Advanced Master's Degree
Electrical Energy

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Advanced Master's Degree
Electrical Energy

- Modality: **online**
- Duration: **2 years**
- Certificate: **TECH Global University**
- Credits: **120 ECTS**
- Schedule: **at your own pace**
- Exams: **online**

Website: **www.techtitute.com/us/engineering/advanced-master-degree/advanced-master-degree-electrical-energy**

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01

Introduction

An electrical engineer is capable of designing and finding solutions for any type of installation, working in power plants, sub-stations, transmission lines, telecommunications and, in short, in any type of industry involved in this area. The importance of their work today makes it necessary to have programs that help them specialize in new trends and techniques to improve their skills and work proposals. Therefore, this degree has been designed to delve into the guidelines that optimize the control of maintenance costs of some power plants, the new proposals for sustainable energy and, with a technical and economic perspective, to understand the process of construction and design of a high voltage infrastructure.

Knowing the components and equipment used in steam generators will help you to keep an electric boiler safe"

In any modern society, the supply of electricity is indispensable for its functioning. Without it, hospitals would not be able to operate at their maximum capacity, industries would not be able to provide their services and, taking into account technological advances, web servers would not be able to store and transmit the information that moves the world.

In order for humanity to continue its development, it is necessary to have a number of professionals dedicated to generating and improving the electrical industry. Because of this, this program has been devised to help specialists learn the correct process of design, development and maintenance of different electrical infrastructures. Thus, we will begin by explaining the different technologies that have been implemented in recent years, such as wind, solar and hydroelectric. This will allow a better understanding of how each of them work, the support required and the economic investment needed for their operation.

In addition, it is essential for engineers to know how to build and maintain all these constructions. For this purpose, in the module dedicated to this topic, each class will be separated according to the structure to be worked on. In this way, the student will learn, specifically, how to clean the different turbines of steam generators, the maintenance that a wind farm should receive, and even the care that the components of a nuclear power plant should receive.

On the other hand, an excellent electrical engineer must have a deep understanding of the importance of the economic operation of infrastructures. Therefore, this Advanced Master's Degree presents the essential safety factors and regulations in the generation, transmission and distribution stages of Electrical Energy. In the first section, importance will be given to the transport process, taking into account the different connection lines, high voltage, overhead and subway. The legislation governing electrical substations will also be presented. Here you will learn about their operation, classification and architecture, allowing the student to become familiar with the different control equipment that make up these buildings. They will also learn how to perform a substation analysis, which varies according to the voltage rating.

This **Advanced Master's Degree in Electrical Energy** contains the most complete and up-to-date program on the market. The most important features include:

- The development of case studies presented by experts in Electrical Energy
- The graphic, schematic, and eminently practical contents with which they are created, provide scientific and practical information on the disciplines that are essential for professional practice
- Practical exercises where self-assessment can be used to improve learning
- Special emphasis on innovative methodologies in the field of Engineering
- Theoretical lessons, questions to the expert, debate forums on controversial topics, and individual reflection assignments
- Content that is accessible from any fixed or portable device with an Internet connection

This Advanced Master's Degree will help you to know the advancements in the thermodynamic processes of energy production in this type of power plants"

The electricity sector is betting on new energy sources. Become the engineer they need to maintain new infrastructures"

Apply improvements in thermodynamic energy production processes.

Know in detail the protocols and treaties on atmospheric emissions and their influence on combined cycle plants.

It includes, in its teaching staff, professionals from the engineering field, who contribute their work experience to this program, as well as renowned specialists from reference societies and prestigious universities.

Its multimedia content, developed with the latest educational technology, will enable the professional to contextual learning, i.e., a simulated environment that will provide an immersive study programmed to train in real situations.

This program is designed around Problem-Based Learning, whereby the student must try to solve the different professional practice situations that arise during the course. For this purpose, the professional will be assisted by an innovative interactive video system created by renowned and experienced experts.

02

Objectives

This Advanced Master's Degree is oriented to the professional improvement of the students. Therefore, it has a series of general and specific objectives to better understand the knowledge imparted. In this way, they will be able to perform the design, analysis and maintenance of different power plants, taking into account the type of renewable or non-renewable energy they use. For all this, the engineer will achieve an adequate profile for the development and management of electrical projects of great importance for the sector.

Participate in large projects by controlling and preparing the working environment in wind turbines"

General objectives

- Interpret the investments and feasibility of power generation plants
- Discover the potential business opportunities offered by power generation infrastructures
- Delve into the latest technological and technical trends in Electrical Energy production
- Identify the components necessary for the correct functionality and operation of the facilities that make up the power generation plants
- Establish preventive maintenance plans that ensure and guarantee the proper operation of power plants, taking into account human and material resources, the environment and the most rigorous quality standards
- Successfully manage maintenance plans for power generation plants
- Analyze the different productivity techniques existing in power generation plants, taking into account the particular characteristics of each facility
- Select the most appropriate contracting model according to the characteristics of the power generation plant to be built
- Interpret the regulatory framework of electrical energy distribution and transmission infrastructures
- Discover the potential business opportunities offered by high voltage infrastructures in the generation and sale of electricity
- Address the particularities to correctly manage the design, project, construction and execution of high voltage installations and electrical substations: human and material resources, quality and environmental management; and the financing of this type of constructions and installations
- Bid and prepare tenders for high voltage infrastructure and/or electrical substation construction projects
- Bid and prepare tenders for the maintenance and economic operation of high voltage infrastructures and/or electrical substations
- Define the current rules and regulations together with the necessary procedures and permits from the public administration to successfully undertake the project, construction and start-up phases of this type of infrastructure
- Learn the latest trends, technologies and techniques in high-voltage infrastructures and electrical substations
- Establish preventive maintenance plans that ensure and guarantee the proper functioning of the infrastructure, taking into account human and material resources, the environment and the most rigorous quality standards
- Successfully manage maintenance plans in electrical infrastructures
- Analyze the different maintenance techniques existing in the electrical network, taking into account the particular characteristics of each installation
- Address emergency repairs, identifying and prioritizing the different elements that make up the electrical system
- Select the corresponding subcontractors and professionals to carry out the various and complex works that interact in a high voltage infrastructure and/or electrical substation

Specific objectives

- Identify the most appropriate generation technology for a given power demand or need for expansion of the power generation park
- Detailed knowledge and diversification of the different generation techniques and technologies
- Integrate renewable energies into the electric power generation fleet
- Establish the guidelines that must be taken into account in the environmental management of this type of facilities
- Study the profitability of a power generation plant based on production revenues/costs, plant economics and financial planning
- Interpret the concepts of energy and heat involved in the production of electrical energy, together with the different fuels involved in the process
- Approach the analysis and study of the thermodynamic processes that occur during the operation of the industrial processes of electric power generation
- Break down the components and equipment that make up the steam generators used in the production of electric energy
- Acquire knowledge of the operation of the systems that are part of steam generators
- Analyze the operating procedures of steam generators for safe functionality
- Correctly manage the different controls to which steam generators used for electric power generation must be subjected
- Interpret the production process of conventional thermal power plants together with the different systems involved in it
- Address the start-up and planned shutdowns in this type of power plant
- Know in detail the composition of power generation equipment and its auxiliary systems

- Acquire the necessary knowledge to optimize the operation of turbogenerators, turbines and auxiliary systems that are part of the power generation process in a conventional power plant
- Correct management of the physical-chemical treatment of water to be converted into steam for energy production, together with the failures caused by poor treatment
- Correct sizing of the flue gas treatment and purification system to minimize the environmental impact of this type of power plant and comply with new environmental regulations and legislation
- Prepare documentation related to the safety and design of steam generators in conventional thermal power plants
- Analyze alternatives to traditional fuels and the modifications to be made to a conventional plant to adapt it to renewable fuels
- Interpret the solar potential and the parameters to be taken into account in the site selection of solar installations
- Address the needs of installations that can be supplied with off-grid photovoltaic systems
- Know in detail the elements that make up the photovoltaic plants connected to the electrical distribution network
- Acquire the necessary knowledge to carry out photovoltaic installations in self-consumption mode
- Correct selection and dimensioning of the necessary elements in a thermoelectric/thermosolar power generation plant
- Correctly analyze the operation of the different solar collectors that are part of solar thermal power plants
- Manage the different methodologies for energy storage in thermoelectric power plants
- Design of a thermoelectric power plant with CCP technology collectors
- Coordinate the operation of the different systems that are part of the combined cycle facilities
- Size the improvements in the thermodynamic processes of energy production in this type of power plants
- Detailed knowledge of the protocols and treaties on atmospheric emissions and how they influence combined cycle plants
- Acquire the necessary knowledge to optimize the operation of gas turbines, reciprocating engines and waste heat boilers
- Identify the parameters that affect the performance of the combined cycle power plant
- Structure the auxiliary systems of combined cycle plants
- Select the ideal operating level based on the different types of existing combined cycle plants
- Develop projects for hybridization of combined cycles with solar energy
- Establish operating and safety criteria according to the requirements of the system to be supported by cogeneration
- Analyze the different types of cycles that can exist in cogeneration plants
- Know in detail the technology associated with reciprocating engines and turbines used in cogeneration plants
- Delve into the knowledge of pyrotubular steam generators
- Integrate the operation of the different technologies used in machines with absorption techniques
- Assign priorities in trigeneration, tetrageneration and microcogeneration facilities
- Supervise and control the correct operation of cogeneration plants with tail cycle
- Select the type and size of the cogeneration plant according to the energy needs to be covered in the annexed installations
- Identify new trends in cogeneration plants
- Identify water resources and optimize the type of water resource use
- Delve into the functioning of the power generation technique and which variables allow to optimize its productivity

- Select the most suitable generation turbine according to the current state of technology
- Breakdown of the different typologies and functionality of dams for the accumulation of water resources
- Control the operation of hydroelectric power plants using pumping techniques
- Analyze the civil works equipment necessary to undertake this type of project
- Regulate and control the production of electric energy in this type of power plants
- Deal in detail with the technologies and techniques of mini-hydraulic plants
- Identify suitable locations for the construction of wind farms
- Know in detail and interpret data from meteorological stations to analyze the potential of a wind farm
- Control and prepare the working environment in wind turbines
- Apply the different working techniques for the construction of wind turbines
- Assess the operation of a wind turbine and the latest trends in wind power generation
- Elaborate and promote the feasibility of wind power generation parks
- Diagnose the equipment necessary to build offshore wind power generation plants
- Locate marine resources for electrical energy generation
- Plan the construction of a wave energy power generation plant
- Analyze the fundamentals of nuclear energy and its potential for energy generation
- Evaluate the parameters involved in nuclear reactions
- Identify the components, equipment and functionality of the systems of a nuclear power plant
- Delve into the operation of the different types of reactors currently operating in nuclear power plants
- Optimize the performance of thermodynamic processes in nuclear power plants
- Establish operational and operating guidelines for safety in this type of plants
- Know in detail the treatment associated with the waste produced in nuclear power plants, together with the decommissioning and dismantling of a nuclear power plant
- Delve into the knowledge of the evolution of nuclear power plants and the new generation of plants that will be built soon
- Evaluate the potential of SMR small modular reactors
- Select the most beneficial type of contract for the construction of a power production plant
- Analyze how the exploitation of renewable energies affects the electricity market
- Perform maintenance to optimize the performance of the steam generators
- Diagnose failures in gas and steam turbines and reciprocating engines
- Elaborate the maintenance plan of a wind farm
- Execute and design the maintenance plan of a photovoltaic plant
- Study the profitability of a production plant by analyzing its life cycle
- In-depth knowledge of the elements attached to an electric power production plant for its discharge to the distribution network
- Interpret the operation and regulation of the electricity system, its main actors, the regulations applicable to the purchase/sale and transmission of energy
- Know and diversify which activities are regulated and which are in free competition within the electricity sector
- Acquire the necessary background knowledge of the existing technologies and techniques in the generation of electrical energy and the future trend of the same
- Specify the necessary elements for human resources management: planning, recruitment, selection and administration
- Addressing quality assurance by analyzing potential suppliers and the associated costs involved
- Study the profitability of a high-voltage power infrastructure based on distribution revenues/costs, plant economics and financial planning

- Preparing bidding procedures, awarding contracts to the best technical and economic option and formalizing the corresponding contracts
- Interpret the legislative framework applicable to electric power transmission and distribution infrastructures in the construction, electricity and occupational risk prevention sectors
- Address environmental requirements and minimize polluting effects in the construction of electric system infrastructures, analyzing the need or not of an environmental impact study and how to carry it out
- Understand the policy for interconnection of high voltage grids between different countries, the appropriate financial instruments and the horizon of the power grid up to 2030
- Acquire knowledge of how the electricity market works, how prices are formed in the daily market and forward price formation
- Discover the business opportunities offered by the electricity market and the profit analysis of the electricity sector
- Analyze the mechanisms of adjustment and demand of electrical energy and competition in the electricity market
- Process the files and grant the necessary permits for the execution and start-up of high voltage infrastructure facilities and electrical substations, together with the expropriation procedures, if necessary
- Correctly manage procurement in the construction phase, identifying the corresponding processes and their participants in each phase of the process
- Planning and control of construction, with allocation of the corresponding responsibility centers
- Prepare and draft the specifications for high voltage electrical infrastructure projects and electrical substations
- Interpret the legislative framework in the design and execution of high voltage lines, their classification and the particular conditions for the type of installation in question
- Address the protection of avifauna and other species in the selection of components during the construction of a high voltage overhead line
- Know the composition of high voltage lines in order to be able to make a correct selection of the elements that compose them during their design and project
- Acquire knowledge of the technology and current trends in the construction of high-voltage overhead lines
- Correct dimensioning of high voltage lines, taking into account the characteristics of the terrain, the area where the line is to be built and the properties of the electrical energy to be transported
- Correctly manage the construction of high-voltage lines in all phases: civil works, hoisting, stringing, etc.
- Elaborate the health and safety plan for the high voltage power line installation project
- Analyze projects and preliminary projects to undertake the bidding process for the execution of high-voltage installations
- Interpret the legislative framework in the design and execution of electrical substations, their classification, the human and material means necessary to carry them out and the particular conditions for the type of installation in question
- Address the needs of particular situations taking into account the architecture of the high voltage network
- Know the elements that compose an electrical substation in order to make a correct selection of the elements that compose it during its design and project
- Acquire knowledge of current technology and trends in the construction of electrical substations
- Select and size correctly the power and protection elements to be installed for the correct operation of the electrical substation

- Correctly manage the construction of electrical substations in all its phases: civil works, hoisting, stringing, etc.
- Analyze the operation of an electrical substation by its working voltage: high voltage and very high voltage
- Coordinate the insulation system of high voltage infrastructures to avoid interference, overlapping and malfunctioning caused by them
- Size installations based on fire protection legislation and regulations in both passive and active dimensions
- Know the telecommunication systems that are implemented in electrical infrastructures avoiding interferences, identifying communication protocols and the variants of remote control and remote management
- Acquire knowledge of the technology and current trends in protection and control systems against failures due to natural causes and/or disturbances of the electrical network
- Identify the emergency and safety systems associated with alternating current and direct current supplies, prioritizing actions
- Establish the guidelines for the correct management of the occupational risk prevention law during the execution of construction works of high voltage infrastructures and electrical substations
- Correctly manage waste generation, taking into account its classification, treatment and corresponding segregation measures
- Characterize the automation of high voltage infrastructure operation according to IEC 61850 protocol specifications
- Prepare budgets for the construction and execution of high voltage infrastructure projects and electrical substations
- Establish operating and safety criteria according to the requirements of the electrical system
- Operate within the electrical system according to the requirements and demands of national and international connections and interconnections
- Assign priorities in the operation and maintenance of high-voltage infrastructures and electrical substations
- Supervise and control the correct operation of an infrastructure, taking into account alarms, signaling, execution of maneuvers and associated procedures
- Organize and correctly delimit the maintenance functions of an infrastructure
- Optimize and manage available resources to obtain the best performance in terms of equipment, personnel and assigned work time
- Early diagnosis of potential and potent failures in safety and critical equipment to maximize the economic performance of the infrastructure
- Establish predictive maintenance systems according to currently existing technologies and techniques
- Plan, select and implement computerized maintenance management systems
- Integrate new trends and procedures for maintenance operations in power grid infrastructures
- Identify, accredit and demand the companies and professionals authorized by the administration to carry out work on high voltage lines
- Know and interpret the technical-regulatory inspections on high voltage overhead lines required by the administration and which external agents can perform them
- Control and prepare the work environment for the execution of maintenance work and assign the tasks to the professionals who must perform it
- Apply the different work techniques available for the execution of operations with electrical voltage
- Elaborate the annual maintenance plan required for high voltage lines
- Diagnose equipment and perform preventive maintenance operations on high-voltage power lines
- Locate faults in subway high voltage lines and use the necessary equipment for this purpose

- Troubleshooting and corrective maintenance work on high-voltage lines
- Investigate the most frequent anomalies and future failures in high-voltage lines due to the connection to the power grid, the environment and the surroundings where the high-voltage line is located
- Identify, accredit and require the companies and professionals authorized by the administration to perform work in electrical substations
- Know and interpret the technical-regulatory inspections in electrical substations required by the administration and which external agents can perform them
- Control and prepare the work environment for the execution of maintenance work and assign the tasks to the professionals who are to perform it
- Evaluate the condition of critical equipment in an electrical substation
- Elaborate the annual maintenance plan required in electrical substations
- Diagnose equipment and perform preventive maintenance operations in electrical substations
- Troubleshoot electrical substations and use the necessary equipment for this purpose
- Troubleshoot faults and perform corrective maintenance work in electrical substations
- Investigate the most frequent anomalies and future failures in electrical substations
- Elaborate the maintenance manual for the electrical substation
- Plan and predict substation shutdowns in advance to perform scheduled maintenance operations, as well as stockpile critical spare parts to optimize the continuous operation of an electrical substation
- Learn the new trends in electrical substation maintenance based on the principle of reliability
- Assess and act accordingly the state of conservation of the power transformers of an electrical substation
- Maintain and handle encapsulated gis-type electrical substations
- Interact with the telecommunications systems integrated in an electrical substation
- Draw up a self-protection plan for an electrical substation, identify its risks and associated means and protective measures
- Operate and maintain low voltage installations associated with an electrical substation
- Prepare and compose the corresponding worksheets and inspection sheets, and associate them to the scheduled maintenance chronogram
- Identify and declassify potentially explosive areas within an electrical substation
- Establish the maintenance plan for the fire protection system
- Evaluate and classify electrical substation workers based on their specific knowledge of installation and maintenance issues
- Coordinate protections on lines, cables, transformers, busbars and bus couplings
- Analyze the coordination depending on the type of network and element to be protected
- Parameterize the admissible setting limits in the protections
- Calculate the parameters of the protections
- Identify the protections according to their mode of operation: main protection, back-up, cubicle, substation back-up and/or remote back-up
- Operate the opening of high voltage and very high voltage circuit breakers

Even though nuclear power plants are a thing of the past, there is still a need for professionals who know how to operate and maintain them"

03

Skills

At the end of the Advanced Master's Degree program, the students will not only have learned a set of theoretical knowledge, fundamental to the pursuit of their profession, but will also develop a series of managerial skills and competencies that will guarantee them the ability to lead a work team efficiently. In this way, they will be able to manage the execution and installation departments of power generation plants, as well as design action and maintenance plans for electrical structures.

Learn how to coordinate maintenance work or supervise the construction of a new wind farm by completing this Advanced Master's Degree program"

General skills

- Design high voltage infrastructure projects and electrical substations
- Work as a project manager for high voltage electrical infrastructure and electrical substation projects
- Work as site manager for high-voltage electrical infrastructure and electrical substations
- Manage plants of energy production facilities
- Operate within the electricity market
- Coordinate and plan high voltage electrical maintenance in companies
- Coordinate and plan the maintenance of factories/companies with proprietary high-voltage power grids
- Manage execution and installation departments of high voltage infrastructures and electrical substations in large installation and integration companies
- Access to management positions in the energy resources business areas
- Qualify as a specialist technician in the construction of high-voltage electrical infrastructure and electrical substations
- Qualify as a specialist technician in maintenance of high voltage electrical infrastructure and electrical substations
- Bid and prepare tenders for the award of contracts for the construction of high voltage infrastructure and electrical substations
- Bid and prepare tenders for the award of maintenance contracts for high voltage infrastructures and electrical substations

Specific skills

- Design power generation plant projects
- Work as project and site manager for power generation plants
- Manage energy production energy consortiums
- Integrate the operation of a power plant into the electricity market
- Coordinate and plan the maintenance of energy production plants
- Coordinate and plan the maintenance of factories/companies with own power generation
- Manage the execution and installation departments of power generation plants in large installation and integration companies
- Access to management positions in the energy resources business areas
- Qualify as a technician specializing in electrical energy production planning
- Qualify as a specialist technician in the maintenance of electrical energy production plants
- Undertake the preliminary design, economic pre-analysis and feasibility analysis of the investment required for the construction of a high voltage infrastructure
- Plan, manage and organize high-voltage infrastructure and electrical substation projects
- Design high voltage lines, their dimensioning, components, structure, administrative permits, occupational risk prevention and environmental protection
- Design electrical substations according to the required needs, with adequate protection systems and the necessary power and transmission devices
- Design and dimension the mandatory auxiliary systems and services to be implemented in the construction of high voltage electrical infrastructures
- Program and establish the criteria and procedures for the general operation and maintenance of electrical infrastructures
- Schedule, identify and establish maintenance and repair criteria and procedures for high voltage power lines
- Schedule, identify and establish maintenance and repair criteria and procedures for electrical substations
- Schedule, identify and establish maintenance and repair criteria and procedures for auxiliary systems and learn new trends in electrical substation maintenance
- Coordinate the protections of an electrical substation and synchronize them with the national electrical system

The electrical industry needs professionals like you, able to adapt to different situations and act according to the circumstances"

04

Course Management

During the program, the student will be supported by a select group of highly qualified experts to present the contents of the syllabus. They have many years of experience in the industry, so they know perfectly the requirements of the electrical industry today. The latter will be decisive for the professional development of engineers who aspire to be part of international Electrical Energy projects.

You will not be alone. The program is backed by an excellent group of professionals who have participated in different electrical energy projects"

International Guest Director

Adrien Couton is a prominent **international leader in sustainability,** known for his optimistic approach towards transitions to zero net emissions. As such, with extensive **consulting** and **executive management** experience in **strategy and sustainability,** he has established himself as a truly creative problem solver and strategist focused on building high-performing organizations and teams that contribute to keeping **global warming** below 1.5°C.

As such, he has served as Vice President of Sustainability Solutions at ENGIE Impact, where he has helped large public and private entities plan and execute their transitions to **sustainability** and **zero carbon.** Notably, he has also led strategic partnerships and the commercial deployment of digital and advisory solutions to help clients achieve these goals. He has also been **Director** of **Firefly, Paris,** an independent **sustainability** consultancy.

Adrien Couton's career has also developed at the convergence of **private sector** initiatives and **sustainability.** Indeed, he has worked as **Engagement Manager** at **McKinsey & Company,** supporting European utilities, and as **Partner** and **Sustainability Practice Director** at **Dalberg,** a consulting firm focused on **emerging markets.** He has also been **Managing Director** of **India's largest decentralized water systems operator, Naandi Danone JV,** and has held the position of **Private Equity Analyst** at **BNP Paribas.**

To this must be added his time as **Global Portfolio Manager** at **Acumen Fund, New York,** where he has developed two investment portfolios (**Water and Agriculture**) in a pioneering social impact investment fund, applying a VC approach to **sustainability.** In this regard, Adrien Couton has proven to be a dynamic, creative and innovative leader, committed to the fight against **climate change.**

Mr. Couton, Adrien

- Vice President of Sustainability Solutions at ENGIE Impact, San Francisco, United States
- Director at Firefly, Paris
- Partner and Head of Sustainability Practice at Dalberg, India
- Executive Director at Naandi Danone JV, India
- Global Portfolio Manager, Water and Agriculture Portfolios at Acumen Fund, New York
- Engagement Manager at McKinsey & Company, Paris
- Consultant at The World Bank, India
- Private Equity Analyst at BNP Paribas, Paris
- Master's Degree in Public Administration at Harvard University, Harvard University
- Master's Degree in Political Science, Sorbonne University, Paris
- Master's Degree in Business Administration, Ecole d'Etudes Supérieures de Commerce (HECH) Paris

Thanks to TECH, you will be able to learn with the best professionals in the world"

Management

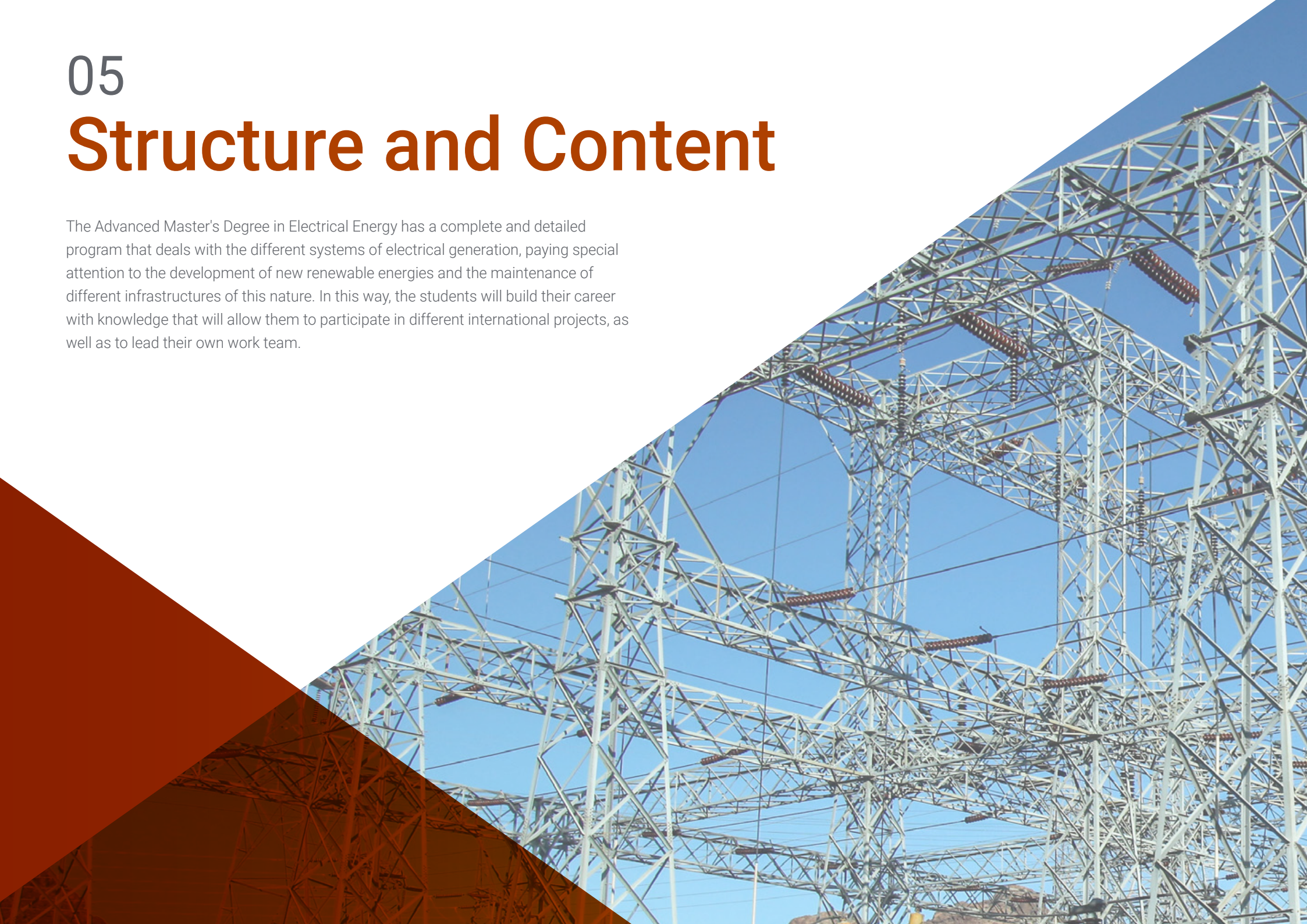
Mr. Palomino Bustos, Raúl

- Director at the Institute for Technical Training and Innovation
- International Consultant in Engineering, Construction and Maintenance of Energy Production Plants for the company RENOVETEC
- Industrial Engineer, University of Carlos III in Madrid
- Industrial Technical Engineer by the EUITI of Toledo
- Master's Degree in Occupational Risk Prevention from the Francisco de Vitoria University
- Master's Degree in Quality and Environment from the Spanish Quality Association
- Technological/training expert recognized and accredited by the State Public Employment Service

05

Structure and Content

The Advanced Master's Degree in Electrical Energy has a complete and detailed program that deals with the different systems of electrical generation, paying special attention to the development of new renewable energies and the maintenance of different infrastructures of this nature. In this way, the students will build their career with knowledge that will allow them to participate in different international projects, as well as to lead their own work team.



To work in the electrical sector, you must learn how to diagnose faults in the equipment and make a plan for equipment failures and carry out a preventive maintenance plan"

Module 1. Economics of Electricity Generation

1.1. Electricity Generation Technologies
- 1.1.1. The Generation Activity
- 1.1.2. Hydraulic Power Plants
- 1.1.3. Conventional Thermal Power Plants
- 1.1.4. Combined Cycle
- 1.1.5. Cogeneration
- 1.1.6. Wind
- 1.1.7. Solar
- 1.1.8. Biomass
- 1.1.9. Tidal
- 1.1.10. Geothermal

1.2. Production Technologies
- 1.2.1. Features
- 1.2.2. Installed Power
- 1.2.3. Power Demand

1.3. Renewable Energies
- 1.3.1. Characterization and Technologies
- 1.3.2. Economy of Renewable Energies
- 1.3.3. Integration of Renewable Energies

1.4. Financing of a Generation Project
- 1.4.1. Financial Alternatives
- 1.4.2. Financial Instruments
- 1.4.3. Financing Strategies

1.5. Valuation of Investments in Electricity Generation
- 1.5.1. Net Present Value
- 1.5.2. Internal Rate of Return
- 1.5.3. Capital Asset Pricing Model (CAPM)
- 1.5.4. Investment Recovery
- 1.5.5. Limitations of Traditional Techniques

1.6. Real Options
- 1.6.1. Typology
- 1.6.2. Principles of Option Pricing
- 1.6.3. Types of Real Options

1.7. Valuation of Real Options
- 1.7.1. Probability
- 1.7.2. Processes
- 1.7.3. Volatility
- 1.7.4. Estimation of the Value of the Underlying Asset

1.8. Economic-Financial Feasibility Analysis
- 1.8.1. Initial Investment
- 1.8.2. Direct Expenses
- 1.8.3. Revenues

1.9. Financing With Own Resources
- 1.9.1. Corporate Income Tax
- 1.9.2. Cash Flows
- 1.9.3. Payback
- 1.9.4. Net Present Value
- 1.9.5. Internal Rate of Return

1.10. Partial Debt Financing
- 1.10.1. Loan
- 1.10.2. Corporate Income Tax
- 1.10.3. Free Cash Flows
- 1.10.4. Debt Service Coverage Ratio
- 1.10.5. Shareholder Cash Flow
- 1.10.6. Shareholder Payback
- 1.10.7. Net Present Value of the Shareholder
- 1.10.8. Internal Rate of Return on Shareholder's Equity

Module 2. Industrial Boilers for Electrical Energy Production and Generation

2.1. Energy and Heat
- 2.1.1. Fuels
- 2.1.2. Energy
- 2.1.3. Thermal Power Generation Process

2.2. Steam Power Cycles
- 2.2.1. Carnot Power Cycle
- 2.2.2. Simple Rankine Cycle
- 2.2.3. Overheating Rankine Cycle
- 2.2.4. Effects of Pressure and Temperature on the Rankine Cycle
- 2.2.5. Ideal Cycle vs. Real Cycle
- 2.2.6. Ideal Reheat Rankine Cycle

2.3. Steam Thermodynamics
- 2.3.1. Steam
- 2.3.2. Types of Steam
- 2.3.3. Thermodynamic Processes

2.4. The Steam Generator
- 2.4.1. Functional Analysis
- 2.4.2. Parts of a Steam Generator
- 2.4.3. Steam Generator Equipment

2.5. Water-Tube Boilers for Power Generation
- 2.5.1. Natural Circulation
- 2.5.2. Forced Circulation
- 2.5.3. Water-Steam Circuit

2.6. Steam Generator Systems I
- 2.6.1. Fuel System
- 2.6.2. Combustion Air System
- 2.6.3. Water Treatment System

2.7. Steam Generator Systems II
- 2.7.1. Water Preheating System
- 2.7.2. Flue Gas System
- 2.7.3. Blower Systems

2.8. Safety in Steam Generator Operation
- 2.8.1. Safety Standards
- 2.8.2. BMS for Steam Generators
- 2.8.3. Functional Requirements

2.9. Control System
- 2.9.1. Fundamental Principles
- 2.9.2. Control Mode
- 2.9.3. Basic Operations

2.10. Steam Generator Control
- 2.10.1. Basic Controls
- 2.10.2. Combustion Control
- 2.10.3. Other Variables to be Controlled

Module 3. Conventional Thermal Power Plants

3.1. Process in Conventional Thermal Power Plants
- 3.1.1. Steam Generator
- 3.1.2. Steam Turbine
- 3.1.3. Condensate System
- 3.1.4. Feed Water System

3.2. Start-Up and Shutdown
- 3.2.1. Start-Up Process
- 3.2.2. Turbine Wheel
- 3.2.3. Synchronization of the Unit
- 3.2.4. Unit Charging Socket
- 3.2.5. Stop

3.3. Electricity Generation Equipment
- 3.3.1. Electric Turbogenerator
- 3.3.2. Steam Turbine
- 3.3.3. Turbine Parts
- 3.3.4. Turbine Auxiliary System
- 3.3.5. Lubrication and Control System

3.4. Electric Generator
- 3.4.1. Synchronous Generator
- 3.4.2. Parts of the Synchronous Generator
- 3.4.3. Generator Excitation
- 3.4.4. Voltage Regulator
- 3.4.5. Generator Cooling
- 3.4.6. Generator Protections

3.5. Water Treatment
- 3.5.1. Water for Steam Generation
- 3.5.2. External Water Treatment
- 3.5.3. Internal Water Treatment
- 3.5.4. Effects of Fouling
- 3.5.5. Corrosion Effects

3.6. Efficiency
- 3.6.1. Mass and Energy Balance
- 3.6.2. Combustion
- 3.6.3. Steam Generator Efficiency
- 3.6.4. Heat Losses

3.7. Environmental Impact
- 3.7.1. Environmental Protection
- 3.7.2. Environmental Impact of Thermal Power Plants
- 3.7.3. Sustainable Development
- 3.7.4. Smoke Treatment

3.8. Conformity Assessment
- 3.8.1. Requirements
- 3.8.2. Manufacturer Requirements
- 3.8.3. Boiler Requirements
- 3.8.4. User Requirements
- 3.8.5. Operator Requirements

3.9. Security/safety
- 3.9.1. Fundamental Principles
- 3.9.2. Design
- 3.9.3. Fabrication
- 3.9.4. Materials

3.10. New Trends in Conventional Power Plants
- 3.10.1. Biomass
- 3.10.2. Waste
- 3.10.3. Geothermal

Module 4. Solar Generation

4.1. Energy Capture
- 4.1.1. Solar Radiation
- 4.1.2. Solar Geometry
- 4.1.3. Solar Radiation Optical Path
- 4.1.4. Solar Collectors Orientation
- 4.1.5. Peak Sunshine Hours

4.2. Isolated Photovoltaic Systems
- 4.2.1. Solar Cells
- 4.2.2. Solar Collectors
- 4.2.3. Charge Regulator
- 4.2.4. Batteries
- 4.2.5. Inverters
- 4.2.6. Design of an Installation

4.3. Grid-Connected Photovoltaic Systems
- 4.3.1. Solar Collectors
- 4.3.2. Monitoring Structures
- 4.3.3. Inverters

4.4. Solar Photovoltaic for Self-Consumption
- 4.4.1. Design Requirements
- 4.4.2. Energy Demand
- 4.4.3. Viability

4.5. Thermoelectric Power Plants
- 4.5.1. Operation
- 4.5.2. Components
- 4.5.3. Advantages Over Non-Concentrating Systems

4.6. Medium Temperature Concentrators
- 4.6.1. Parabolic-Cylinder Collectors PCC
- 4.6.2. Linear Fresnel
- 4.6.3. Fixed Mirror FMSC
- 4.6.4. Fresnel Lenses

4.7. High Temperature Concentrators
- 4.7.1. Solar Tower
- 4.7.2. Parabolic Discs
- 4.7.3. Receiving Unit

4.8. Parameters
- 4.8.1. Angles
- 4.8.2. Aperture Area
- 4.8.3. Concentration Factor
- 4.8.4. Interception Factor
- 4.8.5. Optical Efficiency
- 4.8.6. Thermal Efficiency

4.9. Energy Storage
- 4.9.1. Thermal Fluid
- 4.9.2. Thermal Storage Technologies
- 4.9.3. Rankine Cycle with Thermal Storage

4.10. Design of 50 MW Thermoelectric Power Plant with PCC
- 4.10.1. Solar Field
- 4.10.2. Power Block
- 4.10.3. Electricity Production

Module 5. Combined Cycles

5.1. Combined Cycle
- 5.1.1. Current Combined Cycle Technology
- 5.1.2. Thermodynamics of Combined Gas-Steam Cycles
- 5.1.3. Future Trends in the Development of Combined Cycles

5.2. International Agreements for Sustainable Development
- 5.2.1. Kyoto Protocol
- 5.2.2. Montreal Protocol
- 5.2.3. Paris Climate

5.3. Brayton Cycle
- 5.3.1. Ideal
- 5.3.2. Real
- 5.3.3. Cycle Improvements

5.4. Rankine Cycle Improvements
- 5.4.1. Intermediate Reheating
- 5.4.2. Regeneration
- 5.4.3. Use of Supercritical Pressures

5.5. Gas Turbine
- 5.5.1. Operation
- 5.5.2. Performance
- 5.5.3. Systems and Subsystems
- 5.5.4. Classification

5.6. Recovery Boiler
- 5.6.1. Recovery Boiler Components
- 5.6.2. Pressure Levels
- 5.6.3. Performance
- 5.6.4. Characteristic Parameters

5.7. Steam Turbine
- 5.7.1. Components
- 5.7.2. Operation
- 5.7.3. Performance

5.8. Auxiliary Systems
- 5.8.1. Cooling System
- 5.8.2. Combined Cycle Performance
- 5.8.3. Advantages of Combined Cycles

5.9. Pressure Levels in Combined Cycles
- 5.9.1. One Level
- 5.9.2. Two Levels
- 5.9.3. Three Levels
- 5.9.4. Typical Configurations

5.10. Combined Cycle Hybridization
- 5.10.1. Fundamentals
- 5.10.2. Economic Analysis
- 5.10.3. Emission Savings

Module 6. Cogeneration

6.1. Structural Analysis
- 6.1.1. Functionality
- 6.1.2. Heat Requirements
- 6.1.3. Process Alternatives
- 6.1.4. Justification

6.2. Types of Cycles
- 6.2.1. With Reciprocating Gas or Fuel Oil Engine
- 6.2.2. With Gas Turbine
- 6.2.3. With Steam Turbine
- 6.2.4. In Combined Cycle with Gas Turbine
- 6.2.5. In Combined Cycle with Reciprocating Engine

6.3. Alternative Engines
- 6.3.1. Thermodynamic Effects
- 6.3.2. Gas Engine and Auxiliary Elements
- 6.3.3. Energy Recovery

6.4. Pyrotubular Boilers
- 6.4.1. Types of Boilers
- 6.4.2. Combustion
- 6.4.3. Water Treatment

6.5. Absorption Machines
- 6.5.1. Operation
- 6.5.2. Absorption vs. Compression
- 6.5.3. Lithium Bromide/Water
- 6.5.4. Ammonia/Water

6.6. Trigeneration, Tetrageneration and Microcogeneration
- 6.6.1. Trigeneration
- 6.6.2. Tetrageneration
- 6.6.3. Microcogeneration

6.7. Exchangers
- 6.7.1. Classification
- 6.7.2. Air-Cooled Heat Exchangers
- 6.7.3. Plate Heat Exchangers

6.8. Bottoming Cycle
- 6.8.1. Organic Rankine Cycle
- 6.8.2. Organic Fluids
- 6.8.3. Kalina Cycle

6.9. Selection of Cogeneration Plant Type and Size
- 6.9.1. Design
- 6.9.2. Types of Technologies
- 6.9.3. Fuel Selection
- 6.9.4. Dimensioning

6.10. New Trends in Cogeneration Plants
- 6.10.1. Services
- 6.10.2. Gas Turbines
- 6.10.3. Alternative Engines

Module 7. Hydraulic Power Plants

7.1. Water Resources
- 7.1.1. Fundamentals
- 7.1.2. Dam Utilization
- 7.1.3. Bypass Utilization
- 7.1.4. Mixed Utilization

7.2. Operation
- 7.2.1. Installed Power
- 7.2.2. Energy Produced
- 7.2.3. Waterfall Height
- 7.2.4. Flow Rate
- 7.2.5. Components

7.3. Turbines
- 7.3.1. Pelton
- 7.3.2. Francis
- 7.3.3. Kaplan
- 7.3.4. Michell-Banky
- 7.3.5. Turbine Selection

7.4. Dams
- 7.4.1. Fundamental Principles
- 7.4.2. Typology
- 7.4.3. Composition and Operation
- 7.4.4. Drainage

7.5. Pumping Power Plants
- 7.5.1. Operation
- 7.5.2. Technology
- 7.5.3. Advantages and Disadvantages
- 7.5.4. Pumped Storage Plants

7.6. Civil Works Equipment
- 7.6.1. Water Retention and Storage
- 7.6.2. Controlled Flow Evacuation
- 7.6.3. Water Conveyance Elements
- 7.6.4. Water Hammer
- 7.6.5. Balancing Chimney
- 7.6.6. Turbine Chamber

7.7. Electromechanical Equipment
- 7.7.1. Gratings and Cleaners
- 7.7.2. Water Flow Opening and Closing
- 7.7.3. Hydraulic Equipment

7.8. Electrical Equipment
- 7.8.1. Generator
- 7.8.2. Water Flow Opening and Closing
- 7.8.3. Asynchronous Start-Up
- 7.8.4. Starting by Auxiliary Machine
- 7.8.5. Variable Frequency Starting

7.9. Regulation and Control
- 7.9.1. Generation Voltage
- 7.9.2. Turbine Speed
- 7.9.3. Dynamic Response
- 7.9.4. Network Coupling

7.10. Minihydraulics
- 7.10.1. Water Intake
- 7.10.2. Cleaning of Solids
- 7.10.3. Conduction
- 7.10.4. Pressure Chambers
- 7.10.5. Pressure Piping
- 7.10.6. Machinery
- 7.10.7. Suction Pipe
- 7.10.8. Output Channel

Module 8. Wind and Ocean Power Generation

8.1. Wind
- 8.1.1. Origin
- 8.1.2. Horizontal Gradient
- 8.1.3. Measurement
- 8.1.4. Obstacles

8.2. Wind Resource
- 8.2.1. Wind Measurement
- 8.2.2. The Wind Rose
- 8.2.3. Factors Influencing Wind

8.3. Wind Turbine Study
- 8.3.1. Betz Limit
- 8.3.2. Wind Turbine Rotor
- 8.3.3. Electrical Power Generated
- 8.3.4. Power Regulation

8.4. Wind Turbine Components
- 8.4.1. Tower
- 8.4.2. Rotor
- 8.4.3. Multiplier Box
- 8.4.4. Brakes

8.5. Wind Turbine Operation
- 8.5.1. Generation System
- 8.5.2. Direct and Indirect Connection
- 8.5.3. Control System
- 8.5.4. Tendencies

8.6. Feasibility of a Wind Farm
- 8.6.1. Location
- 8.6.2. Wind Resource Study
- 8.6.3. Energy Production
- 8.6.4. Economic Study

8.7. Offshore Wind: Technology Offshore
- 8.7.1. Wind Turbines
- 8.7.2. Foundations
- 8.7.3. Electrical Connection
- 8.7.4. Installation Vessels
- 8.7.5. ROVs

8.8. Offshore Wind: Support of Wind Turbines
- 8.8.1. Hywind Scotland platform, Statoil Spar
- 8.8.2. WinfFlota Platform; Principal Power Semisub
- 8.8.3. GICON SOF Platform TLP
- 8.8.4. Comparison

8.9. Marine Energy
- 8.9.1. Tidal Energy
- 8.9.2. Ocean Thermal Energy Conversion (OTEC)
- 8.9.3. Salt or Osmotic Gradient Energy
- 8.9.4. Ocean Current Energy

8.10. Wave Energy
- 8.10.1. Waves as a Source of Energy
- 8.10.2. Classification of Conversion Technologies
- 8.10.3. Current Technology

Module 9. Nuclear Power Plants

9.1. Theoretical Basis
- 9.1.1. Fundamentals
- 9.1.2. Binding Energy
- 9.1.3. Nuclear Stability

9.2. Nuclear Reaction
- 9.2.1. Fission
- 9.2.2. Fusion
- 9.2.3. Other Reactions

9.3. Nuclear Reactor Components
- 9.3.1. Fuels
- 9.3.2. Moderator
- 9.3.3. Biological Barrier
- 9.3.4. Control Rods
- 9.3.5. Reflector
- 9.3.6. Reactor Shell
- 9.3.7. Coolant

9.4. Most Common Reactor Types
- 9.4.1. Reactor Types
- 9.4.2. Pressurized Water Reactor
- 9.4.3. Boiling Water Reactor

9.5. Other Types of Reactors
- 9.5.1. Heavy Water Reactors
- 9.5.2. Gas-Cooled Reactor
- 9.5.3. Channel Type Reactor
- 9.5.4. Fast Breeder Reactor

9.6. Rankine Cycle in Nuclear Power Plants
- 9.6.1. Differences Between Thermal and Nuclear Power Plant Cycles
- 9.6.2. Rankine Cycle in Boiling Waterpower Plants
- 9.6.3. Rankine Cycle in Heavy Waterpower Plants
- 9.6.4. Rankine Cycle in Pressurized Waterpower Plants

9.7. Nuclear Power Plant Safety
- 9.7.1. Safety in Design and Construction
- 9.7.2. Safety Through Barriers Against the Release of Fission Products
- 9.7.3. Security Through Systems
- 9.7.4. Redundancy, Single Failure and Physical Separation Criteria
- 9.7.5. Operational Safety

9.8. Radioactive Waste, Dismantling and Closure of Facilities
- 9.8.1. Radioactive Waste
- 9.8.2. Dismantling
- 9.8.3. Closure

9.9. Future Tendencies Generation IV
- 9.9.1. Gas-Cooled Fast Reactor
- 9.9.2. Lead-Cooled Fast Reactor
- 9.9.3. Molten Salt Fast Reactor
- 9.9.4. Supercritical Water-Cooled Reactor
- 9.9.5. Sodium-Cooled Fast Reactor
- 9.9.6. Very High Temperature Reactor
- 9.9.7. Evaluation Methodologies
- 9.9.8. Risk of Explosion Evaluation

9.10. Small Modular Reactors SMR
- 9.10.1. SMR
- 9.10.2. Advantages and Disadvantages
- 9.10.3. Types of SMR

Module 10. Construction and Operation of Electrical Energy Production Plants

10.1. Construction
- 10.1.1. EPC
- 10.1.2. EPCM
- 10.1.3. Open Book

10.2. Exploitation of Renewables in the Electricity Market
- 10.2.1. Increase in Renewable Energies
- 10.2.2. Market Failures
- 10.2.3. New Market Trends

10.3. Steam Generator Maintenance
- 10.3.1. Water Pipes
- 10.3.2. Smoke Tubes
- 10.3.3. Recommendations

10.4. Turbine and Engine Maintenance
- 10.4.1. Gas Turbines
- 10.4.2. Steam Turbine
- 10.4.3. Alternative Engines

10.5. Wind Park Maintenance
- 10.5.1. Types of Breakdowns
- 10.5.2. Component Analysis
- 10.5.3. Strategies

10.6. Nuclear Power Plant Maintenance
- 10.6.1. Structures, Systems and Components
- 10.6.2. Behavioral Criteria
- 10.6.3. Behavioral Assessment

10.7. Photovoltaic Power Plants Maintenance
- 10.7.1. Panels
- 10.7.2. Inverters
- 10.7.3. Energy Evacuation

10.8. Hydraulic Power Plant Maintenance
- 10.8.1. Capture
- 10.8.2. Turbine
- 10.8.3. Generator
- 10.8.4. Valves
- 10.8.5. Cooling
- 10.8.6. Oleohydraulics
- 10.8.7. Regulation
- 10.8.8. Rotor Braking and Lifting
- 10.8.9. Excitement
- 10.8.10. Synchronization

10.9. Life Cycle of Energy Producing Plants
- 10.9.1. Life Cycle Analysis
- 10.9.2. LCA Methodologies
- 10.9.3. Limitations

10.10. Auxiliary Elements in Production Plants
- 10.10.1. Evacuation Lines
- 10.10.2. Electrical Substations
- 10.10.3. Protections

Module 11. High and Very High Voltage Infrastructure and Associated Resource Management

11.1. The Electric System
- 11.1.1. Electricity Distribution
- 11.1.2. Reference Standards
- 11.1.3. Regulated Activities and Activities in Free Competition

11.2. Generating Electric Energy
- 11.2.1. Power Generation Technologies and Costs
- 11.2.2. Regulated Activities in the Electricity Sector
- 11.2.3. Supply Assurance and Infrastructure Planning

11.3. Electric Energy Distribution
- 11.3.1. Transportation and Operation of the Electric System
- 11.3.2. Distribution
- 11.3.3. Quality of Supply

11.4. Marketing
- 11.4.1. The Retail Market
- 11.4.2. The Wholesale Market

11.5. Access Tolls, Charges and Tariff Deficits
- 11.5.1. Access Tolls
- 11.5.2. Tariff Deficits

11.6. Planning and Management of Human Resources
- 11.6.1. Planning Human Resources
- 11.6.2. Recruitment and Selection of Human Resources
- 11.6.3. Human Resources Management

11.7. Environmental Management
- 11.7.1. Environment Aspects and Their Management
- 11.7.2. Control Measures

11.8. Organization and Quality Management
- 11.8.1. Assuring Quality
- 11.8.2. Supplier Analysis
- 11.8.3. Associated Costs

11.9. Financing Sources and Cost Analysis
- 11.9.1. Electricity Distribution Revenues and Expenses
- 11.9.2. Economic Data of the Facilities
- 11.9.3. Financial Plan

11.10. Bidding, Contracting and Awarding
- 11.10.1. Types of Bidding
- 11.10.2. Awarding Process
- 11.10.3. Formalizing the Contract

Module 12. Planning and Organizing Projects

12.1. Legislative Frame of Reference
- 12.1.1. Electricity Sector Legislation
- 12.1.2. Construction Legislation
- 12.1.3. Occupational Health and Safety Legislation

12.2. Environmental Regulations and Requirements
- 12.2.1. International, National and Local Regulations
- 12.2.2. Types of Environmental Evaluation
- 12.2.3. Environmental Impact

12.3. International High Voltage Interconnection Policy
- 12.3.1. International Energy Infrastructure Policy
- 12.3.2. Financial Instruments
- 12.3.3. Future Perspectives

12.4. The Electric Market
- 12.4.1. Daily Market Price Training
- 12.4.2. Electricity Forward Pricing Training

12.5. Business Opportunities in the Electricity Market
- 12.5.1. Benefit Analysis in the Electricity Market
- 12.5.2. Windfalls Profits and Windfalls Looses

12.6. Operation of the Electric System
- 12.6.1. Adjustment Mechanisms and Production Demand
- 12.6.2. Skills in the Electric Market
- 12.6.3. Economic Theory of Markets and Competition applied to Electricity Markets

12.7. Processing of High Voltage Files
- 12.7.1. Necessary Documentation
- 12.7.2. Procedure
- 12.7.3. Common Administrative Procedure, Domanial, Patrimonial, Patrimonial and Public Interest Assets
- 12.7.4. Expropriation Phase

12.8. Projects and Procurement Management
- 12.8.1. Types of Processes
- 12.8.2. Participants in Project Execution

12.9. Planning and Control in Construction of High Voltage Electrical Infrastructures and Electrical Substations
- 12.9.1. Planning and Control
- 12.9.2. Responsibility Centers

12.10. Specifications
- 12.10.1. Object of the Specifications
- 12.10.2. Specifications of Administrative Clauses
- 12.10.3. Particular Technical Specifications

Module 13. Mandatory Ancillary Services in High Voltage Electrical Infrastructures

13.1. Insulation Coordination
- 13.1.1. Coordination Procedure
- 13.1.2. Coordination Methods
- 13.1.3. Coordination of Isolation in Transmission Lines and Power Substations

13.2. Fire Protection System
- 13.2.1. Reference Legislation
- 13.2.2. Passive Protection
- 13.2.3. Active Protection

13.3. Telecommunication System
- 13.3.1. SCADA Systems
- 13.3.2. Power Line Carrier-PLC
- 13.3.3. Remote Management and Control

13.4. Protection and Control System
- 13.4.1. Faults and Disturbances
- 13.4.2. Protection Systems
- 13.4.3. Control System

13.5. Security and Emergency Systems
- 13.5.1. Alternating Current Services
- 13.5.2. Continuous Current Services
- 13.5.3. Boards

13.6. Occupational Hazard Prevention
- 13.6.1. Job Descriptions
- 13.6.2. Machinery
- 13.6.3. Temporary Facilities
- 13.6.4. Security Conditions

13.7. Waste Management
- 13.7.1. Amount of Waste Estimation
- 13.7.2. Reuse, Appraisal or Disposal Operations
- 13.7.3. Segregation Measures

13.8. Quality Control
- 13.8.1. Receiving Control of Products, Equipment and Systems
- 13.8.2. Work Execution Control
- 13.8.3. Finished Work Control

13.9. Automation of Electrical Infrastructures
- 13.9.1. Protocol IEC 61815
- 13.9.2. Levels of Control
- 13.9.3. Interlocks

13.10. Preparation of Quotations
- 13.10.1. High Voltage Lines
- 13.10.2. Electrical Substations

Module 14. Infrastructure Operation and Maintenance

14.1. Performance and Safety Criteria for Operation within the Power System
- 14.1.1. Control Parameters
- 14.1.2. Operating and Allowable Margins on Control Parameters
- 14.1.3. Reliability Criteria

14.2. Power System Operating Procedures
- 14.2.1. Transportation Network Maintenance Program
- 14.2.2. International Connections Management
- 14.2.3. Information Exchanged by the System Regulator

14.3. Operating Principles
- 14.3.1. Priority Order
- 14.3.2. Equipment Operation and Maneuvering
- 14.3.3. Switch Operations
- 14.3.4. Disconnectors Operation

14.4. Supervision and Control
- 14.4.1. Instalment Supervision
- 14.4.2. Events, Alarms and Signalling
- 14.4.3. Execution of Maneuvers and Procedures

14.5. Maintenance
- 14.5.1. Action Areas
- 14.5.2. Maintenance Organization
- 14.5.3. Maintenance Levels

14.6. Maintenance Management
- 14.6.1. Team Management
- 14.6.2. Human Resource Management
- 14.6.3. Work Management
- 14.6.4. Management Control

14.7. Corrective Maintenance
- 14.7.1. Equipment Fault Diagnosis
- 14.7.2. Wear Mechanisms and Protection Techniques
- 14.7.3. Breakdown Analysis

14.8. Predictive Maintenance
- 14.8.1. Establishing a System of Predictive Maintenance
- 14.8.2. Techniques of Predictive Maintenance

14.9. Management of Computer-Assisted Maintenance
- 14.9.1. Maintenance Management Systems
- 14.9.2. Functional and Organizational Description of a CMMS
- 14.9.3. Development Stages of an CMMS Implementation

14.10. Current Trends in Infrastructure Maintenance
- 14.10.1. RCM Reliability Centered Maintenance
- 14.10.2. TPM Total Productive Maintenance
- 14.10.3. Root Cause Analysis
- 14.10.4. Assigning Jobs

Module 15. Maintenance of High Voltage Transmission Lines

15.1. Qualification of Professionals and Companies
- 15.1.1. High Voltage Professional Credentials
- 15.1.2. Authorized Companies
- 15.1.3. Technical and Human Resources

15.2. Regulatory Inspections
- 15.2.1. Verification and Inspection of High Voltage Power Lines
- 15.2.2. Defect Classification
- 15.2.3. Minimal Technical Resources

15.3. Inspection Procedures
- 15.3.1. Cable Installations in Visitable Galleries and Overhead Lines
- 15.3.2. Certification for Partial Discharge Measurements
- 15.3.3. Tests to Be Performed in Periodic Inspections

15.4. Low Voltage Works
- 15.4.1. The Five Golden Rules
- 15.4.2. Close-Proximity Works

15.5. High Voltage Works
- 15.5.1. Electric Potential Work
- 15.5.2. Electric Remote Works
- 15.5.3. Electric Contact Works

15.6. Yearly Maintenance Plan
- 15.6.1. Corrosion Protection
- 15.6.2. Insulator Washing
- 15.6.3. Thermographic Review
- 15.6.4. Cutting and Pruning of Vegetation
- 15.6.5. Using Drones

15.7. Preventative Maintenance
- 15.7.1. Equipment Subject to Preventative Maintenance
- 15.7.2. Techniques of Predictive Maintenance
- 15.7.3. Maintenance of Underground Networks

15.8. Locating Breakdowns in Underground Lines
- 15.8.1. Cable Breakdowns
- 15.8.2. Processes and Methods of Locating Breakdowns
- 15.8.3. Using Equipment

15.9. Corrective Maintenance in High Voltage Lines
- 15.9.1. Overhead Lines
- 15.9.2. Underground Lines

15.10. Faults in High Voltage Lines
- 15.10.1. Defects and Anomalies After Inspection
- 15.10.2. Electric Network Connection
- 15.10.3. Environmental Conditions
- 15.10.4. Line Surroundings

Module 16. Electrical Substations Maintenance

16.1. Qualification of Professionals and Companies
- 16.1.1. Professional Credentials for Electrical Substations
- 16.1.2. Authorized Companies
- 16.1.3. Technical and Human Resources

16.2. Regulatory Inspections
- 16.2.1. Verification and Inspection
- 16.2.2. Defect Classification

16.3. Direct Current Testing
- 16.3.1. Solid Insulation
- 16.3.2. Remaining Insulation
- 16.3.3. Test Execution

16.4. Alternating Current Testing
- 16.4.1. Solid Insulation
- 16.4.2. Remaining Insulation
- 16.4.3. Test Execution

16.5. Other Critical Tests
- 16.5.1. Test for the Insulation Oil
- 16.5.2. Power Factor Testing

16.6. Preventative Maintenance of Electrical Substations
- 16.6.1. Visual Inspection
- 16.6.2. Thermography

16.7. Disconnectors and Lightning Arresters Maintenance
- 16.7.1. Disconnectors
- 16.7.2. Lightning Arresters

16.8. Switch Maintenance
- 16.8.1. General Inspection
- 16.8.2. Preventative Maintenance
- 16.8.3. Predictive Maintenance

16.9. Power Transformer Maintenance
- 16.9.1. General Inspection
- 16.9.2. Preventative Maintenance
- 16.9.3. Predictive Maintenance

16.10. Elaborating a Maintenance Manual
- 16.10.1. Routine Maintenance
- 16.10.2. Critical Inspections
- 16.10.3. Corrective Maintenance

Module 17. Current Trends and Ancillary Services

17.1. New Trends
- 17.1.1. Maintenance Based on Reliability
- 17.1.2. Development of a System Based on Reliability
- 17.1.3. "Cusum" Control Tool

17.2. Power Transformer Condition Assessment
- 17.2.1. Risk Evaluation
- 17.2.2. Load and Temperature Tests
- 17.2.3. Gas Fuel Chromatography
- 17.2.4. Parameters to Be Controlled in Power Transformers

17.3. Encapsulated Substation Maintenance: GIS
- 17.3.1. Components
- 17.3.2. Settings
- 17.3.3. System Operations

17.4. Telecommunication System: Protection and Control
- 17.4.1. Reliability, Availability and Redundancy
- 17.4.2. Media
- 17.4.3. System Operations

17.5. Safety and Emergencies
- 17.5.1. Risk Assessment
- 17.5.2. Self-Protection Measures and Means
- 17.5.3. Emergency Action Plan

17.6. Maintenance Organization
- 17.6.1. Elaborating Work Order
- 17.6.2. Elaborating Maintenance Sheets
- 17.6.3. Maintenance Schedule

17.7. Low Voltage Maintenance
- 17.7.1. Electrical Panel Operations
- 17.7.2. Technical-Regulatory Inspections and Revisions

17.8. Fire Protection System
- 17.8.1. Legislative Framework
- 17.8.2. Inspections and Revisions

17.9. Explosive Atmospheres
- 17.9.1. Regulatory Framework
- 17.9.2. Evaluation Methodologies
- 17.9.3. Risk of Explosion Evaluation

17.10. Workers Qualifications
- 17.10.1. Worker Training and Information
- 17.10.2. Identifying Jobs With Electrical Risk
- 17.10.3. Worker Consultation and Participation

Module 18. Adjustments and Coordination of Protections in National High Voltage Networks

18.1. Protection Coordination
- 18.1.1. Impedances
- 18.1.2. Intensities
- 18.1.3. Protections

18.2. Protection Functions
- 18.2.1. Distance Function
- 18.2.2. Overcurrent Function
- 18.3.3. Demands on the Protection System

18.3. Generalities
- 18.3.1. Circuits
- 18.3.2. Transformers

18.4. Protections for Meshed Network Circuits
- 18.4.1. Generalities
- 18.4.2. Fouls Between Phases
- 18.4.3. Ground Faults
- 18.4.4. Resistive Faults

18.5. Radial Distribution Circuit Protections
- 18.5.1. Generalities
- 18.5.2. Fouls Between Phases
- 18.5.3. Ground Faults

18.6. Coupling Protections for Meshed Networks
- 18.6.1. Generalities
- 18.6.2. Fouls Between Phases
- 18.6.3. Ground Faults

18.7. Coupling Protections for Non-Meshed Networks
- 18.7.1. Generalities
- 18.7.2. Fouls Between Phases
- 18.7.3. Ground Faults

18.8. Transformer Protections for Meshed Networks
- 18.8.1. Generalities
- 18.8.2. Phase to Phase Faults, HV Winding
- 18.8.3. Phase to Earth, HV Winding
- 18.8.4. Phase to Earth, Tertiary Winding

18.9. Transformer Protections for Non-Meshed Networks
- 18.9.1. Generalities
- 18.9.2. Primary Winding, Interphase Faults
- 18.9.3. Primary Winding, Ground Faults

18.10. Considerations to Consider
- 18.10.1. Calculation Procedure: "Infeed" Factor
- 18.10.2. Homopolar Compensation Factor
- 18.10.3. High Voltage Circuit Breaker Opening Procedure

Bet on your future. Earn this Advanced Master's Degree and significantly improve your job opportunities"

06

Methodology

This academic program offers students a different way of learning. Our methodology uses a cyclical learning approach: **Relearning.**

This teaching system is used, for example, in the most prestigious medical schools in the world, and major publications such as the **New England Journal of Medicine** have considered it to be one of the most effective.

Discover Relearning, a system that abandons conventional linear learning, to take you through cyclical teaching systems: a way of learning that has proven to be extremely effective, especially in subjects that require memorization"

Case Study to contextualize all content

Our program offers a revolutionary approach to developing skills and knowledge. Our goal is to strengthen skills in a changing, competitive, and highly demanding environment.

At TECH, you will experience a learning methodology that is shaking the foundations of traditional universities around the world"

You will have access to a learning system based on repetition, with natural and progressive teaching throughout the entire syllabus.

The student will learn to solve complex situations in real business environments through collaborative activities and real cases.

A learning method that is different and innovative

This TECH program is an intensive educational program, created from scratch, which presents the most demanding challenges and decisions in this field, both nationally and internationally. This methodology promotes personal and professional growth, representing a significant step towards success. The case method, a technique that lays the foundation for this content, ensures that the most current economic, social and professional reality is taken into account.

> *Our program prepares you to face new challenges in uncertain environments and achieve success in your career"*

The case method is the most widely used learning system in the best faculties in the world. The case method was developed in 1912 so that law students would not only learn the law based on theoretical content. It consisted of presenting students with real-life, complex situations for them to make informed decisions and value judgments on how to resolve them. In 1924, Harvard adopted it as a standard teaching method.

What should a professional do in a given situation? This is the question that you are presented with in the case method, an action-oriented learning method. Throughout the program, the studies will be presented with multiple real cases. They will have to combine all their knowledge and research, and argue and defend their ideas and decisions.

Relearning Methodology

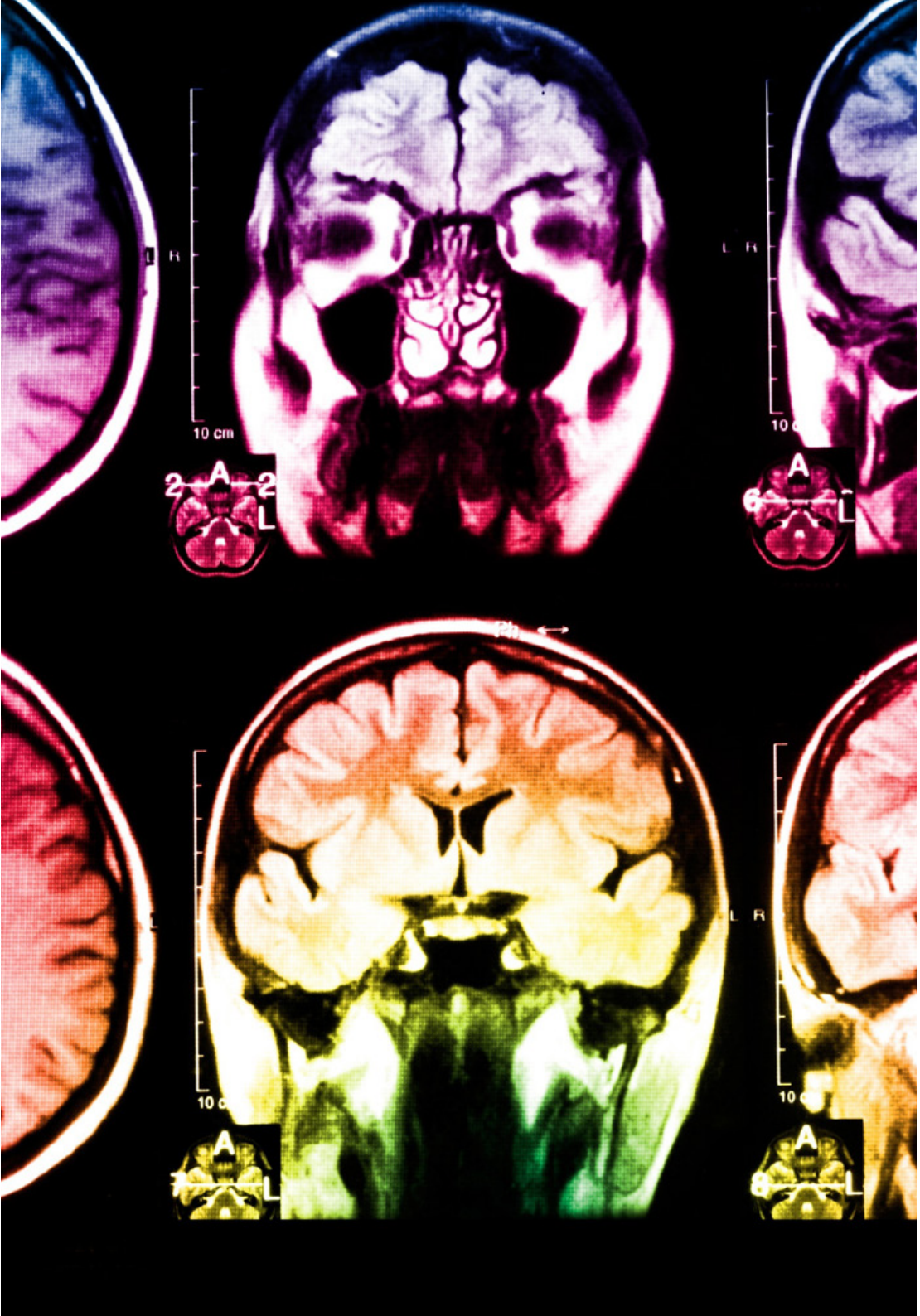
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines 8 different teaching elements in each lesson.

We enhance the Case Study with the best 100% online teaching method: Relearning.

In 2019, we obtained the best learning results of all online universities in the world.

At TECH, you will learn using a cutting-edge methodology designed to train the executives of the future. This method, at the forefront of international teaching, is called Relearning.

Our university is the only one in the world authorized to employ this successful method. In 2019, we managed to improve our students' overall satisfaction levels (teaching quality, quality of materials, course structure, objectives...) based on the best online university indicators.



In our program, learning is not a linear process, but rather a spiral (learn, unlearn, forget, and relearn). Therefore, we combine each of these elements concentrically. This methodology has trained more than 650,000 university graduates with unprecedented success in fields as diverse as biochemistry, genetics, surgery, international law, management skills, sports science, philosophy, law, engineering, journalism, history, and financial markets and instruments. All this in a highly demanding environment, where the students have a strong socio-economic profile and an average age of 43.5 years.

Relearning will allow you to learn with less effort and better performance, involving you more in your training, developing a critical mindset, defending arguments, and contrasting opinions: a direct equation for success.

From the latest scientific evidence in the field of neuroscience, not only do we know how to organize information, ideas, images and memories, but we know that the place and context where we have learned something is fundamental for us to be able to remember it and store it in the hippocampus, to retain it in our long-term memory.

In this way, and in what is called neurocognitive context-dependent elearning, the different elements in our program are connected to the context where the individual carries out their professional activity.

This program offers the best educational material, prepared with professionals in mind:

Study Material

All teaching material is produced by the specialists who teach the course, specifically for the course, so that the teaching content is highly specific and precise.

These contents are then applied to the audiovisual format, to create the TECH online working method. All this, with the latest techniques that offer high quality pieces in each and every one of the materials that are made available to the student.

Classes

There is scientific evidence suggesting that observing third-party experts can be useful.

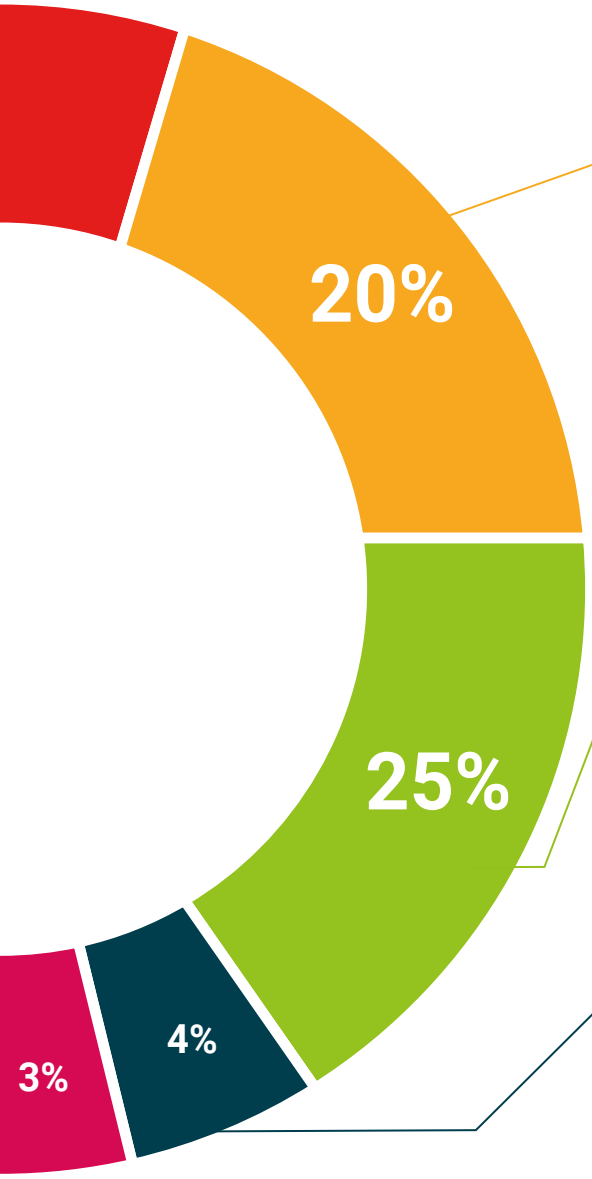
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

Practising Skills and Abilities

They will carry out activities to develop specific skills and abilities in each subject area. Exercises and activities to acquire and develop the skills and abilities that a specialist needs to develop in the context of the globalization that we are experiencing.

Additional Reading

Recent articles, consensus documents and international guidelines, among others. In TECH's virtual library, students will have access to everything they need to complete their course.



Case Studies

Students will complete a selection of the best case studies chosen specifically for this program. Cases that are presented, analyzed, and supervised by the best specialists in the world.

Interactive Summaries

The TECH team presents the contents attractively and dynamically in multimedia lessons that include audio, videos, images, diagrams, and concept maps in order to reinforce knowledge.

This exclusive educational system for presenting multimedia content was awarded by Microsoft as a "European Success Story".

Testing & Retesting

We periodically evaluate and re-evaluate students' knowledge throughout the program, through assessment and self-assessment activities and exercises, so that they can see how they are achieving their goals.

07

Certificate

This Advanced Master's Degree in Electrical Energy guarantees you, in addition to the most rigorous and updated training, access to a Advanced Master's Degree issued by TECH Global University.

Successfully complete this training and receive your university degree without travel or laborious paperwork”

This program will allow you to obtain your **Advanced Master's Degree diploma in Electrical Energy** endorsed by **TECH Global University**, the world's largest online university.

TECH Global University is an official European University publicly recognized by the Government of Andorra (***official bulletin***). Andorra is part of the European Higher Education Area (EHEA) since 2003. The EHEA is an initiative promoted by the European Union that aims to organize the international training framework and harmonize the higher education systems of the member countries of this space. The project promotes common values, the implementation of collaborative tools and strengthening its quality assurance mechanisms to enhance collaboration and mobility among students, researchers and academics.

This **TECH Global University** title is a European program of continuing education and professional updating that guarantees the acquisition of competencies in its area of knowledge, providing a high curricular value to the student who completes the program.

Title: **Advanced Master's Degree in Electrical Energy**

Modality: **online**

Duration: **2 years**

Accreditation: **120 ECTS**


tech global university

Mr./Ms. _____, with identification document _____
has successfully passed and obtained the title of:

Advanced Master's Degree in Electrical Energy

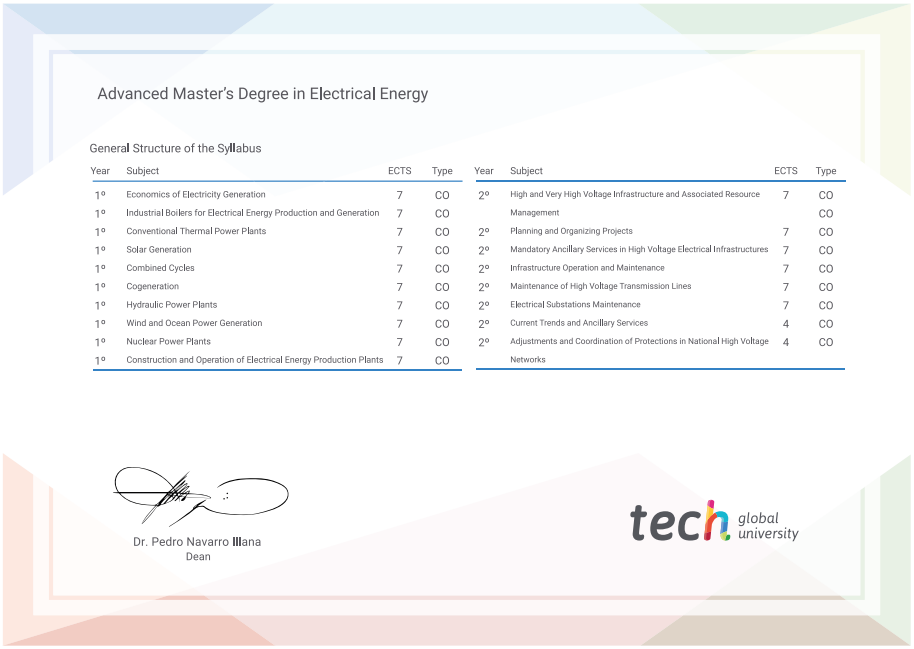
This is a program of 3,000 hours of duration equivalent to 120 ECTS, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

TECH Global University is a university officially recognized by the Government of Andorra on the 31st of January of 2024, which belongs to the European Higher Education Area (EHEA).

In Andorra la Vella, on the 28th of February of 2024

Dr. Pedro Navarro Illana
Rector

This qualification must always be accompanied by the university degree issued by the competent authority to practice professionally in each country. Unique TECH Code: AFWORD23S techtitute.com/certificates


Advanced Master's Degree in Electrical Energy

General Structure of the Syllabus

Year	Subject	ECTS	Type
1º	Economics of Electricity Generation	7	CO
1º	Industrial Boilers for Electrical Energy Production and Generation	7	CO
1º	Conventional Thermal Power Plants	7	CO
1º	Solar Generation	7	CO
1º	Combined Cycles	7	CO
1º	Cogeneration	7	CO
1º	Hydraulic Power Plants	7	CO
1º	Wind and Ocean Power Generation	7	CO
1º	Nuclear Power Plants	7	CO
1º	Construction and Operation of Electrical Energy Production Plants	7	CO
2º	High and Very High Voltage Infrastructure and Associated Resource Management	7	CO
2º	Planning and Organizing Projects	7	CO
2º	Mandatory Ancillary Services in High Voltage Electrical Infrastructures	7	CO
2º	Infrastructure Operation and Maintenance	7	CO
2º	Maintenance of High Voltage Transmission Lines	7	CO
2º	Electrical Substations Maintenance	7	CO
2º	Current Trends and Ancillary Services	4	CO
2º	Adjustments and Coordination of Protections in National High Voltage Networks	4	CO

Dr. Pedro Navarro Illana
Dean

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*Apostille Convention. In the event that the student wishes to have their paper diploma issued with an apostille, TECH Global University will make the necessary arrangements to obtain it, at an additional cost.

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Advanced Master's Degree
Electrical Energy

- Modality: **online**
- Duration: **2 years**
- Certificate: **TECH Global University**
- Credits: **120 ECTS**
- Schedule: **at your own pace**
- Exams: **online**

Advanced Master's Degree
Electrical Energy

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