging
  8. Parameters of definition and cost
  9. Measurement function and voltage protection
  10. Maintenance
› **Module duration:** 8h.
› **Available languages:** SP-EN (*)
› **Reference:** T2S

CURRENT TRANSFORMERS.

› **Goal:** Deepen the specific technical characteristics of a type of measurement and instrument transformer.
› **Aimed at:** Engineers and technicians with basic or general knowledge about instrumentation transformers, who need to get familiar with specific parameters of these assets of the electrical installations.
› **Modality:** Theoretical.
› **General program:**
  1. Why are they used and where can they be found?
  2. Transformer components
  3. Insulation technologies
  4. Internal insulation technologies
  5. External insulation technologies
  6. Different designs of current transformers
  7. Tests
  8. Aging
  9. Parameters of definition and cost
  10. Measurement and Protection function - Saturation flow
  11. Accuracy class PR
  12. Remanence in current transformers
  13. Relationship between various types of classes
  14. Minimum requirements for specification of each class
  15. Substitution of a standard core for a core with air-gaps
  16. Application recommendation
› **Module duration:** 8h.
› **Available languages:** SP-EN (*)
› **Reference:** T2P
Measurement and Instrument Transformers

**INTRUMENT TRANSFORMERS FOR SSAA - STATE OF THE ART:**

- **Goal:** To get familiar with the specific technical characteristics of an inductive measuring transformer with power applications.
- **Aimed at:** Engineers and technicians with basic knowledge or general on transformers, who need to get familiar with specific parameters of these assets of the electrical installations.
- **Modality:** Theoretical.
- **General program:**
  1. Auxiliary services relevance
  2. Origin of the need
  3. Alternative general requirements
  4. Definition and technical requirements
  5. Standards
  6. Tests
  7. Secondary measure and protection
  8. Three-phase and single-phase transformers
  9. HV connection and influences in protections
  10. Regulations
  11. Models and applications
- **Module duration:** 3h.
- **Available languages:** SP-EN (*)
- **Reference:** T2D

**RESONANCE PHENOMENON.**

- **Goal:** Get familiar with the particular characteristics of technical parameters in a measurement and instrument transformer.
- **Aimed at:** Engineers and technicians with knowledge of instrumentation transformers, who require specific knowledge of the technical parameters of the assets of the electrical installations.
- **Modality:** Theoretical.
- **General program:**
  1. Ferroresonance description
  2. Effects and costs
  3. Resonance
  4. Ferroresonance
  5. Characteristics of ferroresonance
  6. Network configurations prone to ferroresonance
  7. Modeling
  8. Mitigation
- **Module duration:** 5h.
- **Available languages:** SP-EN (*)
- **Reference:** T2T
Measurement and Instrument Transformers

TESTS IN MEASUREMENT TRANSFORMERS.

› **Goal:** To be familiar with the specific and particular tests in a measurement and instrument transformer.
› **Aimed at:** Engineers and technicians with knowledge of instrument transformers, who need to operate or certify compliance with current regulations on the assets of electrical installations.
› **Modality:** Theoretical/Theoretical and practical.
› **General program:**
  1. Definition and importance
  2. Classification
  3. Application of tests according to type of transformer
  4. Routine tests
  5. Type tests
  6. Special tests
› **Module duration:** 5h (theoretical), 8h (theoretical/practical).
› **Available languages:** SP-EN (*)
› **Reference:** T2C

MEASUREMENT TRANSFORMERS STANDARDS AND REGULATIONS.

› **Goal:** Deepen the specific tests and different regulations applicable for a measurement and instrument transformer.
› **Aimed at:** Engineers and technicians with knowledge of instrument transformers, who need to specify or certify compliance with current regulations on the assets of electrical installations.
› **Modality:** Theoretical/Theoretical and practical.
› **Observations:** Complementary module of reference T2C.
› **General program:**
  1. What are the standards
  2. IEC 61869 standards (CT-MVT-CVT-Sensors)
  3. IEEE C57.13 standards (CT-MVT)
  4. ANSI/NEMA standards (CVT)
› **Module duration:** 5h (theoretical), 8h (theoretical/practical).
› **Available languages:** SP-EN (*)
› **Reference:** T2I

MEDIUM VOLTAGE INSTRUMENT TRANSFORMERS.

› **Goal:** Get familiar with the particular characteristics of technical parameters in a measurement and instrument transformer.
› **Aimed at:** Engineers and technicians with knowledge of instrumentation transformers, who require specific knowledge of the technical parameters of the assets of the electrical installations.
› **Modality:** Theoretical.
› **General program:**
  1. Specifications for Medium Voltage Instrument Transformers
  2. Ratings and Requirements for Current and Voltage Transformers
  3. Calculations for Instrument Transformers
  5. Conventional solutions
› **Module duration:** 7h.
› **Available languages:** SP-EN (*)
› **Reference:** T2Y
SUBSTATION AUTOMATION SYSTEMS
Substation automation systems

AUTOMATION SYSTEM - SAS. INTRODUCTION.

› **Goal:** Get familiar with the basic characteristics and generalities of an Electric Power System.
› **Aimed at:** Novice engineers and technicians who are just getting started in the electrical sector, who are not familiar with Power Systems in Substations and who want to have basic knowledge about Automation of electrical installations.
› **Modality:** Theoretical.
› **General program:**
  1. Electric Power System
  2. Primary equipment in Electrical Substations
  3. Control systems
  4. SAS
  5. Common symbols in single-line electric diagram
  6. Automation functions
  7. Bar topology
  8. Protection in Electrical Substations
  9. Current Protections
  10. Synchronism protection
  11. Reclose
  12. Distance protection
  13. Differential Protection
  14. Teleprotection
  15. Standard substation protection schemes
› **Module duration:** 13h.
› **Available languages:** SP-EN (*)
› **Reference:** T1A

COMMUNICATION SYSTEMS BASED ON THE IEC 61850 STANDARD.

› **Goal:** Start to deepen the communication systems in a Substation Automation System, based on the IEC 61850 standard.
› **Aimed at:** Engineers and technicians with knowledge of protection systems, control, measurement and/or communication of a substation, which require a specific knowledge of new communication standards.
› **Modality:** Theoretical.
› **General program:**
  1. Introduction to the IEC 61850 standard Implementation of Protection, Control and Supervision functions using devices, logical nodes and GOOSE messages
  2. Implementation of different Protection and Control logics
  3. Protection scheme tests that use GOOSE messages
  4. IEC 61850 standard and UCA (International Users Group)
  5. Maintenance techniques based on IEC 61850
› **Module duration:** 16h.
› **Available languages:** SP-EN (*)
› **Reference:** T1B


Substation automation systems

**EQUIPMENT WITH COMMUNICATION PROTOCOL BASED ON THE IEC 61850 STANDARD.**

- **Goal:** Deepen the communication systems in a Substation Automation System, based on the IEC 61850 standard.
- **Aimed at:** Engineers and technicians with knowledge of protection, control, measurement and/or communication systems of a substation, who require specific knowledge of new communication standards.
- **Observations:** Continuing module of Reference T1B.
- **Modality:** Theoretical.
- **General program:**
  1. Description of a SAS
  2. Configuration of connections to the Ethernet networks of the substation
  3. XML Management, interpretation and generation of XML
  4. Configuration files import, export and resolution of conflicts in XML files
  5. DataSet configuration
  6. Logical nodes configuration
  7. GOOSE messages configuration
  8. IHM graphic editor
  9. Database
- **Module duration:** 24h.
- **Available languages:** SP-EN (*)
- **Reference:** T1C

**DISTRIBUTION NETWORKS.**

- **Goal:** Analyze the most general aspects of the structures and characteristics of Distribution Networks. Describe the different methods to perform load flows in distribution networks. Determine its behavior in stable state. Selection and coordination of the different protections in radial networks.
- **Aimed at:** Engineers and technicians with general knowledge about protection, control, measurement and/or communication systems of a substation, who need to get more familiar with the distribution networks.
- **Modality:** Theoretical.
- **General program:**
  1. General considerations on distribution networks
  2. Time behavior of loads
  3. Distribution transformers
  4. Calculation of voltage drops, power and energy losses in distribution circuits
  5. Effect of capacitors on distribution networks
  6. Analysis of protections in radial networks
  7. Visual analyzer of electric power distribution systems
- **Module duration:** 24h.
- **Available languages:** SP-EN (*)
- **Reference:** T1D
Substation automation systems

SHORT-CIRCUITS ANALYSIS.

› **Goal:** Analyze the possible types of short circuits and failures in electrical systems, as well as the methods for calculating them.
› **Aimed at:** Engineers and technicians with knowledge about protection and control systems of a substation, who require to deepen specific parameters of networks.
› **Modality:** Theoretical.
› **General program:**
  1. Basic concepts
  2. Representation of elements in industrial systems
  3. Types of short circuit failures in electrical systems
  4. Methods for calculating short-circuit currents
  5. Symmetric components method
  6. Program for the calculation of short circuit in industrial systems
› **Module duration:** 16h.
› **Available languages:** SP-EN (*)
› **Reference:** TIE

PROTECTING CALCULATION AND SETTING COORDINATION.

› **Goal:** To get familiar with the basic characteristics and generalities of protection devices, adjustment parameter calculations, connections, and the principles of operation for protection relays.
› **Aimed at:** Engineers and technicians with general knowledge about protection, control, measurement and/or communication systems of a substation, who need to get more familiar with the protection and application area.
› **Modality:** Theoretical and practical.
› **General Program:**
  1. Introduction to the Protecting calculation and setting coordination studies
  2. Protection Systems Evolution
  3. Electric Power System Behaviour
  4. Protection Philosophy
  5. Instrument Transformers in a Protection System
  6. Principle of calculation
  7. Overcurrent relay characteristics
  8. Limits to protect
  9. Protection relay coordination
  10. Remarks for Protecting calculation and setting coordination studies
  11. Settings calculation
  12. Samples/ Solutions
  13. Practical sample with SW ASPEN ONELINER
› **Module duration:** 24h.
› **Available languages:** ES-EN (*)
› **Reference:** T1G
POWER QUALITY SYSTEM AND DISTRIBUTION AUTOMATION
Power quality systems and distribution automation

**REACTIVE POWER COMPENSATION SYSTEMS.**

› **Goal:** Analyze the most relevant aspects to be taken into account in the choice of capacitor banks and harmonic filters as reactive power compensation systems in an electrical installation, as well as their associated operation and maintenance.

› **Aimed at:** Engineers and technicians, including Maintenance, with general knowledge about reactive compensation systems in a substation, who require to deepen its operation and Maintenance.

› **Modality:** Theoretical.

› **General program:**
   1. Introduction
   2. Information security
   3. Operation conditions
   4. Inspection and Maintenance
   5. Installation
   6. Commissioning
   7. Main components
   8. Protection devices
   9. Operation procedures
   10. Safe de-energizing
   11. Maintenance
   12. Recycling (Components)
   13. Protection and control configuration
   14. Basic theory of power quality

› **Module duration:** 16h.

› **Available languages:** SP-EN-PT (*)

› **Reference:** T14A

**POWER QUALITY IMPROVEMENT AND AD-HOC SOLUTIONS**

› **Goal:** Explain the variables that affect the power quality in a generation system and describe different solutions for grid code compliance

› **Aimed at:** Engineers and technicians, with general knowledge of grid code requirements and compliance, who require deepening their knowledge in renewable energy systems

› **Modality:** Theoretical.

› **General program:**
   1. Optimization of network operability. Grid Codes:
      › Evaluation of the reliability of a system
      › Assessing compliance with frequency control requirements
      › Generation requirements
      › Load flow, transient and dynamic stability
      › Tests to be performed to validate simulation models
      › Simulation requirements and results. Validation
   2. Grid code compliance solutions
   3. Integration of the solution in electrical power systems. Validation of the solution

› **Module duration:** 16h.

› **Available languages:** ES-EN (*)

› **Reference:** T14B
Power quality systems and distribution automation

SECTIONALIZING EQUIPMENT ISOLATED IN SF6 FOR DISTRIBUTION SYSTEMS.

- **Goal**: Deepen the technical, operation, maintenance and control characteristics of sectionalizing equipment isolated in SF6.
- **Aimed at**: Engineers and technicians, including Maintenance, with general knowledge about distribution automation systems, who require a deeper knowledge of this type of assets.
- **Modality**: Theoretical.
- **General program**:
  1. Introduction
  2. Application
  3. Tests
  4. Electrical diagram
  5. Installation
  6. Operation
  7. Maintenance
  8. Control panel and protection relay. Associated software

- **Module duration**: 21h.
- **Available languages**: SP-EN-PT (*)
- **Reference**: T13A
Remarks
5. Remarks

For all the previous modules, we put at your service the following teaching locations:

› ARTECHE facilities in:
  › Spain (Mungía, Madrid)
  › Mexico (Ciudad de México DF, Tepeji del Rio)
  › Brazil (Sao Paulo, Curitiba)
  › Argentina (Córdoba)
  › China (Dalian)

› Client facilities in:
  › Any geographic location

If the location where the course is given is the facilities of ARTECHE in:

› Spain (Mungía)
› Mexico (Tepeji del Rio)
› Argentina (Córdoba)
› China (Dalian)

several modules could be extended to theoretical and practical modality. Please check with us for further information.

*Please contact us to check modules availability in other languages.