Professional Master's Degree

Alternative Internal Combustion Engines

tech technological university

Professional Master's Degree
Alternative Internal Combustion Engines

- » Modality: **online**
- » Duration: **12 months**
- » Certificate: **TECH Technological University**
- » Schedule: **at your own pace**
- » Exams: **online**

Website: **www.techtitute.com/us/engineering/professional-master-degree/master-alternative-internal-combustion-engines**

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01

Introduction

Technological advances and research in the development of Alternative Internal Combustion Engines have led to the reduction of their size, the achievement of greater power and the use of more sophisticated materials. In this sense, sectors such as the aeronautical, naval or industrial sectors have been favored, obtaining more efficient vessels, lighter aircraft or reducing operating costs. Faced with this scenario, TECH has created this 100% online program that leads the engineer to obtain a first level specialization around the latest technical advances in this field and under the rigorous support of scientific studies. A syllabus created by specialists and with numerous teaching resources, accessible 24 hours a day.

A Professional Master's Degree program that will allow you to be up-to-date with the current affairs in motor engineering and current optimization techniques"

Since inventors Lenoir and Otto contributed to the development of the reciprocating internal combustion engine, the techniques for its design and development have undergone significant advances. In this sense, their improvement has led to lower manufacturing costs, faster time to market and much better performance. All these characteristics have, in turn, led to the growth of sectors such as the naval, aeronautical and industrial sectors.

In this scenario, the specialized professional engineer plays a transcendental role. That's why you need to have a solid understanding of advances in injection and ignition systems, technology used for noise and vibration reduction, or improvements in data analysis for predictive maintenance. This 12-month Professional Master's Degree in Alternative Internal Combustion Engines is based on these lines.

It is a program that will lead the students to carry out a deep analysis of the affected Thermodynamic Cycles, their different components, the Design, Modeling and Simulation of all of them. Furthermore, throughout this educational pathway, the engineer will delve into the different strategies with respect to the improvement of the different aspects of the engine, such as the different performances: Emissions and Fuel and Combustion possibilities.

To this end, the graduates are provided with quality multimedia pills, specialized readings, and case studies that will allow them to obtain a dynamic, top-level education that will not only provide them with solid current knowledge in this field, but will also show them future perspectives under the highest scientific rigor.

An excellent opportunity to achieve advanced learning with an excellent team of teachers and a 100% online teaching methodology. The student only needs a digital device with an Internet connection to view, at any time of the day, the content hosted on the virtual platform.

This **Professional Master's Degree in Alternative Internal Combustion Engines** contains the most complete and up-to-date program on the market. The most important features include:

- The development of practical cases presented by experts in Aeronautical Engineering
- The graphic, schematic, and practical contents with which they are created, provide scientific and practical information on the disciplines that are essential for professional practice
- Practical exercises where the process of self-assessment can be used to improve learning
- Its special emphasis on innovative methodologies
- 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

"Enroll in the best digital university in the world according to Forbes and grow professionally in the world of Aeronautical Engineering"

Inquire into the latest research projects and development of new engine concepts through this university program"

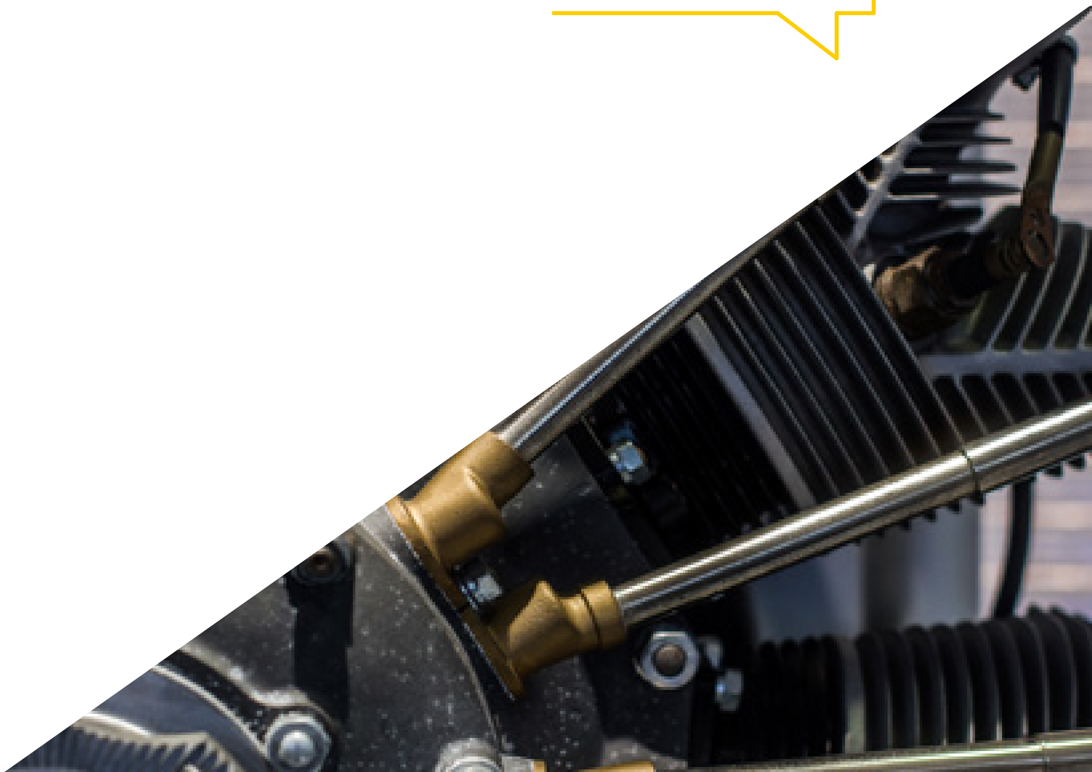
Thanks to the Relearning method used by TECH you will achieve a much more effective learning in less time.

Delve through the best teaching materials on the use of biofuels and their impact on engine performance.

The program's teaching staff includes professionals from the field who contribute their work experience to this educational program, as well as renowned specialists from leading societies and prestigious universities.

The multimedia content, developed with the latest educational technology, will provide the professional with situated and contextual learning, i.e., a simulated environment that will provide immersive education programmed to learn in real situations.

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



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Objectives

This Professional Master's Degree allows the engineer to achieve advanced specialization in the development and design of Power Plants, as well as the resolution of the main problems existing in this field. In addition, this educational journey will allow you to keep abreast of the present and future in the development of Alternative Internal Combustion Engines. All this, through the best multimedia teaching resources and a syllabus prepared by real professionals in aeronautical engineering.

You will be able to increase your professional opportunities in naval, aeronautical or industrial projects”

General Objectives

- Analyze the state of the art of Alternative Internal Combustion Engines (AICE)
- Identify conventional Alternative Internal Combustion Engines, (AICEs)
- Examine the different aspects to be taken into account in the life cycle of AICEas
- Compile the fundamental principles of design, manufacture and simulation of reciprocating internal combustion engines
- Fundamentals of engine testing and validation techniques, including data interpretation and iteration between design and empirical results
- Determine the theoretical and practical aspects of engine design and manufacturing, promoting the ability to make informed decisions at each stage of the process
- Analyze the different injection and ignition methods in alternative internal combustion engines, specifying the advantages and challenges of each type of injection system in different applications
- Determine the natural vibration of internal combustion engines, modally analyzing their frequency and dynamic response, the impact on engine noise in normal and abnormal operation
- Study applicable vibration and noise reduction methods, international regulations and impact on transportation and industry
- Analyze how the latest technologies are redefining energy efficiency and reducing emissions in internal combustion vehicles
- Explore in depth Miller cycle engines, controlled compression ignition (HCCI), compression ignition (CCI) and other emerging concepts
- Analyze the technologies that enable compression ratio adjustment and their impact on efficiency and performance
- Fundamentals of integrating multiple approaches, such as the Atkinson-Miller cycle and spark controlled ignition (SCCI), to maximize efficiency under a variety of conditions
- Delve into the principles of engine data analysis
- Analyze the different alternative fuels on the market, their properties and characteristics, storage, distribution, emissions and energy balance
- Analyze the different systems and components of hybrid and electric motors
- Determine the energy control and management methods, their optimization criteria and their implementation in the transportation sector
- Fundamentals of an in-depth and up-to-date understanding of the challenges, innovations and future prospects in the field of engine research and development, with a focus on alternative internal combustion engines and their integration with advanced technologies and emerging propulsion systems

"In only 12 months you will achieve a university program to increase your professional possibilities in naval, aeronautical or industrial projects"

Specific Objectives

Module 1. Alternative Internal Combustion Engines

- Analyze the thermodynamic cycles involved in the operation of IACMs
- Concrete operation of conventional MCIA such as Otto or Diesel cycle
- Establish the different existing performance terms
- Identify the elements that make up MCIAs

Module 2. Design, manufacture and simulation of Alternative Internal Combustion Engines (AICM)

- Develop the key concepts in the design of combustion chambers, considering the relationship between geometry and combustion efficiency
- Analyze the different materials and manufacturing processes applicable to engine components, considering factors such as resistance, temperature and durability
- Evaluate the importance of precise tolerances and adjustments in the efficient and durable operation of motors
- Use simulation software to model engine behavior under various conditions and optimize engine performance
- Determine validation tests on test benches to evaluate performance, durability and efficiency of motors
- Examine the lubrication, cooling, timing, valve, feed, ignition and exhaust systems in detail, considering their influence on overall engine performance

Module 3. Injection and ignition systems

- Compile the principles of fuel injection
- Determine the types of fuel injection, their uses and characteristics
- Evaluate how direct and indirect injection affects efficiency and air-fuel mixture formation
- Examine the operation of a diesel injection system: common rail system
- Fundamentals of the different injection and electronic ignition systems
- Analyze the fundamental aspects for the control and calibration of injection systems

Module 4. Vibration, noise and engine balancing

- Determine the vibration and noise modes generated by a reciprocating internal combustion engine
- Modal analysis of internal combustion engines, their dynamic response, frequency and torsional vibrations
- Establish the different techniques for balancing motors
- Develop the techniques used in noise and vibration control and reduction
- Identify maintenance tasks required to maintain levels within tolerances
- Support the impact of vibration and noise in industry and transportation, based on applicable international standards

Module 5. Advanced alternative internal combustion engines

- Explore in depth Miller cycle engines, controlled compression ignition (HCCI), compression ignition (CCI) and other emerging concepts
- Analyze the technologies that enable compression ratio adjustment and their impact on efficiency and performance
- Fundamentals of integrating multiple approaches, such as the Atkinson-Miller cycle and spark controlled ignition (SCCI), to maximize efficiency under a variety of conditions
- Assess the future prospects of alternative internal combustion engines and their relevance in the context of the evolution towards more sustainable propulsion systems

Module 6. Diagnosis and maintenance of reciprocating internal combustion engines

- Compile diagnostic methods and maintenance types
- Identify the types of existing tests and diagnostics
- Develop optimization measures for maintenance
- Demonstrate the validity of good maintenance practices

Module 7. Alternative fuels and their impact on performance

- Determine the different alternative fuels on the market
- Analyze the characteristics and properties of different alternative fuels
- Examine the forms of storage and distribution of each of the alternative fuels
- Evaluate alternative fuels performance and impact on emissions
- Identify the advantages and disadvantages of each based on their applicability
- Compile the environmental regulations surrounding alternative fuels
- Establish the economic and social impact of alternative fuels

Module 8. Optimization: electronic management and emission control

- Develop advanced concepts on which engine optimization is applied
- Analyze heat losses and mechanical losses of combustion engines and their improvement points
- Establish the different methods of optimization based on consumption and efficiency
- Evaluate performance optimization in internal combustion engines
- Review the main concepts of thermal and volumetric optimization
- Examine the different emission control methods
- Strengthen detection and electronic management methods
- Review the regulations applicable to gas emissions

Module 9. Hybrid engines and extended-range electric vehicles

- Identify the types of hybrid and electric motors
- Develop the parameters and challenges of electric and hybrid motor design
- Establish optimization criteria for hybrid and electric motors
- Analyze energy recovery systems
- Identify the fundamental aspects of the loading infrastructure

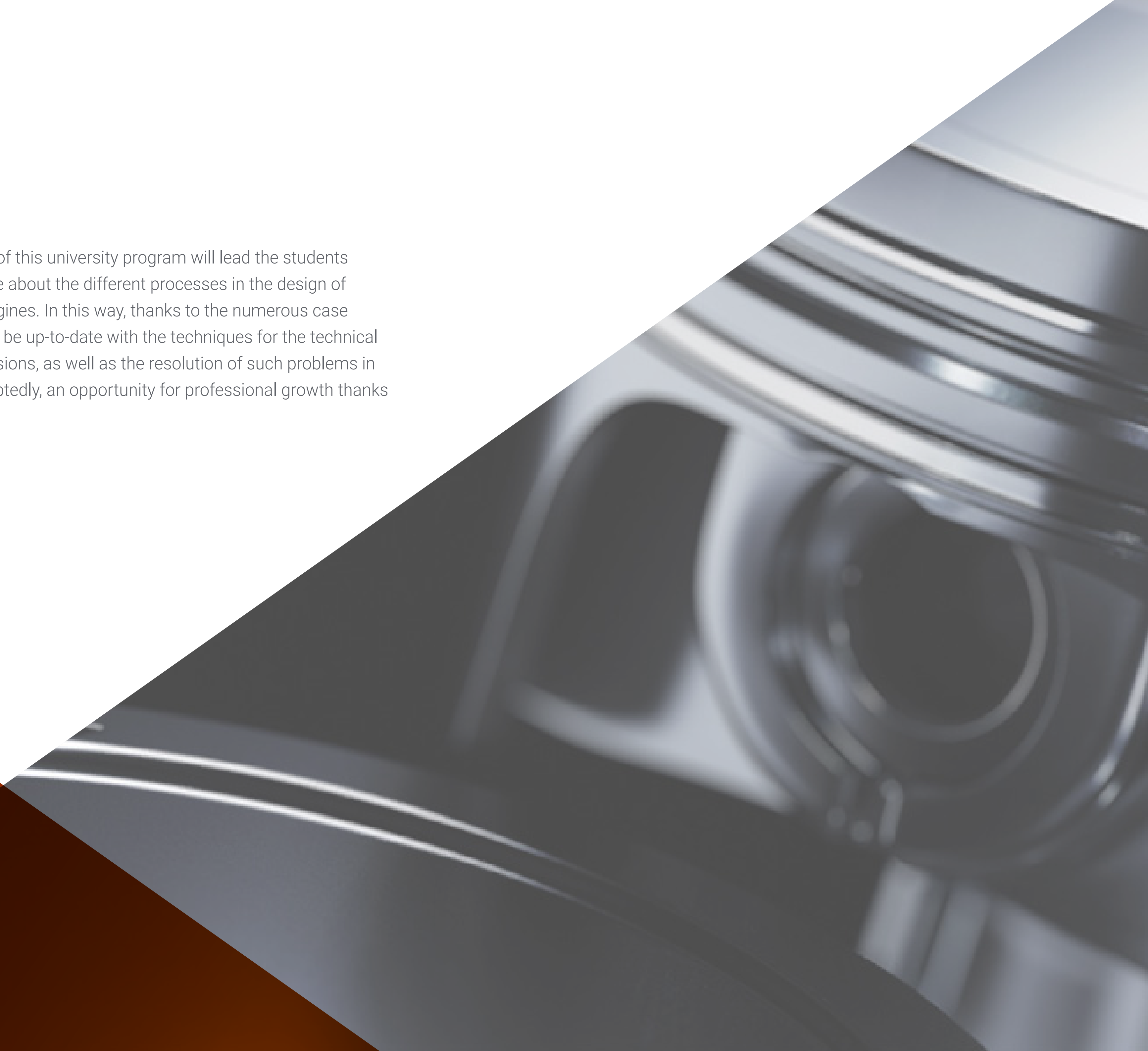
Module 10. Research and development of new engine concepts

- Analyze the economic and commercial prospects of internal combustion and reciprocating engines, exploring how they influence research and development investment as well as business strategies
- Develop the ability to understand and design policies and strategies to promote innovation in engines, considering the role of governments and companies in this process
- Explore emerging trends and analyze the different sectors and their future prospects

03

Skills

The theoretical-practical approach of this university program will lead the students to achieve a high level of knowledge about the different processes in the design of Alternative Internal Combustion Engines. In this way, thanks to the numerous case study simulations, the graduate will be up-to-date with the techniques for the technical evaluation of noise reduction, emissions, as well as the resolution of such problems in a much more effective way. Undoubtedly, an opportunity for professional growth thanks to the best teaching content.

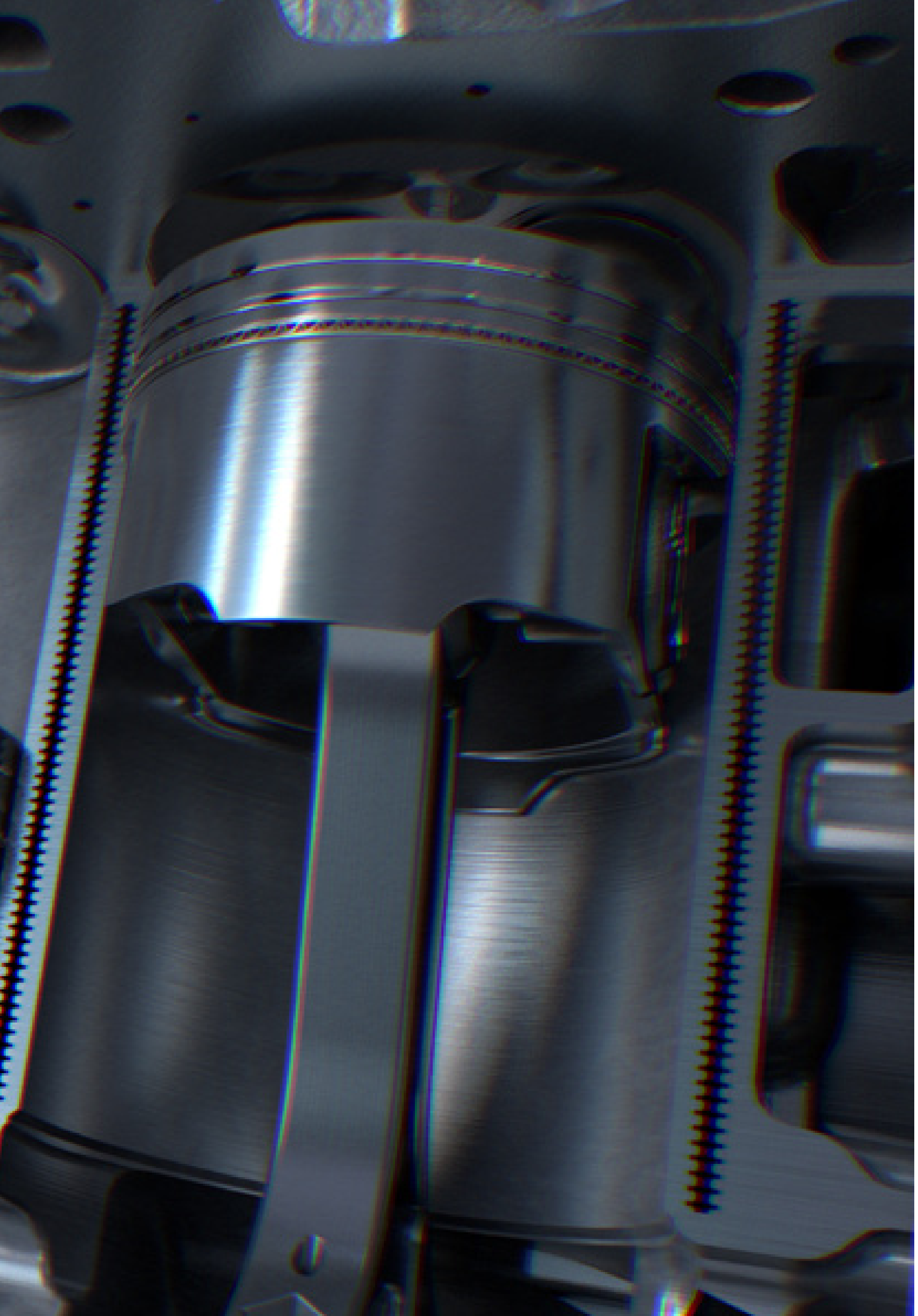


With this Professional Master's program you will get to know the future perspectives of Alternative Internal Combustion Engines"

General Skills

- Develop skills to apply simulation and modeling tools in the design and optimization of engines with the objective of improving efficiency and performance
- Evaluate and compare different approaches in order to make informed decisions in the design and development of propulsion systems
- Develop and design Power Plants (mainly MCIA), applicable to other types of engines
- Analyze and solve the different problems that may exist in the design and use of Power Plants or any of their components

Thanks to this educational proposal you will apply to your projects the most recent and cutting-edge technologies for the reduction of emissions"



Specific Skills

- Analyze the types of existing maintenance
- Establish the methods used for damage detection and remediation
- Generate guidelines for the improvement of maintenance plans
- Apply the optimization and emission control methods currently implemented in the market
- Assess the future prospects of alternative internal combustion engines and their relevance in the context of the evolution towards more sustainable propulsion systems
- Encourage critical analysis and problem solving related to the design and manufacture of alternative internal combustion engines
- Apply advanced concepts in alternative internal combustion engines

04

Course Management

In order to promote quality education available to all, TECH has selected an excellent team of teachers specialized in Aeronautical Engineering. Thanks to their experience in the civil and military aviation sector, the graduates will obtain a first-level learning experience. Furthermore, throughout this educational journey, the students will be able to solve any doubts they may have about the syllabus thanks to the proximity of the expert teachers who are part of it.

The excellent team of specialists in Aeronautical Engineering will provide you with the most advanced and current knowledge in Alternative Internal Combustion Engines"

Management

Mr. Del Pino Luengo, Isatsi

- Airbus Defence & Space CC295 FWSAR program certification and airworthiness technical manager
- Airworthiness and certification engineer for the engine section in charge of the MTR390 program at the National Institute for Aerospace Technology (NIAT)
- Airworthiness engineer and certification for the VSTOL section by the National Institute for Aerospace Technology (NIAT)
- Aeronautical design and certification engineer for the life extension project of the Spanish Navy AB212 helicopters (PEVH AB212) at Babcock MCSE
- Design and Certification Engineer in the DOA department at Babcock MCSE
- Fleet Technical Office Engineer AS 350 B3/ BELL 212/ SA 330 J.Babcock MCSE
- Qualifying Master's Degree in Aeronautical Engineering from the University of León
- Aeronautical Technical Engineer in Aeromotors, Polytechnic University of Madrid

Professors

Ms. Horcajada Rodríguez, Carmen
- Civil servant of the Ministry of Defense at the National Institute of Aerospace Technology (ISDEFE)
- Technical Assistant for ISDEFE
- Design and Certification Engineer for Sirium Aerotech
- Master's Degree in Integrated Quality, Environmental and Occupational Risk Prevention Management Systems
- Degree in Aerospace Engineering
- Specialization in Aerospace Vehicles by the Polytechnic University of Madrid

Mr. Mariner Bonet, Iñaki
- Head of Flight Test Office at Avincis Aviation Technics
- Design, Certification and Test Engineer at Avincis Aviation Technics
- Calculation and materials engineer at the Aragon Institute of Technology
- Calculus Engineer at the Polytechnic University of Valencia
- Master in Flight Test and Aircraft Certification (EASA cat 2) by the Polytechnic University of Madrid
- Aeronautical Engineer from the Polytechnic University of Valencia

Mr. Caballero Haro, Miguel
- Test Manager in Vodafone
- Test Manager in Apple Online Store
- SCRUM Product Owner by Scrum Alliance
- LeanSixSigma by Green belt Certificate
- Managing people efectively by Cork College of Commerce

Mr. Madrid Aguado, Víctor Manuel
- Aeronautical Engineer at CAPGEMINI
- Aeronautical Engineer at INAER Helicópteros S.A.U. Spain
- Teacher at the Official College of Aeronautical Technical Engineers
- In-house trainer at Capgemini Spain in Aircraft Certification
- Teacher at CIFP Professor Raúl Vázquez
- Graduated in Aerospace Engineering from the University of León
- Degree in Aeronautical Technical Engineering, specializing in Aircraft, University School of Aeronautical Technical Engineers, Polytechnic University of Madrid
- Part 21, Part 145 & Part M Certification at ALTRAN ASD
- Part 21 Certification at INAER S.A.U

05

Structure and Content

The syllabus of this university program has been designed by a team of professional specialists in Aeronautical Engineering. Thanks to their experience in this field, graduates will have the opportunity to delve deeper into Alternative Internal Combustion Engines: Thermal, mechanical, emissions, design, simulation and construction. All this, in a dynamic way, thanks to the numerous multimedia teaching resources, available 24 hours a day, 7 days a week, from any digital device with Internet connection.

Further extend the knowledge you gain from this program through specialized readings provided by experienced Combustion Engine engineers"

Module 1. Alternative Internal Combustion Engines

1.1. Alternative Internal Combustion Engines: State-of-the-Art
 1.1.1. Alternative Internal Combustion Engines(AICE)
 1.1.2. Innovation and Singularity: Distinctive features of AICEs
 1.1.3. AICE Classification Scheme
1.2. Thermodynamic Cycles in Reciprocating Internal Combustion Engines
 1.2.1. Parameters
 1.2.2. Duty Cycles
 1.2.3. Theoretical and Actual Cycles
1.3. Structure and Systems of Alternative Internal Combustion Engine Components
 1.3.1. Engine Block
 1.3.2. Carter
 1.3.3. Engine Systems
1.4. Combustion and Transmission in Reciprocating Internal Combustion Engine Components
 1.4.1. Cylinders
 1.4.2. Stock
 1.4.3. Crankshaft
1.5. Otto Cycle Gasoline Engines
 1.5.1. Gasoline Engine Operation
 1.5.2. Intake, Compression, Expansion and Exhaust Processes
 1.5.3. Advantages of Gasoline Otto cycle engines
1.6. Diesel Cycle Engines
 1.6.1. Diesel Cycle Engine Operation
 1.6.2. Combustion Process
 1.6.3. Benefits of Diesel Engines
1.7. Gas Engines
 1.7.1. Liquefied Petroleum Gas (LPG) Engines
 1.7.2. Compressed Natural Gas (CNG) Engines
 1.7.3. Gas Engine Applications
1.8. Bifuel and Flexfuel Engines
 1.8.1. Bifuel Engines
 1.8.2. Flexfuel Engines
 1.8.3. Bifuel and Flexfuel Engine Applications
1.9. Other Conventional Engines
 1.9.1. Reciprocating Piston Rotary Engines
 1.9.2. Turbocharging Systems in Reciprocating Engines
 1.9.3. Rotary Engines and Turbocharging Systems Applications
1.10. Applicability of Alternative Internal Combustion Engines
 1.10.1. (AICE) in Industry and Transportation
 1.10.2. Applications in the Industry
 1.10.3. Transportation Applications
 1.10.4. Other Applications

Module 2. Design, Manufacture and Simulation of Alternative Internal Combustion Engines (AICE)

2.1. Combustion Chamber Design
 2.1.1. Combustion Chamber Types
  2.1.1.1. Compact, Wedge-Shaped, Hemispherical
 2.1.2. Relationship between Chamber Shape and Combustion Efficiency
 2.1.3. Design Strategies
2.2. Materials and Fabrication Processes
 2.2.1. Material Selection for Critical Engine Components
 2.2.2. Mechanical, Thermal and Chemical Properties Required for Different Parts
 2.2.3. Manufacturing Processes
  2.2.3.1. Casting, Forging, Machining
 2.2.4. Strength, Durability and Weight in the Choice of Materials
2.3. Tolerances and Adjustments
 2.3.1. Motor Assembly and Operation Tolerances
 2.3.2. Adjustments to Prevent Leaks, Vibrations and Premature Wear and Tear
 2.3.3. Influence of Tolerances on Engine Efficiency and Performance
 2.3.4. Measuring Methods and Tolerance Control during Manufacture

2.4. Simulation and Modeling of Engines
- 2.4.1. Use of Simulation Software to Analyze the Behavior of the Engine
- 2.4.2. Gas Flow, Combustion and Heat Transfer Modeling
- 2.4.3. Virtual Optimization of Design Parameters for Performance Improvement
- 2.4.4. Correlation between Simulation Results and Experimental Tests

2.5. Engine Testing and Validation
- 2.5.1. Test Design and Execution
- 2.5.2. Verification of Simulation Results
- 2.5.3. Iteration between Simulation and Testing

2.6. Test Benches
- 2.6.1. Test Benches Function and Types
- 2.6.2. Instrumentation and Measurements
- 2.6.3. Interpretation of Results and Adjustments to the Design Based on the Tests

2.7. Design and Fabrication: Lubrication and Cooling System
- 2.7.1. Functions of Lubrication and Cooling Systems
- 2.7.2. Lubrication Circuit Design and Oil Selection
- 2.7.3. Air and Liquid Cooling Systems
  - 2.7.3.1. Radiators, Pumps and Thermostats
- 2.7.4. Maintenance and Monitoring to Prevent Overheating and Wear and Tear

2.8. Design and Fabrication: Distribution Systems and Valves
- 2.8.1. Distribution Systems: Synchronization and Motor Efficiency
- 2.8.2. Types of Systems and Their Manufacture
  - 2.8.2.1. Camshaft, Variable Valve Timing, Valve Drive
- 2.8.3. Design of Cam Profiles to Optimize Valve Opening and Closing
- 2.8.4. Design to avoid Interference and Improve Cylinder Filling

2.9. Design and Fabrication: Power, Ignition and Exhaust System
- 2.9.1. Design of Fueling Systems to Optimize the Air-Fuel Mix
- 2.9.2. Function and Design of Ignition Systems for Efficient Combustion
- 2.9.3. Exhaust System Design to Improve Efficiency and Reduce Emissions

2.10. Practical Analysis of Engine Modeling
- 2.10.1. Practical Application of Design and Simulation Concepts in a Case Study
- 2.10.2. Modeling and Simulation of a Specific Engine
- 2.10.3. Evaluation of Results and Comparison with Experimental Data
- 2.10.4. Feedback to Improve Future Designs and Manufacturing Processes

Module 3. Injection and ignition systems

3.1. Fuel Injection
- 3.1.1. Mixing Formation
- 3.1.2. Combustion Chamber Types
- 3.1.3. Mixture Distribution
- 3.1.4. Injection Parameters

3.2. Direct and Indirect Injection Systems
- 3.2.1. Direct and Indirect Injection in Diesel Engines
- 3.2.2. Injector Pump System
- 3.2.3. Operation of a Diesel Injection System: Common Rail System

3.3. High Pressure Injection Technologies
- 3.3.1. In-Line Injection Pump Systems
- 3.3.2. Rotary Injection Pump Systems
- 3.3.3. Systems with Single Injection Pumps
- 3.3.4. Common-Rail Injection Systems

3.4. Mixture Formation
- 3.4.1. Internal Flow in Diesel Injection Nozzles
- 3.4.2. Jet Description
- 3.4.3. Atomization Process
- 3.4.4. Diesel Jet under Evaporative Conditions

3.5. Control and Calibration of Injection Systems
- 3.5.1. Components and Sensors in Injection Systems
- 3.5.2. Engine Maps
- 3.5.3. Motor Calibration

3.6. Spark Ignition Technologies
- 3.6.1. Conventional Ignition (Spark Plugs)
- 3.6.2. Electronic Ignition
- 3.6.3. Adaptive Ignition

3.7. Electronic Ignition Systems
- 3.7.1. Operation
- 3.7.2. Ignition Systems
- 3.7.3. Spark Plugs

3.8. Diagnosis and Troubleshooting of Injection and Ignition Systems
- 3.8.1. Motor-Installation Parameters
- 3.8.2. Thermodynamic Models
- 3.8.3. Sensitivity of Combustion Diagnostics

3.9. Optimization of Injection and Ignition systems
- 3.9.1. Engine Map Design
- 3.9.2. Engine Modeling
- 3.9.3. Engine Map Optimization

3.10. Engine Map Analysis
- 3.10.1. Torque and Power Map
- 3.10.2. Engine Efficiency
- 3.10.3. Fuel Consumption

Module 4. Vibration, Noise and Engine Balancing

4.1. Vibration and Noise on Internal Combustion Engines
- 4.1.1. Evolution of Vibration and Noise Motors
- 4.1.2. Vibration and Noise Parameters
- 4.1.3. Data Acquisition and Interpretation

4.2. Sources of Vibration and Noise in Engines
- 4.2.1. Vibration and Noise Generated by the Block
- 4.2.2. Intake and Exhaust Generated Vibration and Noise
- 4.2.3. Vibration and Noise Generated by Combustion

4.3. Modal Analysis and Dynamic Response of Motors
- 4.3.1. Modal Analysis: Geometry, Materials and Configuration
- 4.3.2. Modal Analysis Modeling: One Degree of Freedom/Multiple Degrees of Freedom
- 4.3.3. Parameters: Frequency, Damping and Vibration Modes

4.4. Frequency and Torsional Vibration Analysis
- 4.4.1. Amplitude and Frequency of Torsional Vibration
- 4.4.2. Vibration Frequencies of Internal Combustion Engines
- 4.4.3. Sensors and Data Acquisition
- 4.4.4. Theoretical vs. Experimental Analysis

4.5. Engine Balancing Techniques
- 4.5.1. In-Line Distribution Engine Balancing
- 4.5.2. V-Distribution Engine Balancing
- 4.5.3. Modeling and Balancing

4.6. Vibration Control and Reduction
- 4.6.1. Control of Natural Vibration Frequencies
- 4.6.2. Vibration and Shock Isolation
- 4.6.3. Dynamic Damping

4.7. Noise Control and Reduction
- 4.7.1. Noise Control and Attenuation Methods
- 4.7.2. Exhaust Silencers
- 4.7.3. Active Noise Cancellation Systems ANCS

4.8. Vibration and Noise Maintenance
- 4.8.1. Lubrication
- 4.8.2. Engine Block Balancing
- 4.8.3. Useful Life of the Systems Dynamic Fatigue

4.9. Impact of Engine Vibration and Noise on Industry and Transportation
- 4.9.1. International Standards in Industrial Plants
- 4.9.2. International Regulations Applicable to Land Transportation
- 4.9.3. International Regulations Applicable to Other Sectors

4.10. Practical Application of Vibration and Noise Analysis of an Internal Combustion Engine
- 4.10.1. Theoretical Modal Analysis of an Internal Combustion Engine
- 4.10.2. Determination of Sensors for Practical Analysis
- 4.10.3. Establishment of Suitable Attenuation Methods and Maintenance Plan

Module 5. Conventional and Advanced Alternative Internal Combustion Engines

5.1. Miller Cycle Engines
- 5.1.1. Miller Cycle Efficiency
- 5.1.2. Intake Valve Opening and Closing Control for Improved Thermodynamic Efficiency
- 5.1.3. Implementation of the Miller Cycle in Internal Combustion Engines Advantages

5.2. Compression Controlled Compression Ignition (HCCI) Engines
- 5.2.1. Controlled Compression Ignition
- 5.2.2. Auto-Ignition Process of the Air-Fuel Mixture without the Need for a Spark
- 5.2.3. Efficiency and Emissions Challenges of Controlling Autoignition

5.3. Compression Ignition Engines (CIE)
- 5.3.1. Comparison between HCCI and CCI
- 5.3.2. Compression Ignition in CIE engines
- 5.3.3. Control of the Air-Fuel Mixture and Adjustment of the Compression Ratio for Optimum Performance

5.4. Atkinson Cycle Engines
- 5.4.1. Atkinson Cycle and Its Variable Compression Ratio
- 5.4.2. Power vs Efficiency
- 5.4.3. Hybrid Vehicle Applications and Part-Load Efficiency

5.5. Pulsed Combustion Engines (PCE)
- 5.5.1. PCE Motors Operation
- 5.5.2. Use of Precise, Time-Controlled Fuel Injections to Achieve Ignition
- 5.5.3. Efficiency and Emissions Control Challenges

5.6. Spark Ignition Engines (SIE)
- 5.6.1. Compression Ignition and Spark Ignition Combination
- 5.6.2. Dual Ignition Control
- 5.6.3. Efficiency and Emissions Reduction

5.7. Atkinson-Miller Cycle Engines
- 5.7.1. Atkinson and Miller Cycle
- 5.7.2. Optimization of Valve Opening to Improve Efficiency at Different Load Conditions
- 5.7.3. Examples of Applications in Terms of Efficiency

5.8. Variable Compression Engines
- 5.8.1. Engines with Variable Compression Ratios
- 5.8.2. Technologies for Real-Time Compression Ratio Adjustment
- 5.8.3. Impact on Engine Efficiency and Performance

5.9. Advanced Internal Combustion Engines (AICE)
- 5.9.1. Compound Duty Cycle Engines
  - 5.9.1.1. HLSI, Combined Oxidation Engines, LTC
- 5.9.2. Technologies Applied to Advanced AICEs
- 5.9.3. Advanced AICE applicability

5.10. Alternative Internal Combustion Engine Innovation and Development
- 5.10.1. Less Conventional Alternative Engine Technologies
- 5.10.2. Examples of Experimental or Emerging Engines
- 5.10.3. Research Lines

Module 6. Diagnosis and Maintenance of Alternate Internal Combustion Engines

6.1. Diagnostic Methods and Failure Analysis
- 6.1.1. Identification and Use of Different Diagnostic Methods
- 6.1.2. Failure Code Analysis and OBD Diagnostics Systems
- 6.1.3. Use of Advanced Diagnostic Tools
  - 6.1.3.1. Scanners and Oscilloscopes
- 6.1.4. Interpretation of Data to Identify Problems and Improve Performance

6.2. Maintenance Types
- 6.2.1. Differentiation between Preventive, Predictive and Corrective Maintenance
- 6.2.2. Selecting the Appropriate Maintenance Strategy According to the Context
- 6.2.3. Planned Maintenance to Minimize Costs and Downtime
- 6.2.4. Focus on Extended Engine Life and Optimal Engine Performance

6.3. Repair and Adjustment of Components
- 6.3.1. Repair and Adjustment Techniques for Key Components
  - 6.3.1.1. Injectors, Spark Plugs and Timing Systems
- 6.3.2. Identification and Troubleshooting of Ignition and Combustion Related Problems
- 6.3.3. Fine-Tuning to Optimize Performance and Efficiency

6.4. Performance and Fuel Economy Optimization
- 6.4.1. Strategies for Improving Fuel Efficiency and Engine Performance
- 6.4.2. Adjustment of Injection and Ignition Parameters to Maximize Fuel Economy
- 6.4.3. Evaluation of the Relationship between Performance and Emissions to Comply with International Environmental Regulations

6.5. Failure Analysis and Troubleshooting
- 6.5.1. Systematic Processes for Identifying and Resolving Engine Failures
- 6.5.2. Use of Flowcharts and Diagnostic Checklists
- 6.5.3. Testing and Analysis to Isolate Specific Problems in Components

6.6. Data Management and Engine Performance Logging
- 6.6.1. Engine Performance Data Collection and Analysis
- 6.6.2. Use of Logs to Monitor Trends and Anticipate Problems
- 6.6.3. Implementation of Recording Systems to Improve Traceability and Preventive Maintenance

6.7. Motor Inspection and Monitoring Techniques
- 6.7.1. Visual and Auditory Inspection of Components for Wear and Damage
- 6.7.2. Vibration and Abnormal Noise Monitoring as Indicators of Problems
- 6.7.3. Use of Sensors and Real-Time Monitoring Systems for Detecting Subtle Changes

6.8. Diagnostic Imaging and Non-Destructive Testing
- 6.8.1. Application of Imaging Techniques to Tetect Problems
  - 6.8.1.1. Thermography, Ultrasound
- 6.8.2. Non-Destructive Testing for Early Defect Detection
- 6.8.3. Interpretation of Imaging Test Results for Maintenance Decisions

6.9. Planning and Execution of Maintenance Programs
- 6.9.1. Design of Customized Maintenance Programs for Different Engines Applications
- 6.9.2. Scheduling of Maintenance Intervals and Activities
- 6.9.3. Coordination of Resources and Teams for Efficient Program Execution

6.10. Best Practices in Engine Maintenance
- 6.10.1. Integration of Techniques and Approaches to Achieve Optimal Results
- 6.10.2. International Safety and Regulatory Compliance During Maintenance
- 6.10.3. Encouraging a Culture of Continuous Improvement in Engine Maintenance

Module 7. Alternative fuels and their impact on performance

7.1. Alternative Fuels
- 7.1.1. Conventional Fuels: Gasoline and Diesel
- 7.1.2. Alternative Fuels: Types
- 7.1.3. Alternative Fuels Comparison and Parameters

7.2. Biocarburants Biodiesel, Bioethanol, Biogas, Bioethanol
- 7.2.1. Obtaining Biofuels Properties
- 7.2.2. Storage and Distribution: International Regulations
- 7.2.3. Performance, Emissions and Energy Balance
- 7.2.4. Applicability in Transportation and Industry

7.3. G Fuels. Natural Gas, Liquefied Gas, Compressed Gas
- 7.3.1. Obtaining Gas Fuels Properties
- 7.3.2. Storage and Distribution: International Regulations
- 7.3.3. Performance, Emissions and Energy Balance
- 7.3.4. Applicability in Transportation and Industry

7.4. Electricity as a Fuel Source
- 7.4.1. Obtaining Electricity and Batteries Properties
- 7.4.2. Storage and Distribution: International Regulations
- 7.4.3. Performance, Emissions and Energy Balance
- 7.4.4. Applicability in Transportation and Industry

7.5. Hydrogen as a Fuel Source: Fuel Cells and Internal Combustion Vehicles
- 7.5.1. Hydrogen Production and Fuel Cells Properties of Hydrogen as a Energy Source
- 7.5.2. Storage and Distribution: International Regulations
- 7.5.3. Performance, Emissions and Energy Balance
- 7.5.4. Applicability in Transportation and Industry

7.6. Synthetic Fuels
- 7.6.1. Obtaining Synthetic or Neutral Fuels Properties
- 7.6.2. Storage and Distribution: International Regulations
- 7.6.3. Performance, Emissions and Energy Balance
- 7.6.4. Applicability in Transportation and Industry

7.7. Next Generation Fuels
- 7.7.1. Properties of Second Generation Fuels
- 7.7.2. Storage and Distribution: Regulations
- 7.7.3. Performance, Emissions and Energy Balance
- 7.7.4. Applicability in Transportation and Industry

7.8. Performance and Emissions Evaluation with Alternative Fuels
- 7.8.1. Performance of Different Alternative Fuels
- 7.8.2. Performance Comparison
- 7.8.3. Emissions from Different Alternative Fuels
- 7.8.4. Emissions Comparison

7.9. Practical Application Short-, Medium- and Long-Haul Performance and Emissions Analysis
- 7.9.1. Alternative Fuels and Environmental Regulations
- 7.9.2. Evolution of International Environmental Regulations
- 7.9.3. International Regulations in the Transportation Sector
- 7.9.4. International Regulations in the Industrial Sector

7.10. economic and Social Impact of Alternative Fuels
- 7.10.1. Energy and Technology Resources
- 7.10.2. Market Availability of Alternatives Fuels
- 7.10.3. Economic, Environmental and Socio-Political Impact

Module 8. Optimization: electronic management and emission control

8.1. Optimization of Alternative Internal Combustion Engines
- 8.1.1. Power, Consumption and Thermal Efficiency
- 8.1.2. Identification of Improvement Points: Heat and Mechanical Losses
- 8.1.3. Optimization of Consumption and Thermal Efficiency

8.2. Heat and Mechanical Losses
- 8.2.1. Parameterization and Sensing of Thermal and Mechanical Losses
- 8.2.2. Cooling
- 8.2.3. Lubrication and Oils

8.3. Measuring Systems
- 8.3.1. Sensors
- 8.3.2. Analysis of Results
- 8.3.3. Practical Application: Analysis and Characterization of a Reciprocating Internal Combustion Engine

Module 9. Hybrid engines and extended-range electric vehicles

9.9. Charging Infrastructure and Fast Charging Systems
- 9.9.1. Recharging Systems
- 9.9.2. Recharge Connectors
- 9.9.3. Residential and Commercial Load
- 9.9.4. Public and Fast Charging Networks

9.10. Cost-Benefit Analysis of Hybrid and Electric Systems
- 9.10.1. Economic Evaluation of the Implementation of Hybrid and Extended Range Electric Systems
- 9.10.2. Manufacturing, Maintenance and Operating Cost Analysis
- 9.10.3. Life Cycle Analysis Amortizations

Module 10. Research and development of new engine concepts

10.1. Evolution of Global Environmental Norms and Regulations
- 10.1.1. Impact of International Environmental Regulations on the Engine Industry
- 10.1.2. International Emission and Energy Efficiency Standards
- 10.1.3. Regulation and Compliance

10.2. Research and Development in Advanced Engine Technologies
- 10.2.1. Innovations in Engine Design and Technology
- 10.2.2. Advances in Materials, Geometry and Manufacturing Processes
- 10.2.3. Balance between Performance, Efficiency and Durability

10.3. Integration of Internal Combustion Engines in Propulsion and Electric Systems
- 10.3.1. Integration of Internal Combustion Engines with Hybrid and Electric Systems
- 10.3.2. Role of Engines in Bbattery Charging and Range Extension
- 10.3.3. Control Strategies and Energy Management in Hybrid Systems

10.4. Transition to Electric Mobility and Other Propulsion Systems
- 10.4.1. Shift from Traditional Propulsion to Electric and Other Alternatives
- 10.4.2. The Different Propulsion Systems
- 10.4.3. Infrastructure Needed for Electric Mobility

10.5. Economic and Commercial Prospects for Internal Combustion Engines
- 10.5.1. Current and Future Economic Scenario for Internal Combustion Engines
- 10.5.2. Market Demand and Consumption Trends
- 10.5.3. Evaluation of the Impact of the Economic Perspective on I+D10.7.Investment Sustainability and Environmental Aspects of Engine Design

10.6. Development of Policies and Strategies to Promote Innovation in Engines
- 10.6.1. Promotion of Innovation in Engines
- 10.6.2. Incentives, Financing and Collaborations in the Development of New Technologies
- 10.6.3. Success Stories in the Implementation of Innovation Policies

10.7. Sustainability and Environmental Aspects of Engine Design
- 10.7.1. Sustainability in Engine Design
- 10.7.2. Approaches to Reduce Emissions and Minimize Environmental Impact
- 10.7.3. Eco-Efficiency in Terms of the Life Cycle of Engines

10.8. Engine Management Systems
- 10.8.1. Emerging Trends in Motor Control and Management
- 10.8.2. Artificial Intelligence, Machine Learning and Real-Time Optimization
- 10.8.3. Analysis of the Impact of Advanced Systems on Performance and Efficiency

10.9. Internal Combustion Engines in Industrial and Stationary Applications
- 10.9.1. Role of Combustion Engines in Industrial and Stationary Applications
- 10.9.2. Use Cases in Power Generation, Industry and Freight Transportation
- 10.9.3. Analysis of the Efficiency and Adaptability of Motors in Industrial and Stationary Applications

10.10. Research in Motor Technologies for Specific Sectors: Maritime, Aerospace
- 10.10.1. Research and Development of Engines for Specific Industries
- 10.10.2. Technical and Operational Challenges in Sectors such as Marine and Aerospace
- 10.10.3. Analysis of the Impact of the Demands of These Sectors in Driving Innovation in Engines

“The teaching materials of this program, elaborated by these specialists, have contents that are completely applicable to your professional experiences”

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

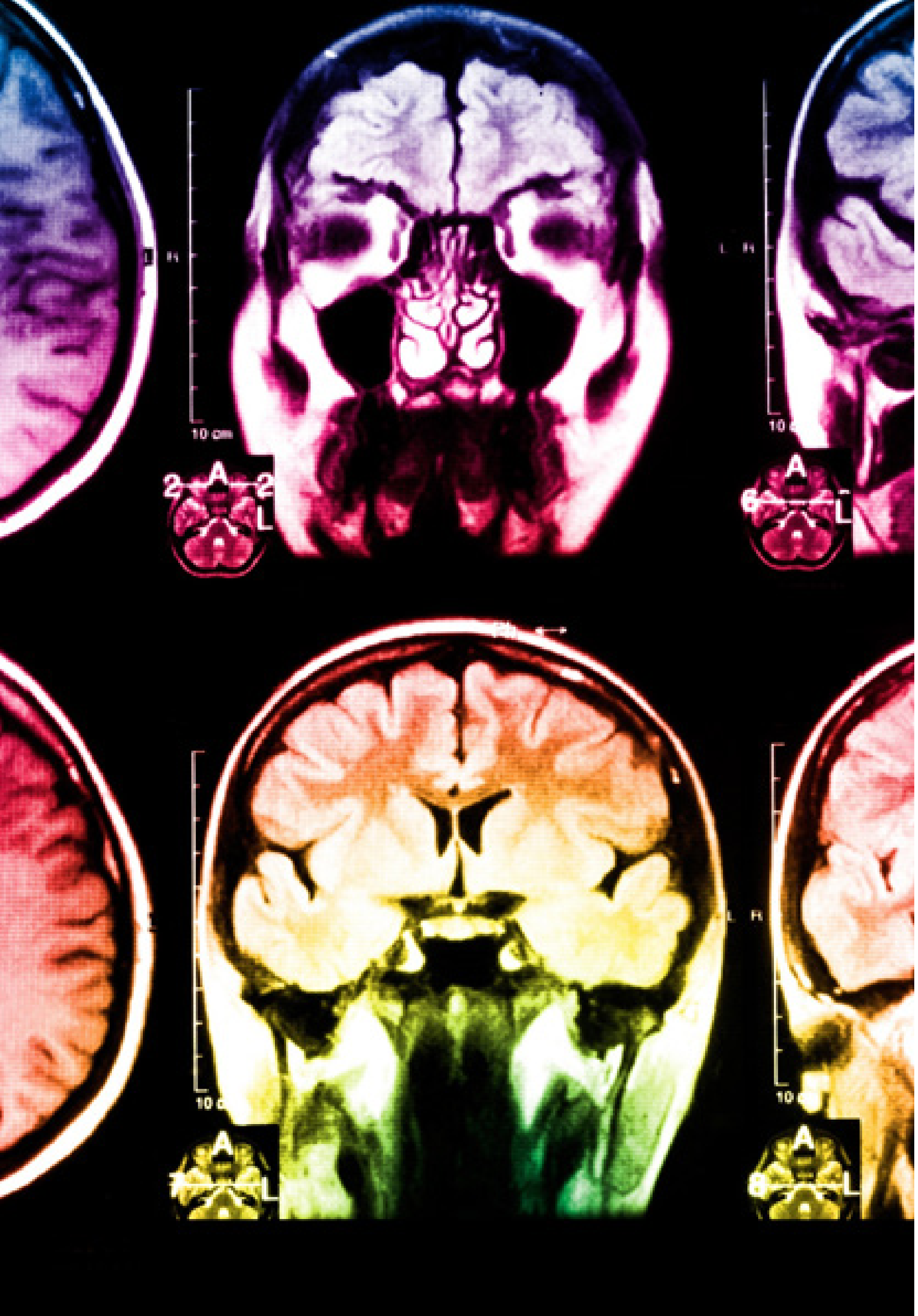
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines 8 different teaching elements in each lesson.

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 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.

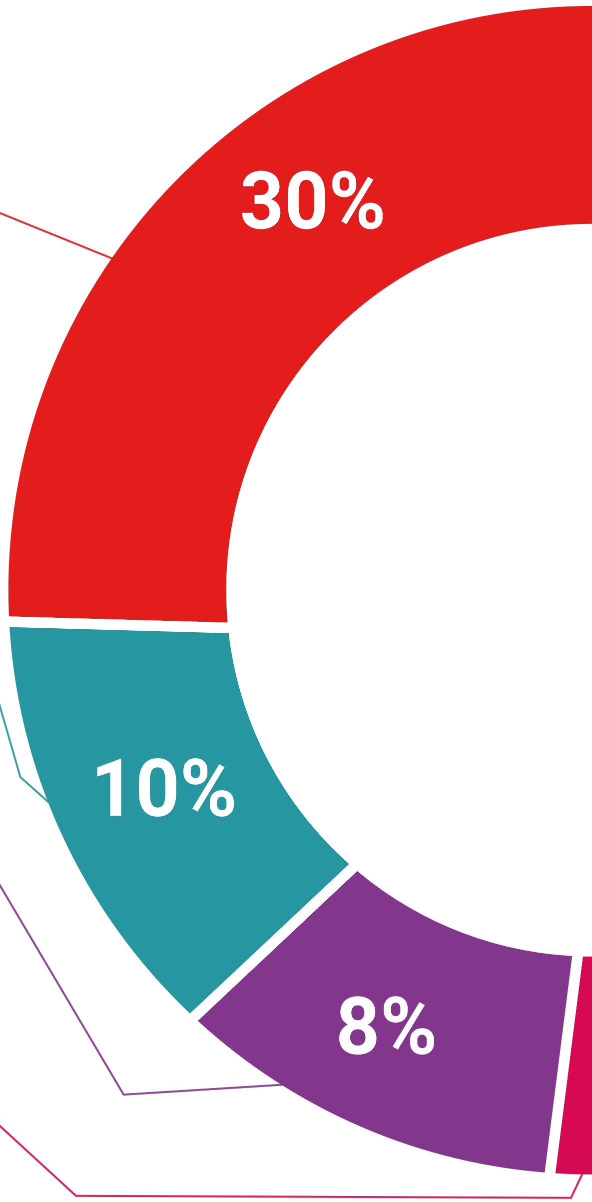
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

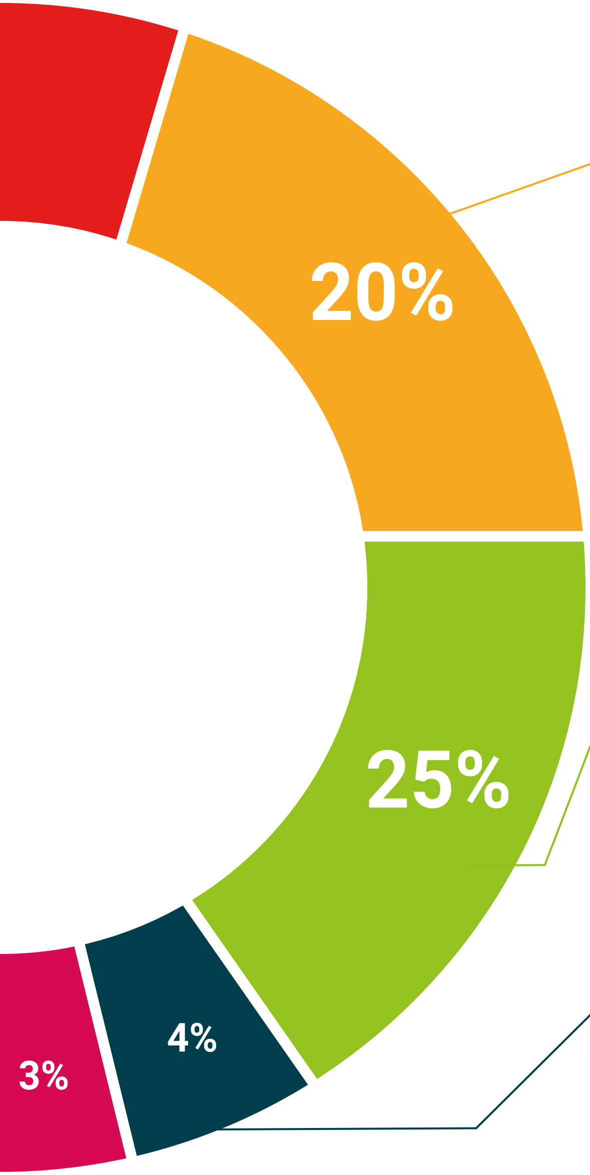
Practising Skills and Abilities

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".

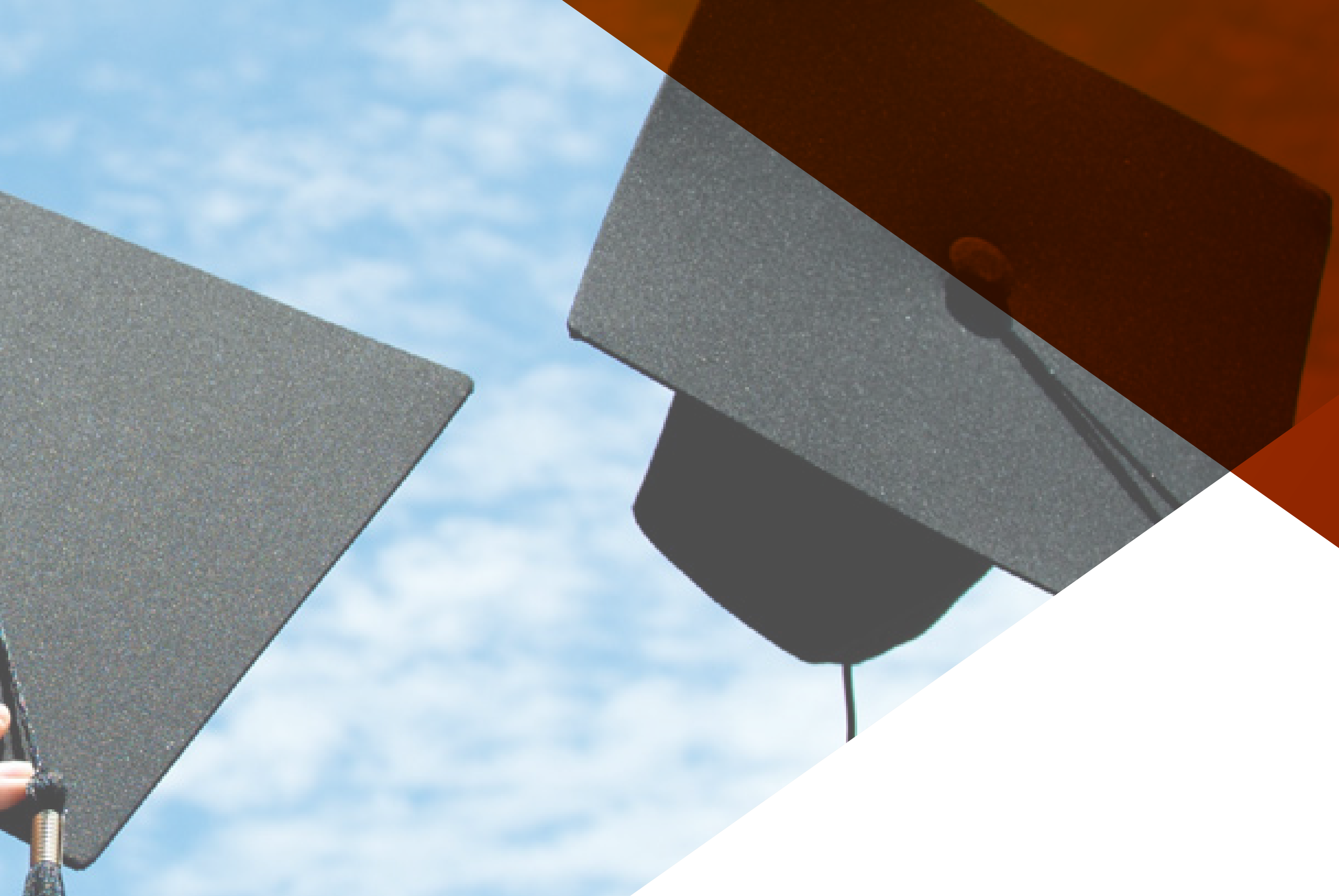
Testing & Retesting

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.

07

Certificate

The Professional Master's Degree in Alternative Internal Combustion Engines guarantees students, in addition to the most rigorous and up-to-date education, access to a Professional Master's Degree diploma issued by TECH Technological University.



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

This **Professional Master's Degree in Alternative Internal Combustion Engines** contains the most complete and up-to-date program on the market.

After the student has passed the assessments, they will receive their corresponding **Professional Master's Degree** issued by **TECH Technological University** via tracked delivery*.

The diploma issued by **TECH Technological University** will reflect the qualification obtained in the Professional Master's Degree, and meets the requirements commonly demanded by labor exchanges, competitive examinations, and professional career evaluation committees.

Title: **Professional Master's Degree in Alternative Internal Combustion Engines**

Official Nº of Hours: **1,500 h.**


tech technological university

Awards the following

DIPLOMA

to

Mr./Ms. _________________, with identification number ____________.

For having successfully passed and accredited the following program

PROFESSIONAL MASTER'S DEGREE

in

Alternative Internal Combustion Engines

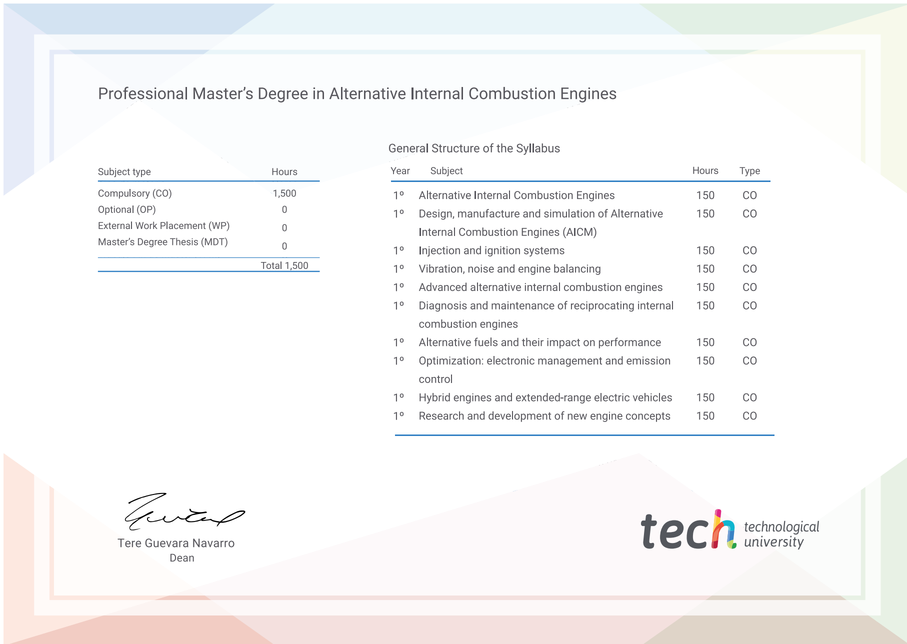
This is a qualification awarded by this University, equivalent to 1,500 hours, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

TECH is a Private Institution of Higher Education recognized by the Ministry of Public Education as of June 28, 2018.

June 17, 2020

Tere Guevara Navarro
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


Professional Master's Degree in Alternative Internal Combustion Engines

Subject type	Hours
Compulsory (CO)	1,500
Optional (OP)	0
External Work Placement (WP)	0
Master's Degree Thesis (MDT)	0
	Total 1,500

General Structure of the Syllabus

Year	Subject	Hours	Type
1º	Alternative Internal Combustion Engines	150	CO
1º	Design, manufacture and simulation of Alternative Internal Combustion Engines (AICM)	150	CO
1º	Injection and ignition systems	150	CO
1º	Vibration, noise and engine balancing	150	CO
1º	Advanced alternative internal combustion engines	150	CO
1º	Diagnosis and maintenance of reciprocating internal combustion engines	150	CO
1º	Alternative fuels and their impact on performance	150	CO
1º	Optimization: electronic management and emission control	150	CO
1º	Hybrid engines and extended-range electric vehicles	150	CO
1º	Research and development of new engine concepts	150	CO

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

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Professional Master's Degree
Alternative Internal Combustion Engines

- Modality: **online**
- Duration: **12 months**
- Certificate: **TECH Technological University**
- Schedule: **at your own pace**
- Exams: **online**

Professional Master's Degree
Alternative Internal Combustion Engines

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