Hybrid Professional Master's Degree

Hydrogen Technology

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Hydrogen Technology

Modality: **Hybrid (Online + Internship)**
Duration: **12 months**
Certificate: **TECH Global University**
Credits: **60 + 4 ECTS**
Website: **www.techtitute.com/us/engineering/hybrid-professional-master-degree/hybrid-professional-master-degree-hydrogen-technology**

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01

Introduction

According to the International Energy Agency, Hydrogen has the capacity to cover up to 20% of the world's energy demand in the coming years, playing a crucial role in the decarbonization of sectors where emissions reduction is more complex. Faced with this situation, the most prestigious entities demand the incorporation of highly qualified experts in Hydrogen Technologies, capable of providing clean and sustainable energy. Therefore, it is necessary that professionals adopt in their procedures the most innovative techniques in areas such as the production of this chemical element or creation of Refueling Stations. In view of this, TECH presents a revolutionary university program that brings together the most avant-garde procedures in this field.

Thanks to this Hybrid Professional Master's Degree, you will lead the most innovative projects in the field of Hydrogen and ensure their adequacy to both technical and regulatory requirements"

In the context of the global search for sustainable alternatives to fossil fuels, Hydrogen Technology emerges as a promising solution due to its potential to provide clean and sustainable energy. Faced with this situation, professionals need to update their knowledge frequently to keep abreast of developments in this emerging and constantly evolving sector. In this way, engineers will be able to incorporate aspects such as recent developments in fuel cells and advanced storage systems into their practice. However, this can be a challenge as most of the educational programs on the market are limited to the mere transmission of knowledge.

However, this can be a challenge as most of the educational programs on the market are limited to the mere transmission of knowledge. The academic itinerary will provide a review of recent innovations in the production, storage and use of Hydrogen, highlighting how these technologies can be integrated into existing energy systems. At the same time, the syllabus will delve into the regulatory aspects currently in force regarding the use of hydrogen. Thanks to this, graduates will carry out good practices in the implementation of the safety plan. Also the didactic materials will delve into the analysis of Green Hydrogen production plans, so that graduates will be able to develop highly sustainable projects that reinforce their social responsibility.

Regarding the methodology of this university program, it consists of two stages. The first is theoretical and is taught in a convenient 100% online format. In this sense, TECH uses its disruptive Relearning system to guarantee a progressive and natural learning, which does not require extra efforts such as the traditional memorization. Afterwards, the program includes a practical stay of 3 weeks in a reference entity linked to Hydrogen Technology. This will allow graduates to take what they have learned to the practical field, in a real work scenario in the company of a team of experienced professionals in this area.

This **Hybrid Professional Master's Degree in Hydrogen Technology** contains the most complete and up-to-date scientific program on the market. The most important features include:

- Development of more than 100 case studies presented by Hydrogen Technology professionals
- Its graphic, schematic and practical contents provide essential information on those disciplines that are indispensable for professional practice
- Emphasis on the safest techniques for storage, transportation and distribution of Hydrogen
- Highly knowledgeable about current Hydrogen regulatory issues
- Emphasis on sustainable and environmentally friendly practices
- All of this will be complemented by 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
- Furthermore, you will be able to carry out an internship in one of the best companies

Are you looking to incorporate into your praxis the most sophisticated tools to perform techno-economic analysis? Thanks to this program you will accurately assess the feasibility of Hydrogen Technologies"

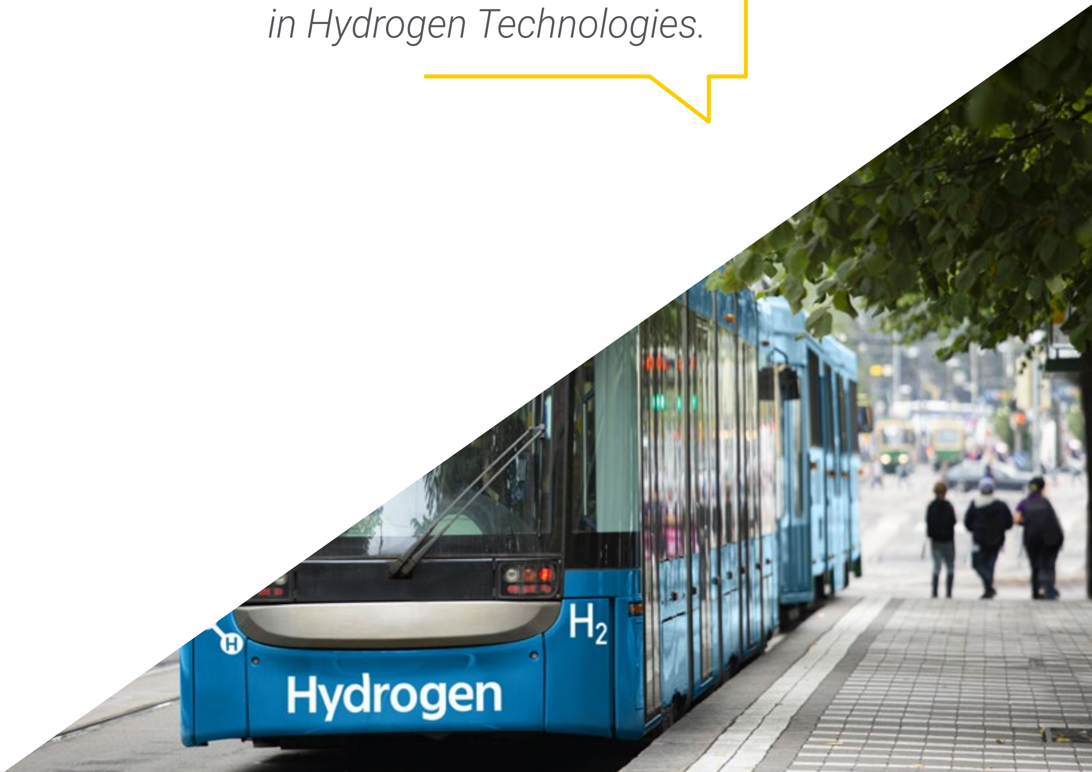
You will have a 3 week internship in a well known company, where you will participate in initiatives of storage, transport and use of Hydrogen"

In this proposal of Master's Degree, of professionalizing character and blended learning modality, the program is aimed at updating engineers who develop their functions in different industries and require a high level of qualification. The contents are based on the latest scientific evidence, and oriented in a didactic way to integrate theoretical knowledge in the practice of Hydrogen Technology, and the theoretical-practical elements will facilitate the updating of knowledge and allow informed decision making.

Thanks to its multimedia content elaborated with the latest educational technology, they will allow the engineering professional a situated and contextual learning, that is, a simulated environment that will provide an immersive learning programmed to learn in real situations. This program is designed around Problem-Based Learning, whereby the physician must try to solve the different professional practice situations that arise during the course. For this purpose, students will be assisted by an innovative interactive video system created by renowned and experienced experts.

This university program allows you to practice in simulated environments, which provide immersive learning programmed to prepare in real situations.

You will be able to participate in research and development activities. You will contribute to the advancement of knowledge in Hydrogen Technologies.



02

Why Study this Hybrid Professional Master's Degree?

With the increasing global focus on renewable energies and the need for sustainable solutions to climate change, Hydrogen Technology is emerging as a field that offers numerous advantages to both institutions and society at large. To stay at the forefront of future energy proposals, professionals need access to education that seamlessly combines a theoretical and practical approach. Only in this way will they be able to develop advanced skills and immerse themselves in the reality of a challenging work sector. With this idea in mind, TECH has created this pioneering degree, where the most recent updates in areas such as electrolysis processes, fuel cells or hydrogen project management are merged with a practical stay in a prestigious entity. This will allow graduates to develop their full potential in the field of Hydrogen Technology and prepare them to make the jump to the most prestigious institutions in the industry.

In just 12 months you will master the legislative framework and market dynamics related to Hydrogen"

1. Updating from the latest technology available

Industry 4.0 is having a significant impact on most industries, especially in the field of Hydrogen Technology. A sample of this is advanced electrolysis, which allow the optimization of electrolytic cell configurations to increase efficiency and reduce operating costs. Through this university program, TECH will provide students with the most advanced technological tools to perform their work comfortably.

2. Gaining in-depth knowledge from the experience of top specialists

This Hybrid Professional Master's Degree has the participation of distinguished experts in Hydrogen Technology. In the first stage of the program, the teachers will be in charge of providing students with personalized guidance. Then, during the practical stay, the graduates will be supported by real professionals based in the institution that will host them for this type of specialization.

3. Entering first-class professional environments

Loyal to its philosophy of offering the most complete itineraries on the market, TECH carefully chooses the institutions that will host its students during the 3-week practical internship program included in this program. These companies have a high prestige, thanks to their staff and their high specialization in the field of Hydrogen Technology.

4. Combining the best theory with state-of-the-art practice

This program completely breaks several schemes in the current pedagogical market, where university programs with little focus on didactic specialization prevail. Far from this, TECH presents a disruptive learning model, under a theoretical-practical approach that facilitates the access of engineering professionals to reference institutions.

5. Expanding the boundaries of knowledge

Through the university program, TECH offers engineers the opportunity to expand their professional horizons from an international perspective. This is possible thanks to the wide range of contacts and collaborators available at TECH, the largest digital university in the world.

You will have full practical immersion at the center of your choice"

03
Objectives

Upon completion of this Hybrid Professional Master's Degree, engineers will become experts in the emerging field of Hydrogen, recognizing that it is a clean and sustainable energy source. Therefore, specialists will have a solid technical understanding of the fundamental principles of the production, storage, distribution and use of this chemical element following high safety parameters.

Through this university program, you will encourage the use of Hydrogen as a sustainable energy source and promote its application in a variety of sectors such as transportation"

General Objective

- Through this Hybrid Professional Master's Degree's in Hydrogen Technology, engineers will experience a remarkable leap in quality in their professional career. These professionals will acquire advanced practical skills to design, operate and maintain systems related to this chemical element (from fuel cells to production facilities). In addition, the specialists will stand out for their innovation and development of new solutions in the field of Hydrogen to improve its economic viability and operational efficiency. Furthermore, they will take into consideration the environmental impact of Hydrogen Technologies and promote their integration into sustainable energy systems

You will assess the environmental impact of Hydrogen Technologies from feedstock extraction to energy production and final disposal"

Specific Objectives

Module 1. Hydrogen as an Energy Vector
- Interpret in depth the singularities of the Hydrogen environment
- Examine the existing legislative framework in the Hydrogen environment
- Evaluate the members of the Hydrogen value chain, as well as the needs to achieve the hydrogen economy
- Delve into the knowledge of Hydrogen as a molecule
- Determine the most relevant concepts of the Hydrogen environment
- Analyze the integration of hydrogen in Hydrogen infrastructures

Module 2. Hydrogen Production and Electrolysis
- Determine the methods of Hydrogen production from fossil fuels
- Analyze the mechanisms of Hydrogen generation from biomass
- Establish the modes of biological Hydrogen formation
- Differentiate the different electrolysis technologies for hydrogen production
- Examine the electrochemistry behind electrolysis processes
- Perform techno-economic modeling of an electrolysis system

Module 3. Hydrogen Storage, Transport and Distribution
- Develop the different possibilities of storage, transport and distribution of Hydrogen
- Determine the different ways of transporting, storing and distributing of Hydrogen
- Analyze the possibilities and limitations of hydrogen export
- Delve into the techno-economic analysis of large-scale Hydrogen logistics

Module 4. Hydrogen End Uses
- Qualify the student in e-fuels production processes
- Specialize the student in Hydrogen integration in fuel cell vehicles
- Analyze the idiosyncrasies of the hydrogen-industry relationship
- Examine the Haber-Bosch process and methanol production in depth
- Determine the relationship between hydrogen and its use in refineries and its use in steel mills
- Raise student awareness of the need for natural gas substitution

Module 5. Hydrogen Fuel Cells
- Analyze the chemistry that governs the operation of PEMFCs
- Specialize the student in the design of the PEMFC membrane-electrode assembly
- Understand the operation of the PEMFC fuel cell stack
- Analyze the characteristics of other types of fuel cells
- Establish the sizing of the fuel cell system according to the final application
- Determine fuel cell integration by end-use

Module 6. Hydrogen Vehicle Refueling Stations

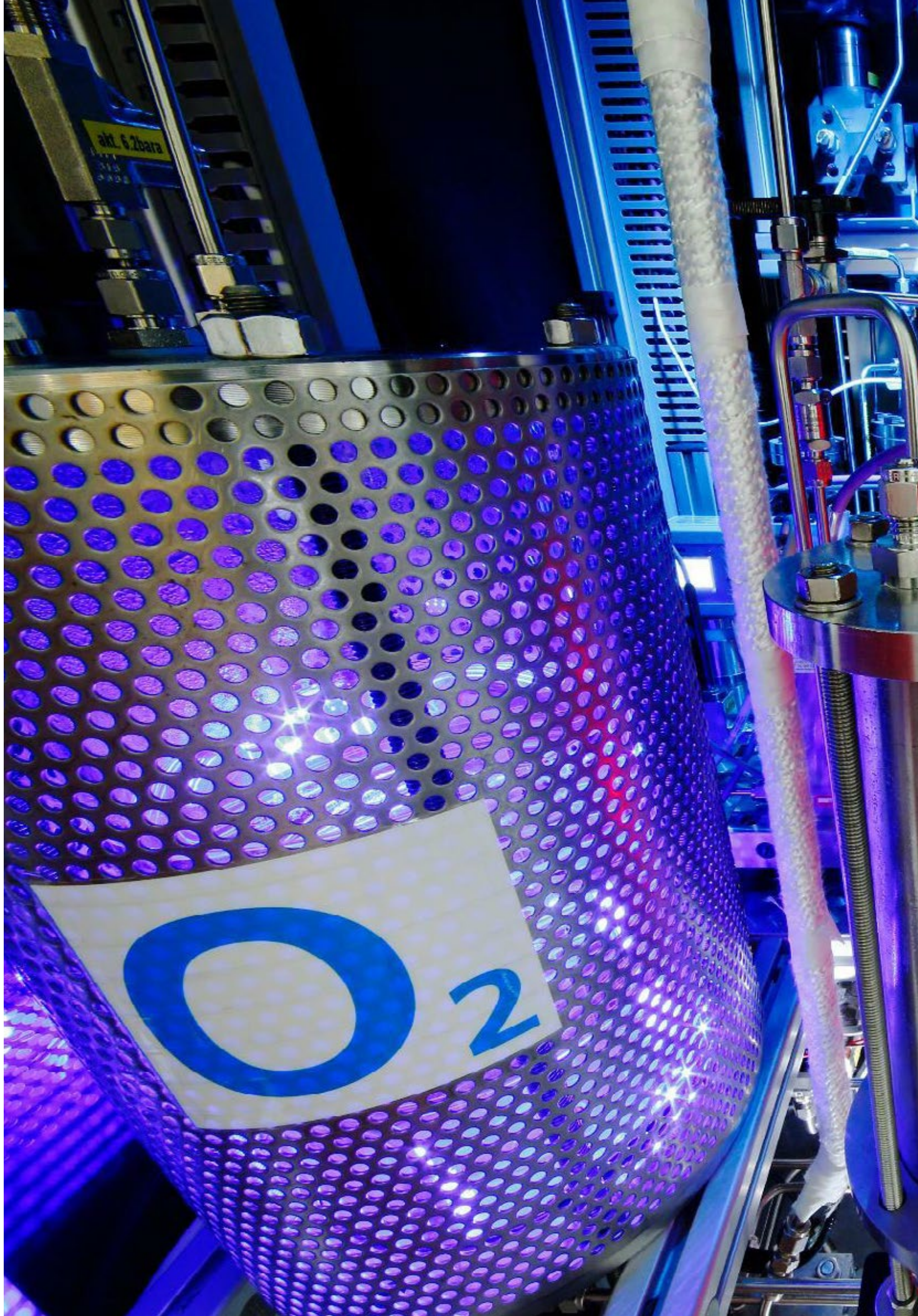
- Establishing the different typologies of Hydrogen refueling stations
- Establish the design parameters
- Compile storage strategies at different pressure levels
- Analyze dispensing and its associated problems
- Master the concepts of safety and associated regulations
- Specialize students in modeling the operation of a Hydrogen refueling station

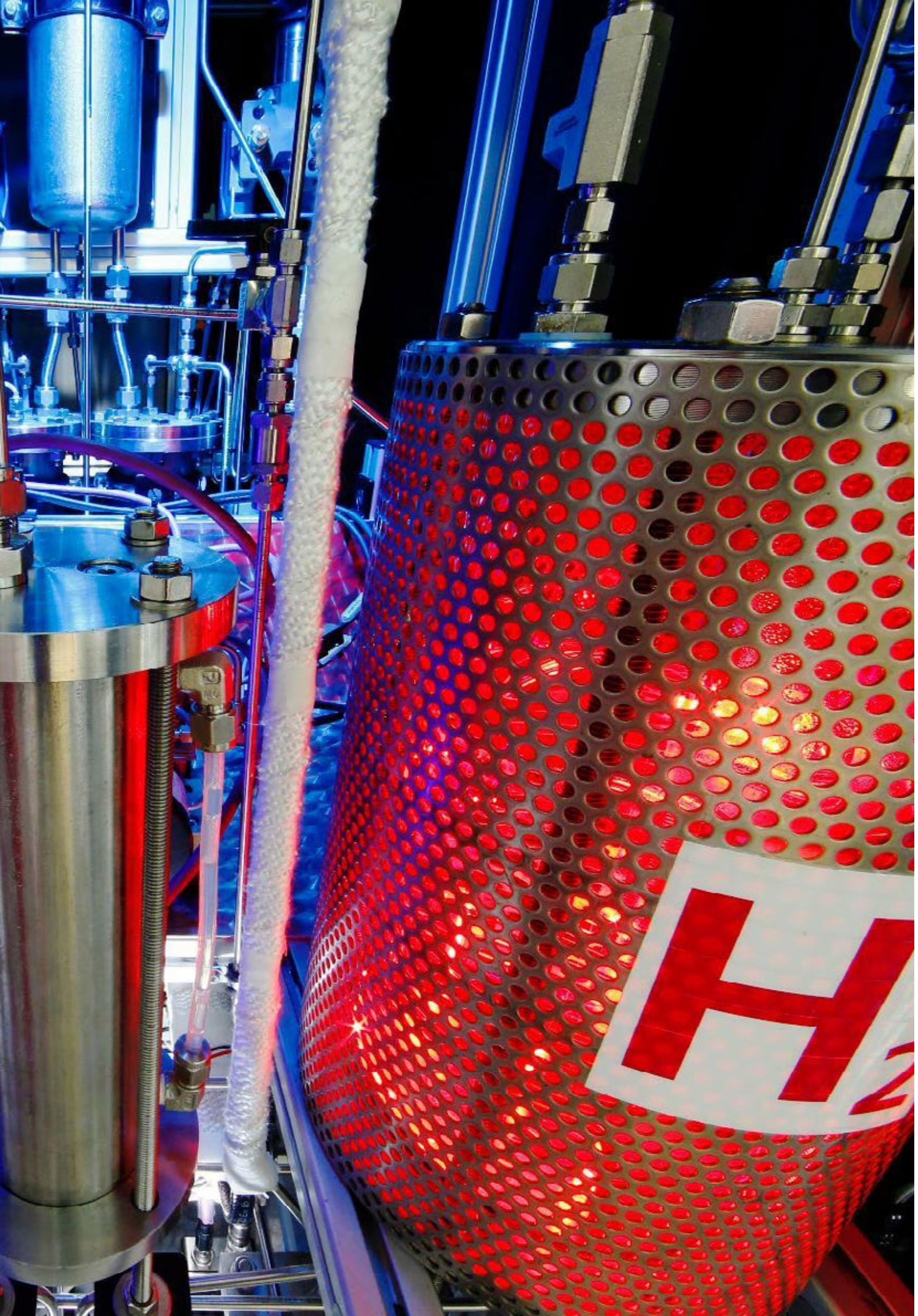
Module 7. Hydrogen Markets

- Understand the different markets in which hydrogen can penetrate
- Understand hydrogen sales price bands according to end-uses
- Analysis of current hydrogen demand and production
- Knowledge of Hydrogen market expansion plans
- Evaluation of real Hydrogen projects
- Explanation of the guarantee of origin system and its necessity

Module 8. Hydrogen Regulatory and Safety Aspects

- Study of best practices for Hydrogen project deployment
- Instruction on the documentation required by the administration
- Delve into key application directives
- Study the safety of Hydrogen installations





Module 9. Hydrogen Project Planning and Management

- Compile project management tools
- Explore the different parts of project planning

Module 10. Technical and Economic Analysis and Feasibility of Hydrogen Projects

- Develop specialized knowledge on techno-economic and feasibility analysis of Hydrogen projects
- Determine the structuring of hydrogen projects and their financing
- Analyze the keys to electricity supply for green hydrogen production
- Learn how to develop a feasibility analysis and its different scenarios

You will combine theory and professional practice through a demanding and rewarding educational approach"

04
Skills

Upon completion of this Hybrid Professional Master's Degree, graduates will master the safest techniques for the storage, transport and utilization of Hydrogen. In this line, professionals will integrate the use of this chemical element in current energy systems, including its use in fuel cells, for electricity generation and as fuel for vehicles. In addition, engineers will be highly qualified to both design and optimize facilities that produce or use Hydrogen, keeping safety and operational efficiency in mind at all times.

You will lead innovative projects in Hydrogen Technology, facilitating new processes that contribute to the transition to a more sustainable and environmentally friendly economy"

General Skills

- Conceptual design of a Hydrogen refueling station
- Develop the techniques of cogeneration and electricity production with fuel cells and their importance
- Develop skills in analyzing the possibilities and choosing the most appropriate method of hydrogen storage, transportation and analysis and distribution for their project
- Design the complete electrolysis system

You will have access to the contents from any fixed or portable device with Internet connection. Even from your cell phone!"

Specific Skills

- Assess the possibilities offered by Hydrogen
- Enhance the ability to choose the most suitable financing tool
- Efficient management of Hydrogen projects
- Expand the analysis of the import and export potential of different countries
- Delve into the knowledge of Project Finance focused on the development of hydrogen projects
- Characterize and identify project costs and revenues, as well cash flows and profitability indicators
- Analyze the EPC phase and O&M phase of a Hydrogen Project
- Develop expertise on the contracting phase of a project
- Learn about European Hydrogen policies
- Learn about the regulations applicable to Hydrogen projects

05
Educational Plan

The didactic materials that make up this Hybrid Professional Master's Degree are designed by a prestigious teaching staff, made up of specialists with a broad professional background in Hydrogen Technology. In this way, they have created a top quality syllabus that adapts to the demands of the current labor market. In this sense, the syllabus will delve into aspects ranging from Hydrogen Production and Electrolysis or Vehicle Refueling Stations to regulatory aspects. In addition, the program will allow students to develop advanced competencies for the storage, transport and distribution of hydrogen.

This program gives you the opportunity to update your knowledge in a real scenario, with the maximum scientific rigor of an institution at the forefront of technology"

Module 1. Hydrogen as an Energy Vector

1.1. Hydrogen as an Energy Vector. Global Context and Necessity
 1.1.1. Political and Social Context
 1.1.2. Paris CO2 Emission Reduction Commitment
 1.1.3. Circularity
1.2. Hydrogen Development
 1.2.1. Discovery and Production of Hydrogen
 1.2.2. Role of Hydrogen in Industrial Society
 1.2.3. Hydrogen at Present
1.3. Hydrogen as a Chemical Element: Properties
 1.3.1. Properties
 1.3.2. Permeability
 1.3.3. Flammability and Buoyancy Index
1.4. Hydrogen as a Fuel
 1.4.1. Hydrogen Production
 1.4.2. Hydrogen Storage and Distribution
 1.4.3. The Use of Hydrogen as a Fuel
1.5. Hydrogen Economy
 1.5.1. Decarbonization of the Economy
 1.5.2. Renewable Energy Sources
 1.5.3. The Road to the Hydrogen Economy
1.6. Hydrogen Value Chain
 1.6.1. Production
 1.6.2. Storage and Transportation
 1.6.3. End-Uses
1.7. Integration with Existing Energy Infrastructures: Hydrogen as an Energy Vector
 1.7.1. Regulations
 1.7.2. Problems Associated with Hydrogen Embrittlement
 1.7.3. Integration of Hydrogen in Energy Infrastructures. Trends and Realities

1.8. Hydrogen Technologies. Status
- 1.8.1. Hydrogen Technologies
- 1.8.2. Technologies under Development
- 1.8.3. Key Projects for Hydrogen Development

1.9. "Relevant" Type Projects
- 1.9.1. Production Projects
- 1.9.2. Flagship Projects in Storage and Transportation
- 1.9.3. Projects for the Application of Hydrogen as an Energy Vector
- 1.10. Hydrogen in the Global Energy Mix: Current Situation and Prospects
- 1.10.1. The Energy Mix. Global Context
- 1.10.2. Hydrogen in the Energy Mix. Current Situation
- 1.10.3. Development Pathways for Hydrogen. Perspectives

Module 2. Hydrogen Production and Electrolysis

2.1. Fossil Fuel Production
- 2.1.1. Hydrocarbon Reforming Production
- 2.1.2. Generation by Pyrolysis
- 2.1.3. Coal Gasification

2.2. Production From Biomass
- 2.2.1. Hydrogen Production by Biomass Gasification
- 2.2.2. Hydrogen Generation by Biomass Pyrolysis
- 2.2.3. Aqueous Reforming

2.3. Biological Production
- 2.3.1. Water Gas Shift Reaction (WGSR)
- 2.3.2. Dark Fermentation for Biohydrogen Generation
- 2.3.3. Photofermentation of Organic Compounds for Hydrogen Production

2.4. By-Product of Chemical Processes
- 2.4.1. Hydrogen as a By-Product of Petrochemical Processes
- 2.4.2. Hydrogen as a By-Product of Caustic Soda and Chlorine Production
- 2.4.3. Synthesis Gas as a By-Product Generated in Coke Ovens

2.5. Water Separation
- 2.5.1. Photolytic Hydrogen Formation
- 2.5.2. Hydrogen Generation by Photocatalysis
- 2.5.3. Hydrogen Production by Thermal Separation of Water

2.6. Electrolysis: the Future of Hydrogen Generation
- 2.6.1. Hydrogen Generation by Electrolysis
- 2.6.2. Oxidation-Reduction Reaction
- 2.6.3. Thermodynamics of Electrolysis

2.7. Electrolysis Technologies
- 2.7.1. Low Temperature Electrolysis: Alkaline and Anionic Technology
- 2.7.2. Low Temperature Electrolysis: PEM
- 2.7.3. High Temperature Electrolysis

2.8. Stack: the Heart of an Electrolyzer
- 2.8.1. Materials and Components in Low-Temperature Electrolysis
- 2.8.2. Materials and Components in High-Temperature Electrolysis
- 2.8.3. Stack Assembly in Electrolysis

2.9. Balance of Plant and System
- 2.9.1. Balance of Plant Components
- 2.9.2. Balance of Plant Design
- 2.9.3. Balance of Plant Optimization

2.10. Technical and Economic Characterization of Electrolyzers
- 2.10.1. Capital and Operating Costs
- 2.10.2. Technical Characterization of an Electrolyzer Operation
- 2.10.3. Techno-Economic Modeling

Module 3. Hydrogen Storage, Transportation and Distribution

3.1. Hydrogen Storage, Transportation, and Distribution Forms
- 3.1.1. Hydrogen Gas
- 3.1.2. Liquid Hydrogen
- 3.1.3. Hydrogen Storage in Solid State

3.2. Hydrogen Compression
- 3.2.1. Hydrogen Compression. Necessity
- 3.2.2. Problems Associated with the Compression of Hydrogen
- 3.2.3. Equipment

3.3. Gaseous State Storage
- 3.3.1. Problems Associated with Hydrogen Storage
- 3.3.2. Types of Storage Tanks
- 3.3.3. Storage Tank Capacities

Module 4. Hydrogen End-Uses

4.9. Cogeneration and Production of Electricity with Fuel Cells
- 4.9.1. Fuel Cell Production
- 4.9.2. Discharge to the Grid
- 4.9.3. Microgrids

4.10. Others Hydrogen End-Uses: Chemical, Semiconductor, Glass Industry
- 4.10.1. Chemical Industry
- 4.10.2. Semiconductor Industry
- 4.10.3. Glass Industry

Module 5. Hydrogen Fuel Cells

5.1. PEMFC (Proton-Exchange Membrane Fuel Cell) Fuel Cells
- 5.1.1. Chemistry Governing PEMFCs
- 5.1.2. Operation of the PEMFC
- 5.1.3. PEMFC Applications

5.2. Membrane-Electrode Assembly in PEMFCs
- 5.2.1. MEA Materials and Components
- 5.2.2. PEMFC Catalysts
- 5.2.3. Circularity in PEMFC

5.3. Stack in PEMFC Piles
- 5.3.1. Stack Architecture
- 5.3.2. Assembly
- 5.3.3. Power Generation

5.4. Balance of Plant and PEMFC Stack System
- 5.4.1. Balance of Plant Components
- 5.4.2. Balance of Plant Design
- 5.4.3. System Optimization

5.5. SOFC (Sodium Oxide Fuel Cells) Fuel Cells
- 5.5.1. Chemistry Governing SOFCs
- 5.5.2. SOFCs Operation
- 5.5.3. Applications

5.6. Other Types of Fuel Cells: Alkaline, Reversible, Direct Methanation, etc.
- 5.6.1. Alkaline Fuel Cells
- 5.6.2. Reversible Fuel Cells
- 5.6.3. Direct Methanation Fuel Cells

5.7. Applications of Fuel Cells I. In Mobility, Electric Power Generation, Thermal Generation
- 5.7.1. Fuel Cells in Mobility
- 5.7.2. Fuel Cells in Power Generation
- 5.7.3. Fuel Cells in Thermal Generation

5.8. Fuel Cell Applications II. Techno-Economic Modeling
- 5.8.1. Technical and Economic Characterization of the PEMFC
- 5.8.2. Capital and Operating Costs
- 5.8.3. Technical Characterization of the Operation of a PEMFC
- 5.8.4. Techno-Economic Modeling

5.9. Dimensioning of PEMFC for Different Applications
- 5.9.1. Static Modeling
- 5.9.2. Dynamic Modeling
- 5.9.3. PEMFC Integration in Vehicles

5.10. Stationary Fuel Cells Grid Integration
- 5.10.1. Stationary Fuel Cells in Renewable Microgrids
- 5.10.2. System Modeling
- 5.10.3. Techno-Economic Study of a Fuel Cell in Stationary Use

Module 6. Hydrogen Refueling Stations

6.1. Hydrogen Vehicle Refueling Corridors and Networks
- 6.1.1. Hydrogen Vehicle Refueling Networks. Current State
- 6.1.2. Global Hydrogen Vehicle Refueling Station Deployment Targets
- 6.1.3. Cross-border Corridors for Hydrogen Refueling.

6.2. Hydrogen Plant Types, Modes of Operation and Dispensing Categories
- 6.2.1. Types of Hydrogen Refueling Station
- 6.2.2. Operating Modes of the Hydrogen Refueling Stations
- 6.2.3. Dispensing Categories According to Standards

6.3. Design Parameters
- 6.3.1. Hydrogen Refueling Station. Components
- 6.3.2. Design Parameters according to Hydrogen Storage Type
- 6.3.3. Design Parameters according to the Station's Target Use

6.4. Storage and Pressure Levels
- 6.4.1. Storage of Hydrogen Gas at Hydrogen Refueling Stations
- 6.4.2. Gas Storage Pressure Levels
- 6.4.3. Liquid Hydrogen Storage in Hydrogen Refueling Stations

6.5. Compression Stages
- 6.5.1. Hydrogen Compression. Necessity
- 6.5.2. Compression Technologies
- 6.5.3. Optimization

6.6. Dispensing and Precooling
- 6.6.1. Precooling according to Regulations and Vehicle Type. Necessity
- 6.6.2. Hydrogen Dispensing Cascade
- 6.6.3. Thermal Phenomena of Dispensing

6.7. Mechanical Integration
- 6.7.1. Refueling Stations with On-Site Hydrogen Production
- 6.7.2. Refueling Stations without Hydrogen Production
- 6.7.3. Modularization

6.8. Preliminary Design of a Hydrogen Plant
- 6.8.1. Presentation of the Case Study
- 6.8.2. Development of the Case Study
- 6.8.3. Resolution

6.9. Cost Analysis
- 6.9.1. Capital and Operating Costs
- 6.9.2. Technical Characterization of a Hydrogen Refueling Station Operation
- 6.9.3. Techno-Economic Modeling

Module 7. Hydrogen Markets

7.1. Energy Markets
- 7.1.1. Integration of Hydrogen in the Gas Market
- 7.1.2. Interaction of Hydrogen Price with Fossil Fuels Prices
- 7.1.3. Interaction of the Hydrogen Price with the Electricity Market Price

7.2. Calculation of LCOHs and Sales Price Bands
- 7.2.1. Presentation of the Case Study
- 7.2.2. Development of the Case Study
- 7.2.3. Resolution

7.3. Global Demand Analysis
- 7.3.1. Current Hydrogen Demand
- 7.3.2. Hydrogen Demand Derived from New Uses
- 7.3.3. Objectives to 2050

7.4. Analysis of Hydrogen Production and Types of Hydrogen
- 7.4.1. Current Hydrogen Production
- 7.4.2. Green Hydrogen Production Plans
- 7.4.3. Impact of Hydrogen Production on the Global Energy System

7.5. International Roadmaps and Plans
- 7.5.1. Submission of International Plans
- 7.5.2. Analysis of International Plans
- 7.5.3. Comparison between Different International Plans

7.6. Green Hydrogen Market Potential
- 7.6.1. Green Hydrogen into the Natural Gas Grid
- 7.6.2. Green Hydrogen in Mobility
- 7.6.3. Green Hydrogen in Industries

7.7. Analysis of Large-Scale Projects in the Deployment Phase: USA, Japan, Europe, China
- 7.7.1. Project Selection
- 7.7.2. Analysis of Selected Projects
- 7.7.3. Conclusions

7.8. Centralization of Production: Countries with Export and Import Potential
- 7.8.1. Renewable Hydrogen Production Potential
- 7.8.2. Renewable Hydrogen Import Potential
- 7.8.3. Transportation of Large Volumes of Hydrogen

7.9. Guarantees of Origin
- 7.9.1. Need for a System of Guarantees of Origin
- 7.9.2. CertifHy
- 7.9.3. Approved Systems of Guarantees of Origin

7.10. Hydrogen Supply Contracts: Offtake Contracts
 7.10.1. Importance of Offtake Contracts for Hydrogen Projects
 7.10.2. Keys to Offtake Contracts: Price, Volume and Duration
 7.10.3. Review of a Standard Contract Structure

Module 8. Explain the System of Guarantees of Origin and the Need For It

8.1. EU Policies
 8.1.1. European Hydrogen Strategy
 8.1.2. REPowerEU Plan
 8.1.3. Hydrogen Roadmaps in Europe

8.2. Incentive Mechanisms for the Deployment of the Hydrogen Economy
 8.2.1. Need for Incentive Mechanisms for the Deployment of the Hydrogen Economy
 8.2.2. Incentives at European Level
 8.2.3. Examples of Incentives in European Countries

8.3. Regulation Applicable to Production and Storage, Use of Hydrogen in Mobility and in the Gas Grid
 8.3.1. Applicable Regulation for Production and Storage
 8.3.2. Applicable Regulation for the Use of Hydrogen in Mobility
 8.3.3. Regulation Applicable for the Use of Hydrogen in the Gas Grid

8.4. Standards and Best Practices in Security Plan Implementation
 8.4.1. Applicable Standards: CEN/CELEC
 8.4.2. Good Practices in the Implementation of the Security Plan
 8.4.3. Hydrogen Valleys

8.5. Required Project Documentation
 8.5.1. Technical Projects
 8.5.2. Environmental Documentation
 8.5.3. Certification

8.6. European Directives. Application Key: PED, ATEX, LVD, MD and EMC.
 8.6.1. Pressure Equipment Regulations
 8.6.2. Explosive Atmosphere Regulations
 8.6.3. Chemical Storage Regulations

Module 9. Hydrogen Project Planning and Management

Module 10. Technical-Economic and Feasibility Analysis of Hydrogen Projects

10.1. Green Hydrogen Power Supply
- 10.1.1. The Keys to PPAs (Power Purchase Agreement)
- 10.1.2. Self-Consumption with Green Hydrogen
- 10.1.3. Hydrogen Production in Off-Grid Configuration

10.2. Technical and Economic Modeling of Electrolysis Plants
- 10.2.1. Definition of Production Plant Requirements
- 10.2.2. CAPEX (Capital Expenditure)
- 10.2.3. OPEX (Operational Expenditure)

10.3. Technical and Economic Modeling of Storage Facilities according to Formats (GH2, LH2, Green Ammonia, Methanol, LOHC)
- 10.3.1. Technical Assessment of Different Storage Facilities
- 10.3.2. Cost Analysis
- 10.3.3. Selection Criteria

10.4. Technical and Economic Modeling of Hydrogen Transportation, Distribution, and End-Use Assets
- 10.4.1. Transportation and Distribution Cost Assessment
- 10.4.2. Technical Limitations of Current Hydrogen Transportation and Distribution Methods
- 10.4.3. Selection Criteria

10.5. Structuring of Hydrogen Projects. Financing Alternatives
- 10.5.1. Keys to the Choice of Financing
- 10.5.2. Private Equity Financing
- 10.5.3. Public Funding

10.6. Identification and Characterization of Project Revenues and Costs
- 10.6.1. Revenues
- 10.6.2. Costs
- 10.6.3. Joint Assessment

10.7. Calculation of Cash Flows and Project Profitability Indicators (IRR, NPV, others).
- 10.7.1. Cash Flow
- 10.7.2. Profitability Indicators
- 10.7.3. Case Study

10.8. Feasibility Analysis and Scenarios
- 10.8.1. Scenario Design
- 10.8.2. Scenario Analysis
- 10.8.3. Scenario Analysis

10.9. Use Case based on Project Finance
- 10.9.1. Relevant Figures of the SPV (Special Purpose Vehicle)
- 10.9.2. Development Process
- 10.9.3. Conclusions

10.10. Assessment of Barriers to Project Feasibility and Future Prospects
- 10.10.1. Existing Barriers to Hydrogen Project Feasibility
- 10.10.2. Assessment of the Current Situation
- 10.10.3. Future Perspectives

With this university program, you will master the most innovative techniques for the storage, distribution and use of Hydrogen as an energy source"

06

Clinical Internship

Once the online theoretical period is completed, this program includes an internship program in a reference entity linked to Hydrogen Technology. During this itinerary, the graduates will have at their disposal the support of a tutor, who will accompany them throughout the process, both in the preparation and in the development of the internship.

You will carry out your internship in a distinguished entity belonging to the Hydrogen Technology sector"

Students who embark on this Hybrid Professional Master's Degree will have the opportunity to perform an intensive Internship Program, lasting 3 weeks, in a reference company with extensive experience in the field of Hydrogen Technology. Therefore, from Monday to Friday, in days of 8 consecutive hours, graduates will work in a real business scenario, where they will be able to develop their skills in this area.

Throughout this on-site stay, students will be tutored by a professional in this industry, who will ensure that all the objectives for which this program has been designed are met. In this sense, his extensive knowledge in this field will enable students to progress in the labor market immediately.

Undoubtedly, engineers are facing an excellent opportunity to learn by working in a field highly demanded by companies, which requires constant updating in order to offer top quality services.

The practical part will be performed with the active participation of the student performing the activities and procedures of each area of competence (learning to learn and learning to do), with the accompaniment and guidance of teachers and other fellow students that facilitate teamwork and multidisciplinary integration as transversal competences for the praxis of Hydrogen Technology Engineering (learning to be and learning to relate).

The procedures described below will be the basis of the practical part of the program, and their implementation will be subject to the center's own availability and workload, the proposed activities being the following:

You will be specialized in a reference institution, equipped with the most innovative technological tools for you to perform your work successfully"

Module	Practical Activity
Manufacturing and obtaining of Hydrogen	Design electrolysis systems that use electricity to decompose water into Hydrogen and oxygen
	Optimize operating conditions (such as temperature, pressure or electrolyte concentration) to increase Hydrogen efficiency and reduce costs
	Integrate renewable energy sources with electrolysis systems to produce Green Hydrogen
	Manage equipment maintenance to ensure efficient as well as continuous operation
Depot, transport and delivery processes	Develop safe storage solutions for hydrogen (whether in gaseous form at high pressure, liquid at low temperatures or bonded to other materials such as metal hydrides)
	Plan infrastructures for efficient hydrogen transport (including pipelines or tankers)
	Improve the distribution network to ensure that Hydrogen is available where and when needed
	Create emergency procedures to handle possible incidents during storage and transport
Refueling Station Engineering	Construct Hydrogen Refueling Stations, including site selection or component layout to the integration of compression systems
	Implement systems that efficiently manage the flow of Hydrogen from storage to dispensing into vehicles
	Perform regular maintenance and timely repairs to ensure the operability of the facilities
	Collect and analyze operational data in order to evaluate station performance
Project Development and Implementation	Conduct thorough feasibility analysis and environmental impact assessments to ensure both technical feasibility and sustainability of the initiative
	Design integrated systems for Hydrogen handling (such as production plants, storage systems or production plants, storage systems or refueling stations)
	Oversee project implementation, from conception to completion, ensuring that time, cost and quality objectives are met
	Identify, analyze and manage risks associated with Hydrogen projects, developing strategies to mitigate them

Civil Liability Insurance

This institution's main concern is to guarantee the safety of the trainees and other collaborating agents involved in the internship process at the company. Among the measures dedicated to achieve this is the response to any incident that may occur during the entire teaching-learning process.

To this end, this entity commits to purchasing a civil liability insurance policy to cover any eventuality that may arise during the course of the internship at the center.

This liability policy for interns will have broad coverage and will be taken out prior to the start of the Internship Program period. That way professionals will not have to worry in case of having to face an unexpected situation and will be covered until the end of the internship program at the center.

General Conditions of the Internship Program

The general terms and conditions of the internship program agreement shall be as follows:

1. TUTOR: During the Hybrid Professional Master's Degree, students will be assigned with two tutors who will accompany them throughout the process, answering any doubts and questions that may arise. On the one hand, there will be a professional tutor belonging to the internship center who will have the purpose of guiding and supporting the student at all times. On the other hand, they will also be assigned with an academic tutor whose mission will be to coordinate and help the students during the whole process, solving doubts and facilitating everything they may need. In this way, the student will be accompanied and will be able to discuss any doubts that may arise, both clinical and academic.

2. DURATION: The internship program will have a duration of three continuous weeks, in 8-hour days, 5 days a week. The days of attendance and the schedule will be the responsibility of the center and the professional will be informed well in advance so that they can make the appropriate arrangements.

3. ABSENCE: If the students does not show up on the start date of the Hybrid Professional Master's Degree, they will lose the right to it, without the possibility of reimbursement or change of dates. Absence for more than two days from the internship, without justification or a medical reason, will result in the professional's withdrawal from the internship, therefore, automatic termination of the internship. Any problems that may arise during the course of the internship must be urgently reported to the academic tutor.

4. CERTIFICATION: Professionals who pass the Hybrid Professional Master's Degree will receive a certificate accrediting their stay at the center.

5. EMPLOYMENT RELATIONSHIP: the Hybrid Professional Master's Degree shall not constitute an employment relationship of any kind.

6. PRIOR EDUCATION: Some centers may require a certificate of prior education for the Hybrid Professional Master's Degree. In these cases, it will be necessary to submit it to the TECH internship department so that the assignment of the chosen center can be confirmed.

7. DOES NOT INCLUDE: The Hybrid Professional Master's Degree will not include any element not described in the present conditions. Therefore, it does not include accommodation, transportation to the city where the internship takes place, visas or any other items not listed.

However, students may consult with their academic tutor for any questions or recommendations in this regard. The academic tutor will provide the student with all the necessary information to facilitate the procedures in any case.

07
Where Can I Do the Internship?

TECH's philosophy is based on offering high quality academic programs, which is why it carefully selects the institutions for its students' internships. Thanks to this, students will have the opportunity to carry out their internships in internationally renowned companies and in an environment of excellence. In this way, they will be able to be part of multidisciplinary teams led by experts in Hydrogen Technology.

You will do your Internship Program in a prestigious company, where you will be surrounded by the best professionals in Hydrogen Technology"

The student will be able to complete the practical part of this Hybrid Professional Master's Degree at the following centers:

Engineering

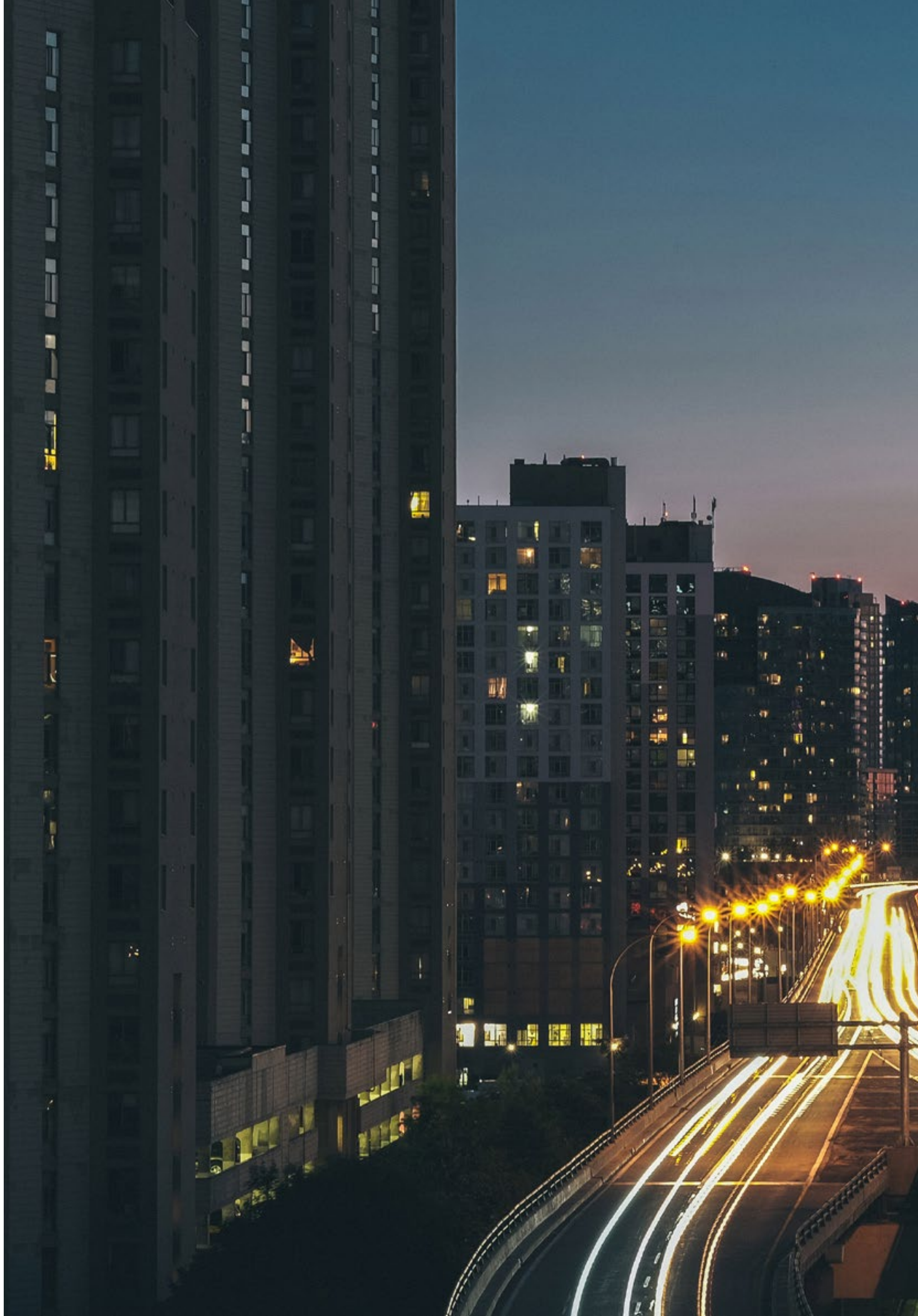
Neuwalme

Country	City
Spain	Pontevedra

Address: Estrada Fragosiño, 32, 34, Sárdoma, 36214 Vigo, Pontevedra

Neuwalme stands out for its specialization in the sale of Oleo-hydraulics and Pneumatics.

Related internship programs:
-Hydrogen Technology



Delve into the most relevant theory in this field, subsequently applying it in a real work environment"

08

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

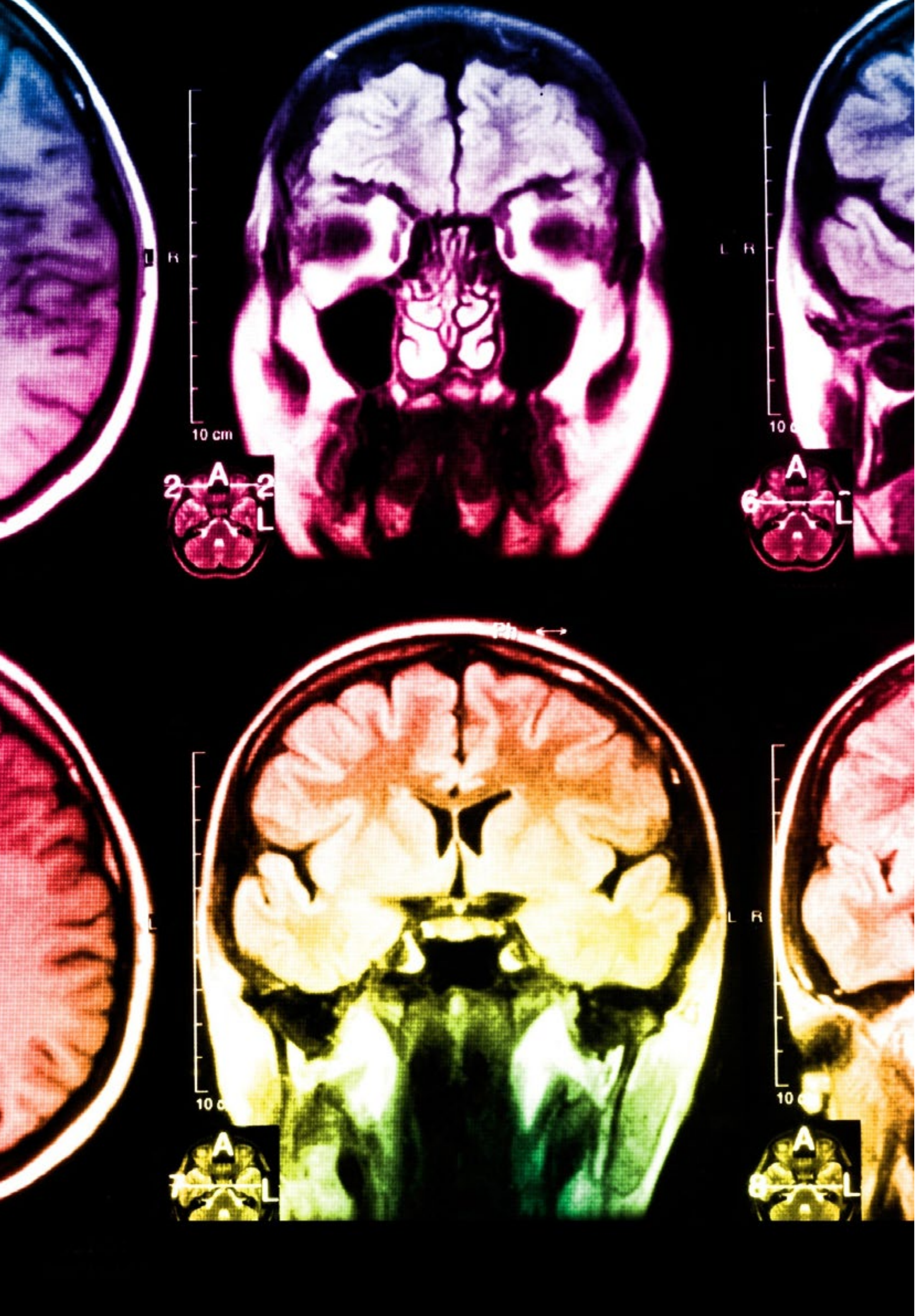
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines 8 different teaching elements in each lesson.

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 re-learn). 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 e-learning, 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.

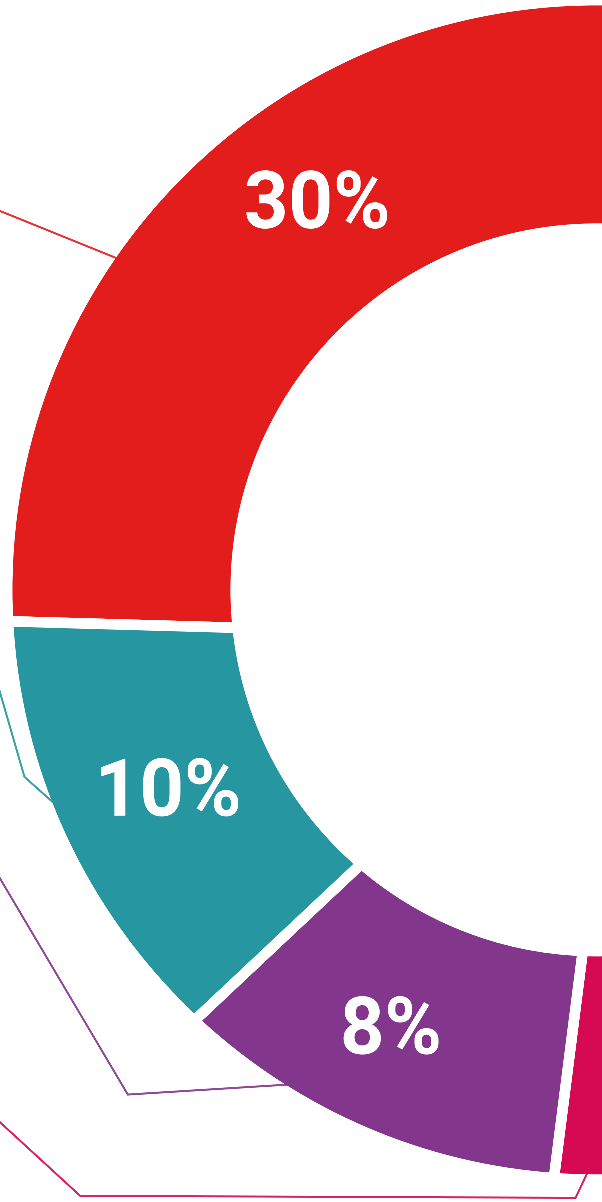
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

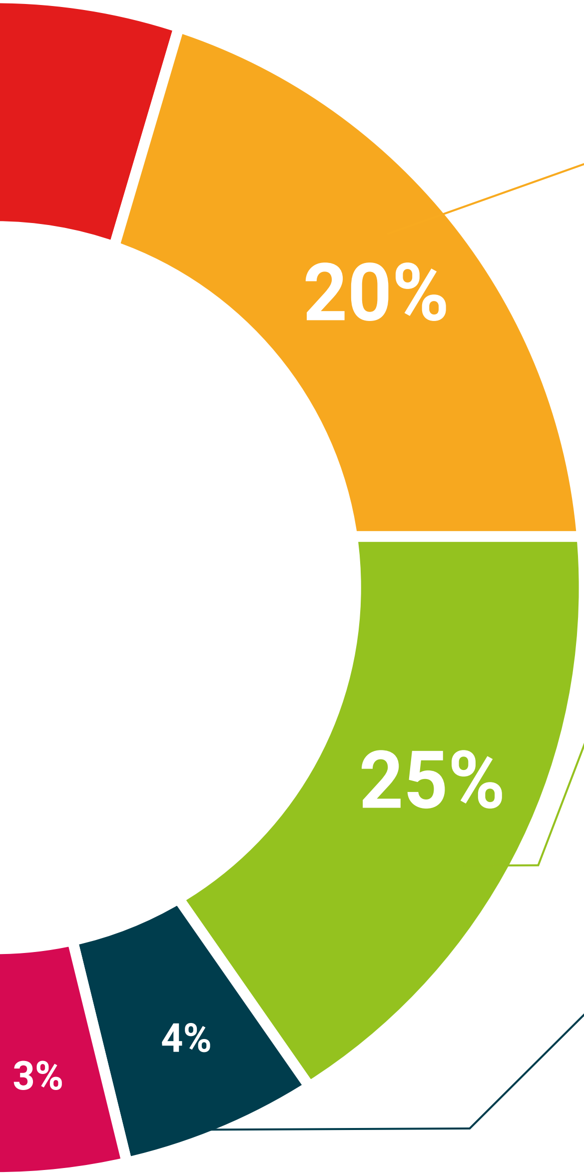
Practising Skills and Abilities

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.

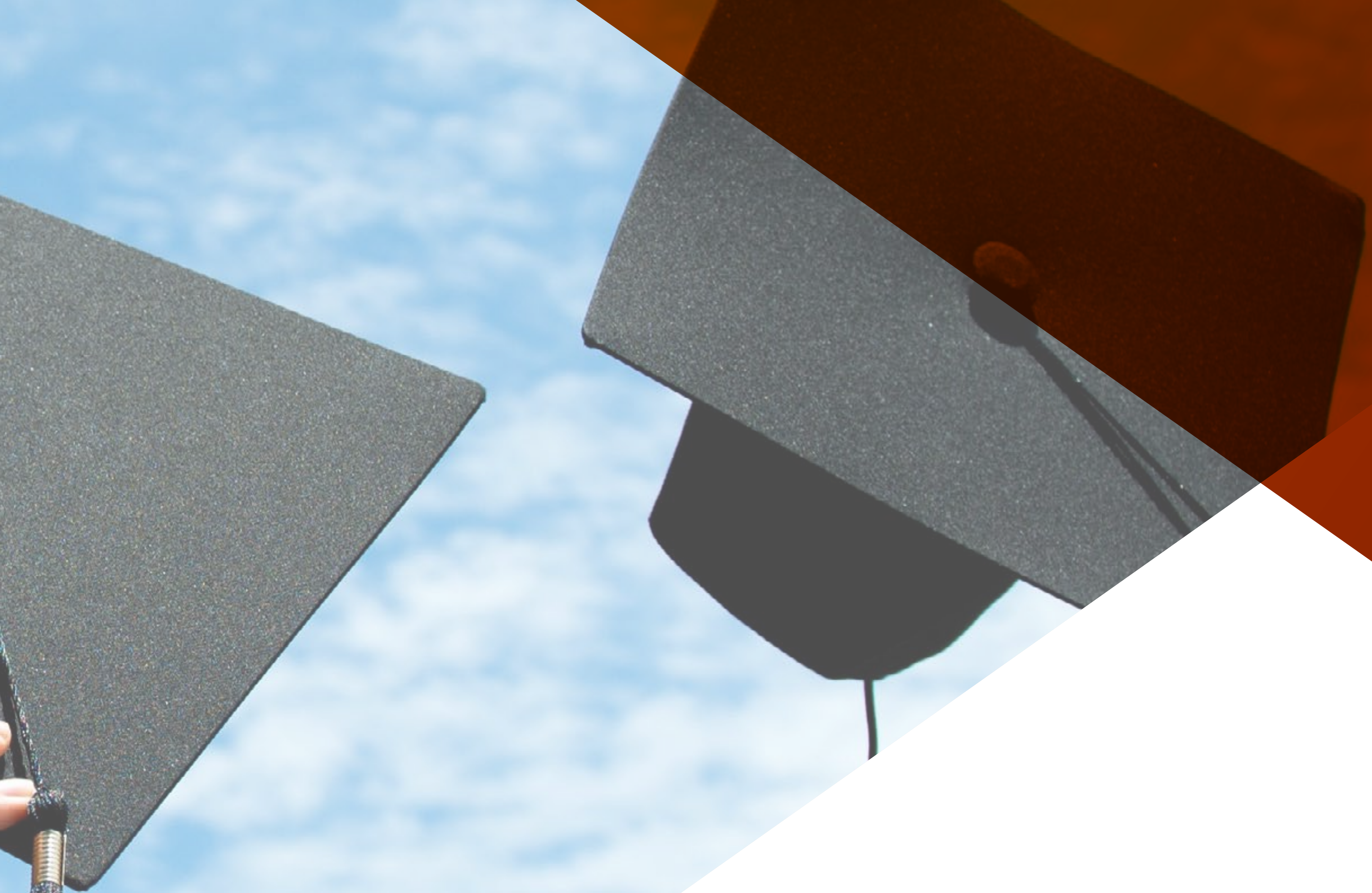
This exclusive educational system for presenting multimedia content was awarded by Microsoft as a "European Success Story".

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.

09
Certificate

The Hybrid Professional Master’s Degree in Hydrogen Technology guarantees students, in addition to the most rigorous and up-to-date education, access to a Hybrid Professional Master’s Degree issued by TECH Global University.



Successfully complete this program and receive your university qualification without having to travel or fill out laborious paperwork"

This private qualification will allow you to obtain a **Hybrid Professional Master's Degree in Hydrogen Technology** 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** private qualification 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: **Hybrid Professional Master's Degree in Hydrogen Technology**

Modality: **Hybrid (Online + Internship)**

Duration: **12 months**

Accreditation:: **60 + 4 ECTS**

tech global university

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

Hybrid Professional Master's Degree in Hydrogen Technology

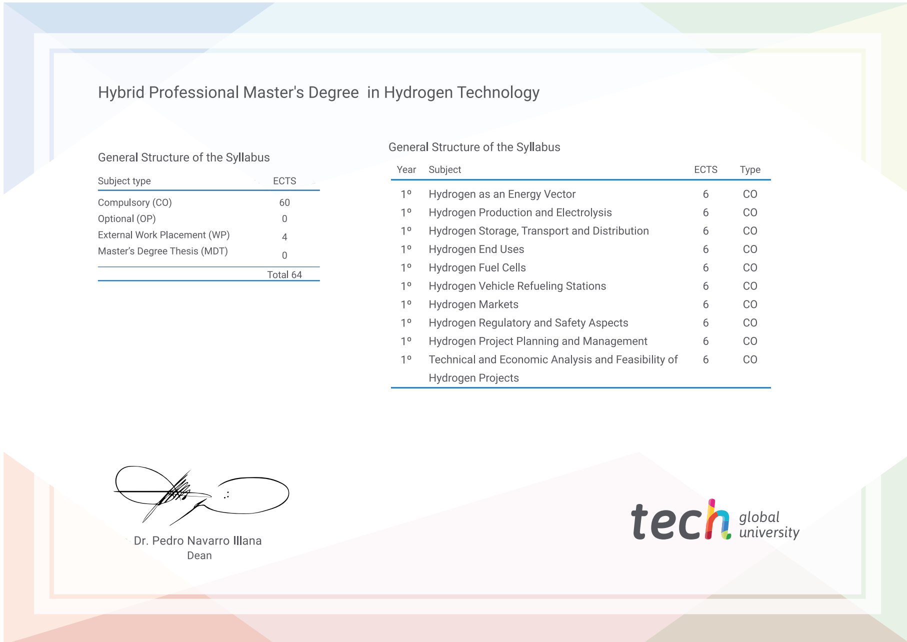
This is a private qualification of 1,920 hours of duration equivalent to 64 ECTS, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

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
Dean

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



Hybrid Professional Master's Degree in Hydrogen Technology

General Structure of the Syllabus

Subject type	ECTS
Compulsory (CO)	60
Optional (OP)	0
External Work Placement (WP)	4
Master's Degree Thesis (MDT)	0
	Total 64

General Structure of the Syllabus

Year	Subject	ECTS	Type
1º	Hydrogen as an Energy Vector	6	CO
1º	Hydrogen Production and Electrolysis	6	CO
1º	Hydrogen Storage, Transport and Distribution	6	CO
1º	Hydrogen End Uses	6	CO
1º	Hydrogen Fuel Cells	6	CO
1º	Hydrogen Vehicle Refueling Stations	6	CO
1º	Hydrogen Markets	6	CO
1º	Hydrogen Regulatory and Safety Aspects	6	CO
1º	Hydrogen Project Planning and Management	6	CO
1º	Technical and Economic Analysis and Feasibility of Hydrogen Projects	6	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.

Hybrid Professional Master's Degree

Hydrogen Technology

Modality: **Hybrid (Online + Internship)**

Duration: **12 months**

Certificate: **TECH Global University**

Credits: **60 + 4 ECTS**

Hybrid Professional Master's Degree
Hydrogen Technology

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