

# Postgraduate Certificate

## Compressible Fluid Simulation



## Postgraduate Certificate Compressible Fluid Simulation

- » Modality: online
- » Duration: 6 weeks
- » Certificate: TECH Global University
- » Credits: 6 ECTS
- » Schedule: at your own pace
- » Exams: online

Website: [www.techtitute.com/us/engineering/postgraduate-certificate/compressible-fluid-simulation](http://www.techtitute.com/us/engineering/postgraduate-certificate/compressible-fluid-simulation)

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# 01

# Introduction

Compressible Fluid Simulation is a key field in the aerospace, automotive, energy and environmental industries. In addition, the demand for engineers trained in compressible fluid simulation is steadily increasing, according to a MarketsandMarkets report. This indicates that there is a growing need

for trained professionals in this area to meet the demands of industry and contribute to the development of technology and sustainability in a wide range of sectors. Therefore, TECH has created an academic degree that seeks to provide the professional with the most comprehensive knowledge to identify the particularities in the resolution of hyperbolic differential equations, under a training that is offered in online mode, allowing the student greater flexibility and adaptability.



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*You will be able, thanks to this degree,  
to establish solutions of the Riemann  
problem by characteristics”*

Professionals with expertise in Compressible Fluid Simulation are in high demand by various industries. Thus, in the aerospace or automotive industry, you can design and analyze systems and devices to improve efficiency, reduce costs and minimize environmental impacts. Along the same lines, in the aerospace industry, compressible fluid simulation is used to improve aircraft aerodynamics and reduce air resistance, leading to improved fuel efficiency and reduced emissions. In the automotive industry, this discipline is used to optimize engine cooling systems and improve vehicle aerodynamics, which also translates into greater efficiency and lower emissions of polluting gases.

For all these reasons, TECH has created an academic program to train the professional. In this way, the student will delve into the Euler equations and establish the conservative versus primitive variables. This is a multidisciplinary degree in which the graduate will obtain the necessary skills to face his or her future in this area, with the maximum possible efficiency and the ability to solve any inconvenience.

This is a unique academic degree designed by TECH and taught under the Relearning methodology, which combines the simulation of complex situations, the analysis of clinical cases and an approach based on repetition. In addition, the program is taught 100% online, allowing students to adapt their study time to their personal and professional needs without giving up anything. The methodology of the program is designed to provide the student with a comprehensive and practical education in Compressible Fluid Simulation.

This **Postgraduate Certificate in Compressible Fluids Simulation** contains the most complete and up-to-date scientific program on the market. The most important features include:

- ◆ The development of case studies presented by experts in Textile Engineering
- ◆ The graphic, schematic, and practical contents with which they are created, provide practical information on the disciplines that are essential for professional practice
- ◆ Practical exercises where 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



*Enhance your professional profile with new knowledge in shock waves and stand out in a booming sector"*

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*Enroll now and access all content on Riemannian Invariants or Euler Invariant Equations”*

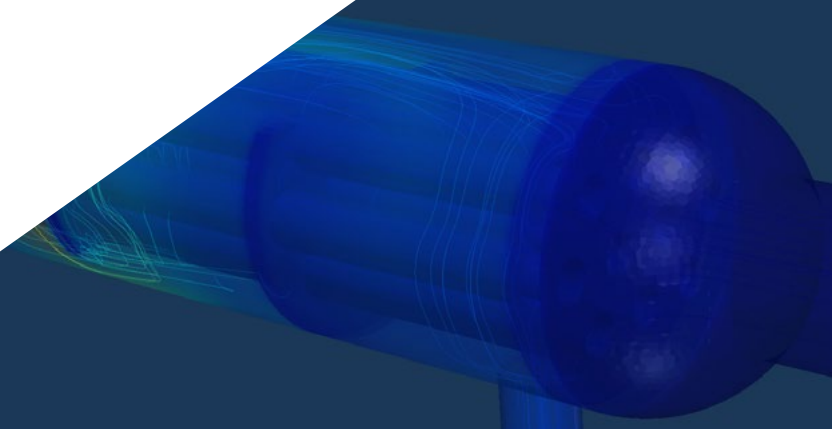
The program’s teaching staff includes professionals from sector who contribute their work experience to this educational program, as well as renowned specialists from leading societies and prestigious universities.

Its 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 an immersive education programmed to learn in real situations.

The design of this program focuses on Problem-Based Learning, by means of which the professional must try to solve the different professional practice situations that are presented throughout the academic course. For this purpose, the student will be assisted by an innovative interactive video system created by renowned experts.

*Give your career the boost it needs and specialize in one of the most promising areas of engineering.*

*Go deeper into the Godunov method and dive into Flux Vector Splitting with this comprehensive program that TECH has prepared for you.*





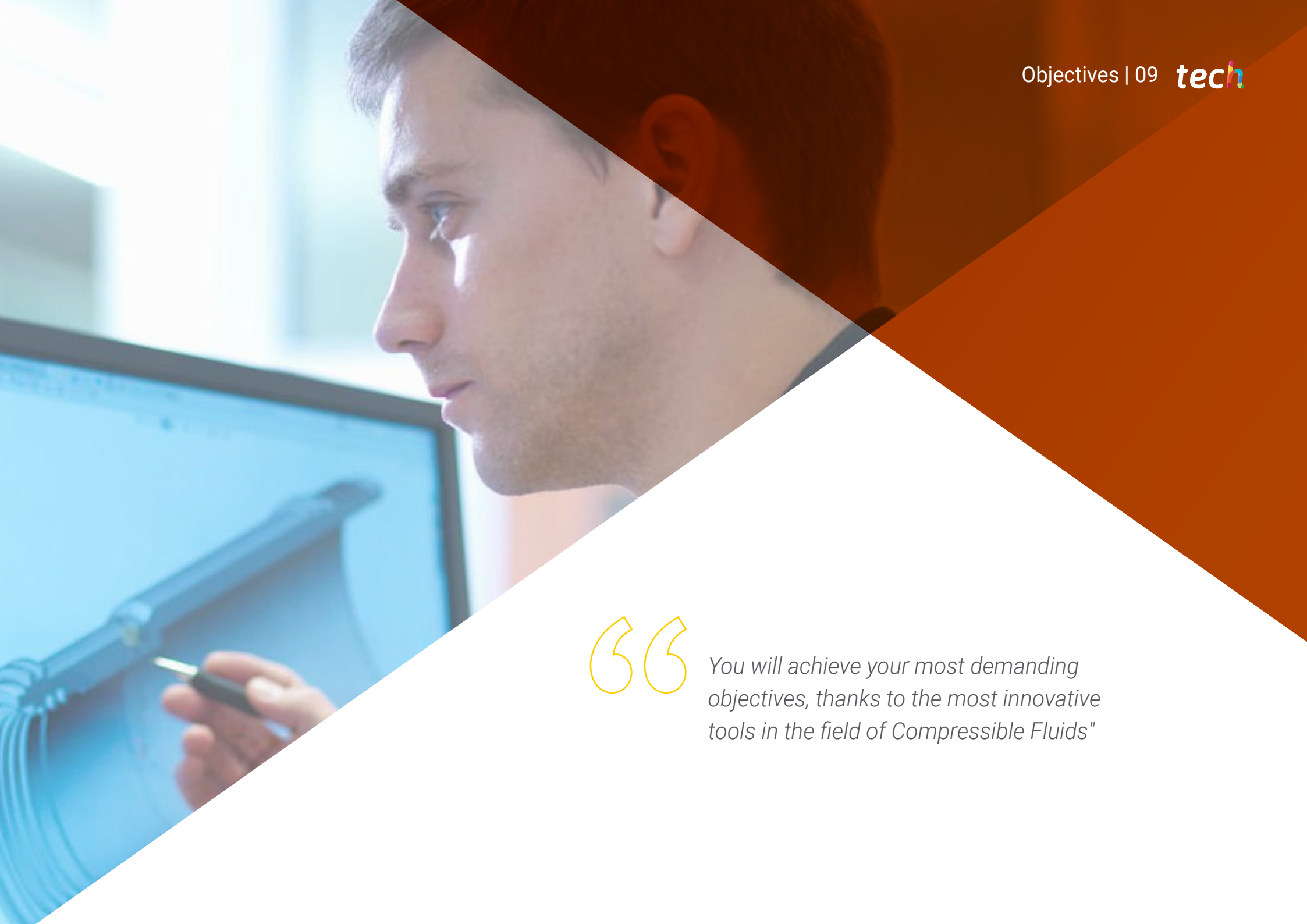
# 02

# Objectives

This Postgraduate Certificate offers engineering professionals the opportunity to acquire in-depth knowledge of Compressible Fluid Simulation through 150 hours of instruction. Thus, the syllabus has been designed by a specialized teaching team that will present in a dynamic and visual way practical examples of the comprehensible regime, as well as the differential equations of the comprehensible fluids.







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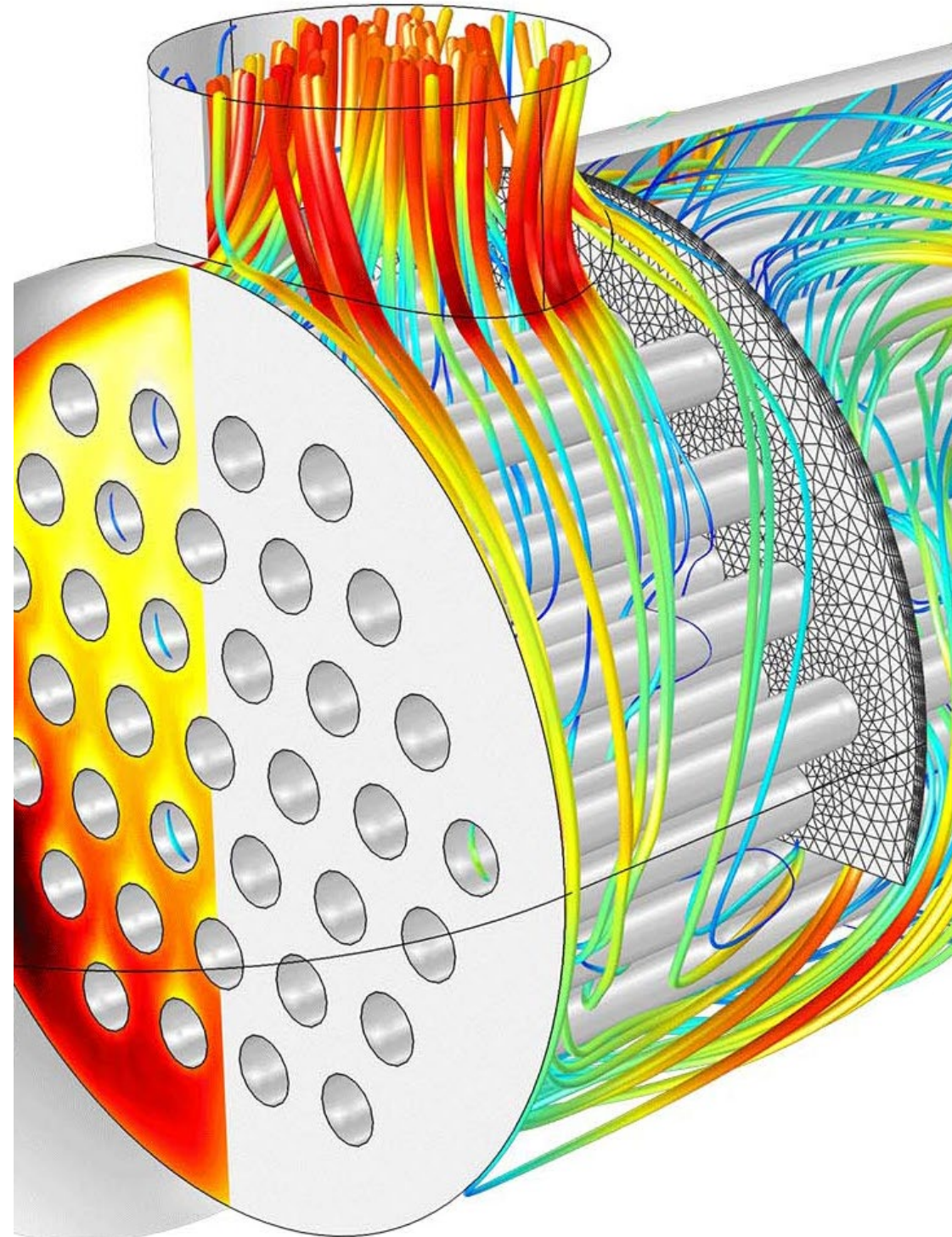
*You will achieve your most demanding objectives, thanks to the most innovative tools in the field of Compressible Fluids"*



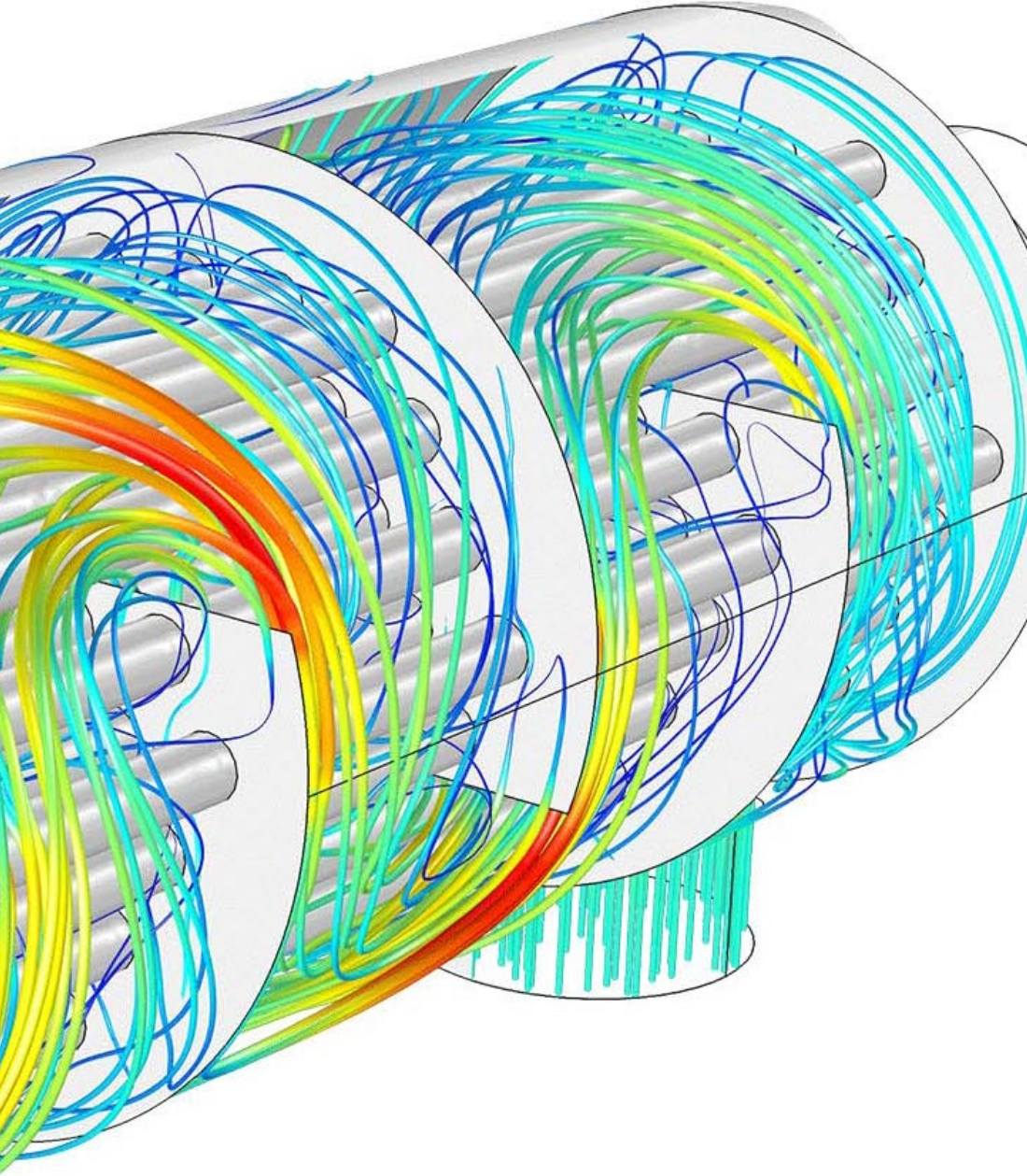
## General Objectives

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- ◆ Establish the basis for the study of turbulence
- ◆ Develop CFD statistical concepts
- ◆ Determine the main computational techniques in turbulence research
- ◆ Generate specialized knowledge in the method of Finite Volumes
- ◆ Acquire specialized knowledge in fluid mechanics calculation techniques
- ◆ Examine the wall units and the different regions of a turbulent wall flow
- ◆ Determine the characteristics of compressible flows
- ◆ Examine multiple models and multiphase methods
- ◆ Develop expertise on multiple models and methods in multiphysics and thermal analysis
- ◆ Interpret the results obtained by correct post-processing







## Specific Objectives

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- ◆ Develop the main differences between compressible and incompressible flow
- ◆ Examine typical examples of the occurrence of compressible fluids
- ◆ Identify the peculiarities in the solution of hyperbolic differential equations
- ◆ Establish the basic methodology for solving the Riemann problem
- ◆ Compile different resolution strategies
- ◆ Analyze the pros and cons of the different methods
- ◆ Present the applicability of these methodologies to the Euler / Navier-Stokes equations, showing classical examples

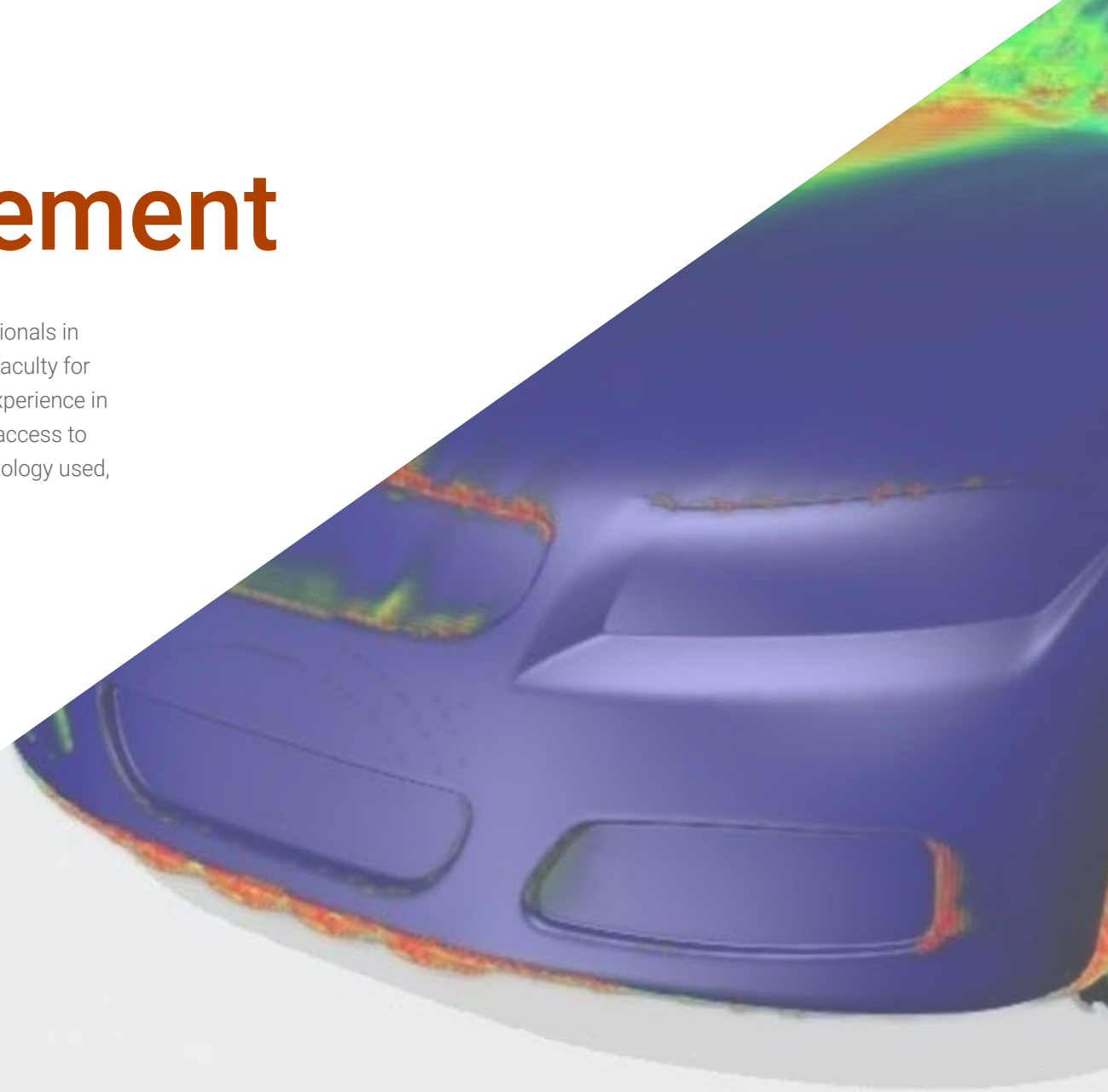
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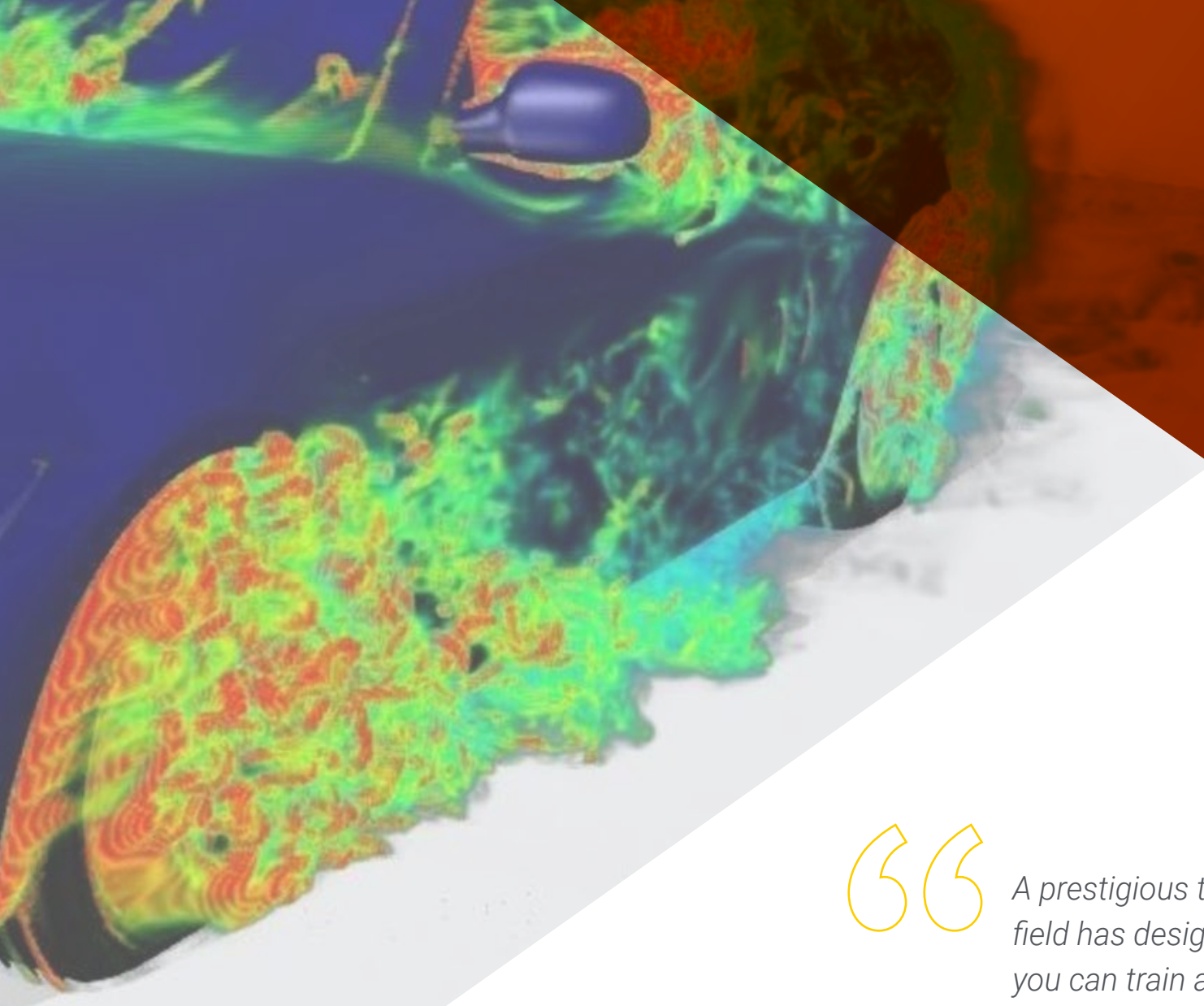
*Improve your skills with the large amount of first-class material available on the virtual campus, which you can access 24 hours a day”*

03

# Course Management

TECH is aware of the importance of having a team of experienced professionals in the area to guide the student, and that is why it has carefully selected the faculty for this program. These professionals are highly trained and have extensive experience in the field of Computational Fluid Mechanics, ensuring that engineers have access to the most innovative and relevant content. In addition, the teaching methodology used, Relearning, is highly efficient and effective.





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*A prestigious team of experts in the field has designed this degree so that you can train and face a successful professional future in this sector”*



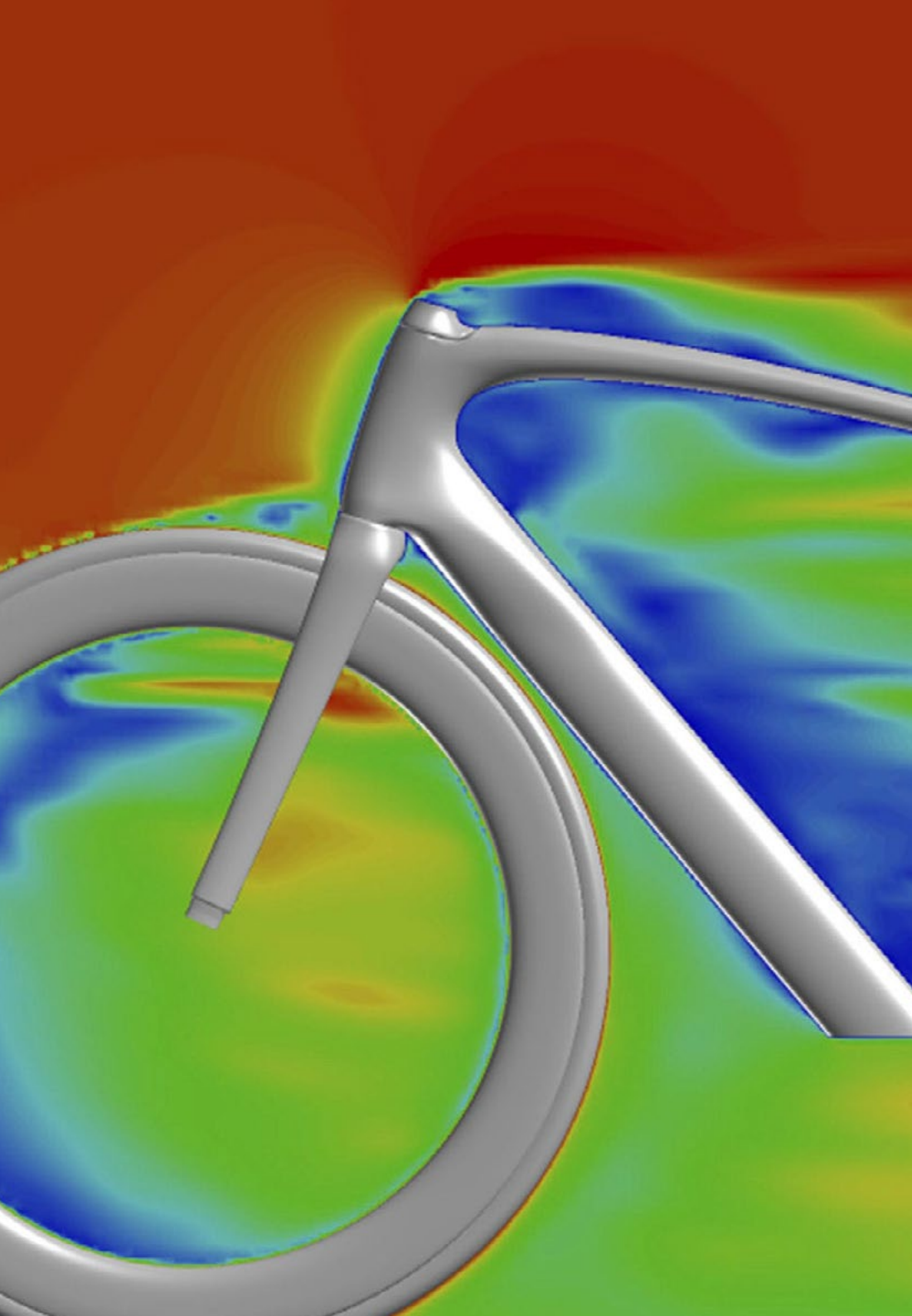
## Management



### Dr. José Pedro García Galache

- ♦ PhD in Aeronautical Engineering from the Polytechnic University of Valencia
- ♦ Degree in Aeronautical Engineering from the Polytechnic University of Valencia
- ♦ Master's Degree in Research in Fluid Mechanics from the Von Kármán Institute for Fluid Dynamics
- ♦ Short Training Programme en el Von Kármán Institute for Fluid Dynamics





## Professors

### Dr. Daniel Espinoza Vásquez

- ◆ Freelance CFD and Programming Consultant
- ◆ CFD Specialist at Particle Analytics Ltd
- ◆ Research Assistant at the University of Strathclyde
- ◆ Teaching Assistant in Fluid Mechanics, University of Strathclyde
- ◆ Dr. in Aeronautical Engineering from the University of Strathclyde
- ◆ Master's Degree in Computational Fluid Mechanics, Cranfield University
- ◆ Degree in Aeronautical Engineering from Universidad Politécnica de Madrid
- ◆ Director of Animation and Operations at Manatí Park
- ◆ Master's Degree MBA Executive from the Columbus International Business School
- ◆ Master's Degree in Administration and Management of Renewable Energies by the Antonio de Nebrija University
- ◆ Master's Degree in Emotional Intelligence and NLP by Euroinnova
- ◆ Certified Park Professional International by Indiana University, in the United States

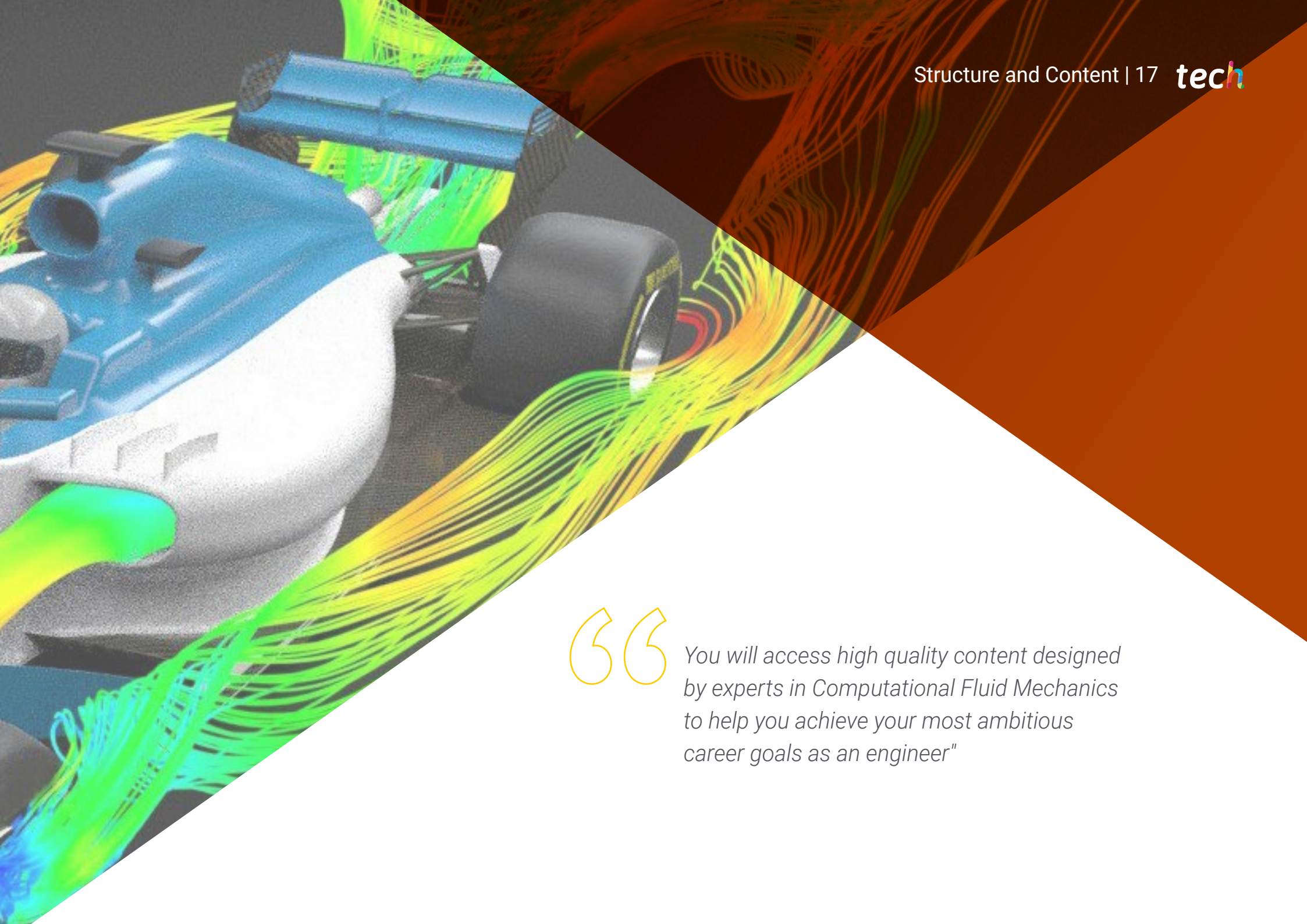
# 04

## Structure and Content

The syllabus of this Postgraduate Certificate has been designed with the objective of offering students an intensive learning program of 150 teaching hours. For this purpose, TECH provides the graduate with multimedia pills, readings and case studies that will allow him/her to deepen in the planning of public-private partnerships in Green Zones, the different types of actions of dynamization and the security elements for their preservation.





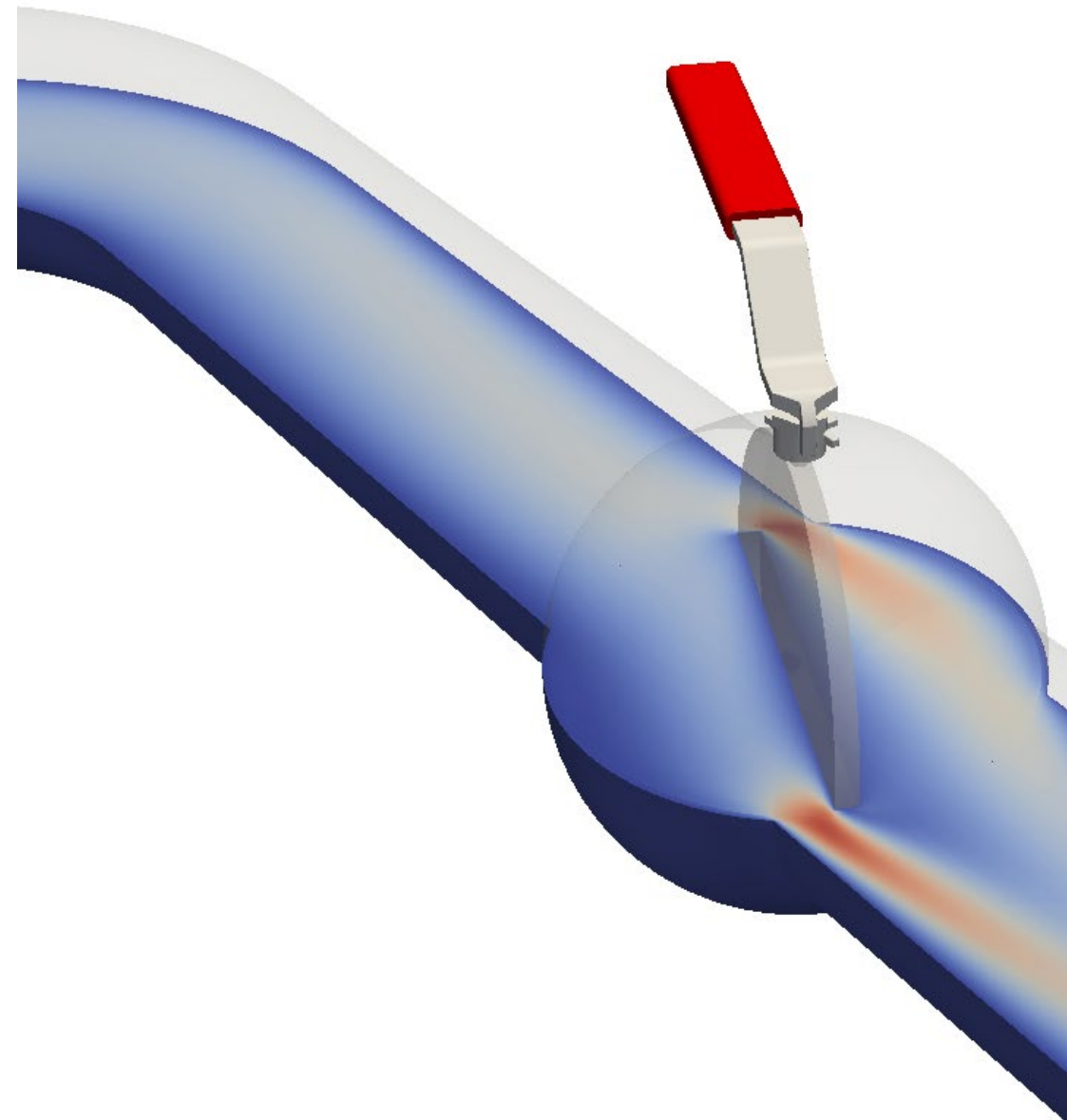


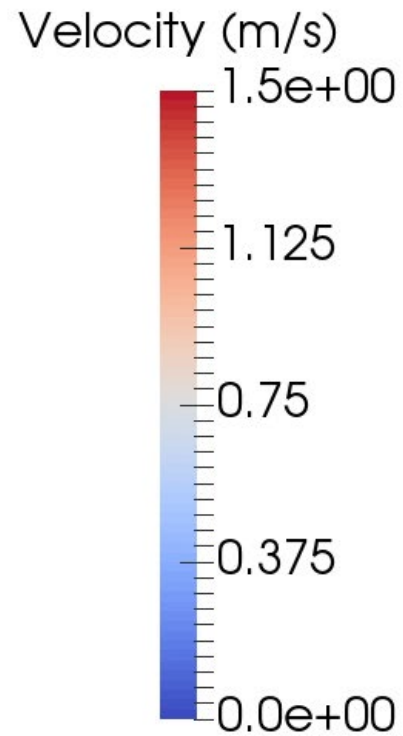
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*You will access high quality content designed by experts in Computational Fluid Mechanics to help you achieve your most ambitious career goals as an engineer”*

## Module 1. Revitalization of Green Zones

- 1.1. Compressible Fluids
  - 1.1.1. Compressible and incompressible fluids. Differences
  - 1.1.2. Equation of State
  - 1.1.3. Differential equations of compressible fluids
- 1.2. Practical examples of the compressible regime
  - 1.2.1. Shock Waves
  - 1.2.2. Prandtl-Meyer Expansion
  - 1.2.3. Nozzles
- 1.3. Riemann's Problem
  - 1.3.1. Riemann's problem
  - 1.3.2. Solution of the Riemann problem by characteristics
  - 1.3.3. Non-linear systems: Shock Waves Rankine-Hugoniot condition
  - 1.3.4. Non-linear systems: Waves and expansion fans. Entropy condition
  - 1.3.5. Riemannian Invariants
- 1.4. Euler Equations
  - 1.4.1. Invariants of the Euler equations
  - 1.4.2. Conservative vs. primitive variables
  - 1.4.3. Solution Strategies
- 1.5. Solutions to the Riemann problem
  - 1.5.1. Exact solution
  - 1.5.2. Conservative numerical methods
  - 1.5.3. Godunov's method
  - 1.5.4. Flux Vector Splitting
- 1.6. Approximate Riemann solvers
  - 1.6.1. HLLC
  - 1.6.2. Roe
  - 1.6.3. AUSM
- 1.7. Higher order methods
  - 1.7.1. Problems of higher order methods
  - 1.7.2. Limiters and TVD methods
  - 1.7.3. Practical Examples

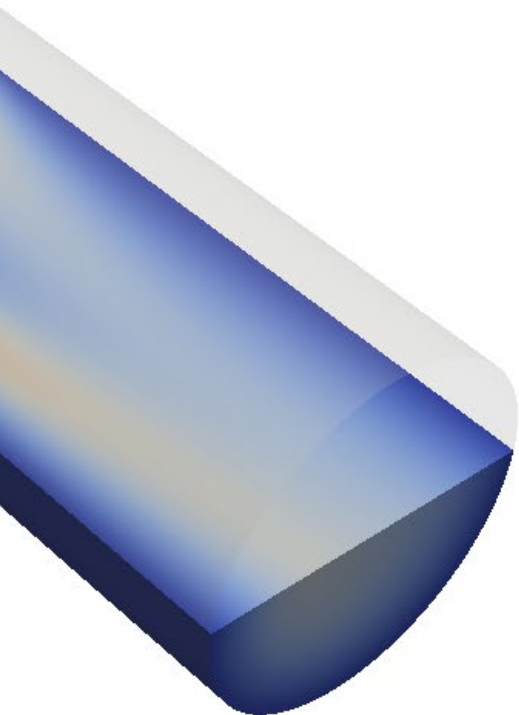




- 1.8. Additional aspects of the Riemann Problem
  - 1.8.1. Non-homogeneous equations
  - 1.8.2. Splitting dimensional
  - 1.8.3. Applications to the Navier-Stokes equations
- 1.9. Regions with high gradients and discontinuities
  - 1.9.1. Importance of meshing
  - 1.9.2. Automatic mesh adaptation (AMR)
  - 1.9.3. Shock Fitting Methods
- 1.10. Compressible flow applications
  - 1.10.1. Sod problem
  - 1.10.2. Supersonic wedge
  - 1.10.3. Convergent-divergent nozzle

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*A curriculum created to ensure your success as an expert in Compressible Fluid Simulation, in an effective way and fast”*





05

# 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.







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*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.*



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

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.*

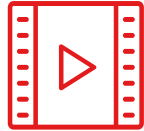
From the latest scientific evidence in the field of neuroscience, not only do we know how to organize information, ideas, images and memories, but we know that the place and context where we have learned something is fundamental for us to be able to remember it and store it in the hippocampus, to retain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



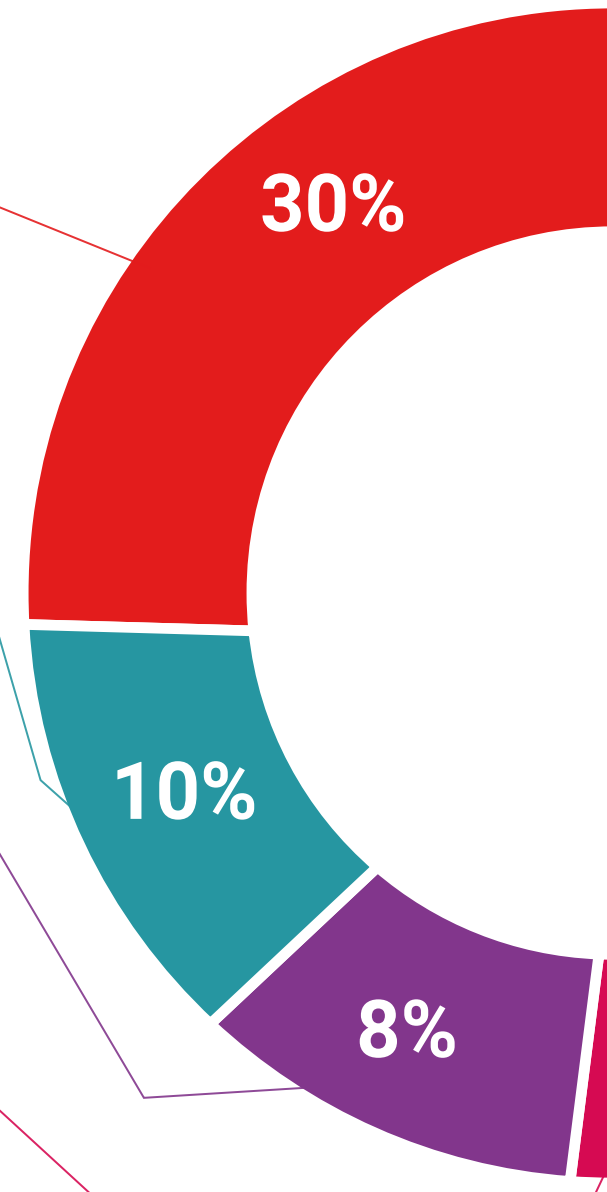
### Practising Skills and Abilities

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.

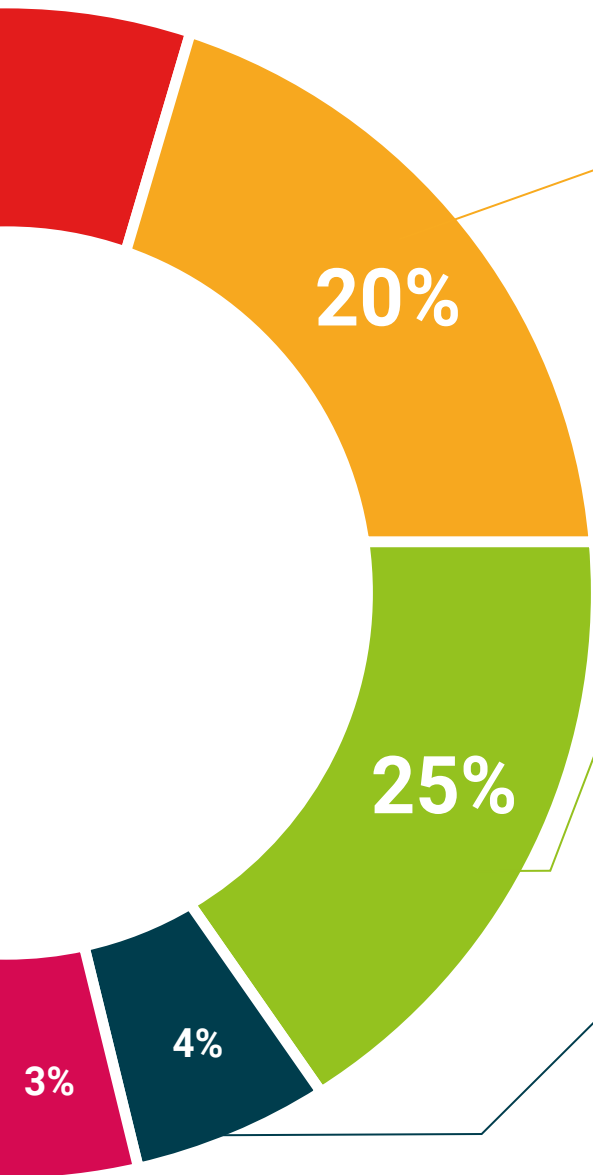


### Additional Reading

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.



06

# Certificate

The Postgraduate Certificate in Compressible Fluid Simulation guarantees students, in addition to the most rigorous and up-to-date education, access to a Postgraduate Certificate issued by TECH Global University.



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

This program will allow you to obtain your **Postgraduate Certificate in Compressible Fluid Simulation** endorsed by **TECH Global University**, the world's largest online university.

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

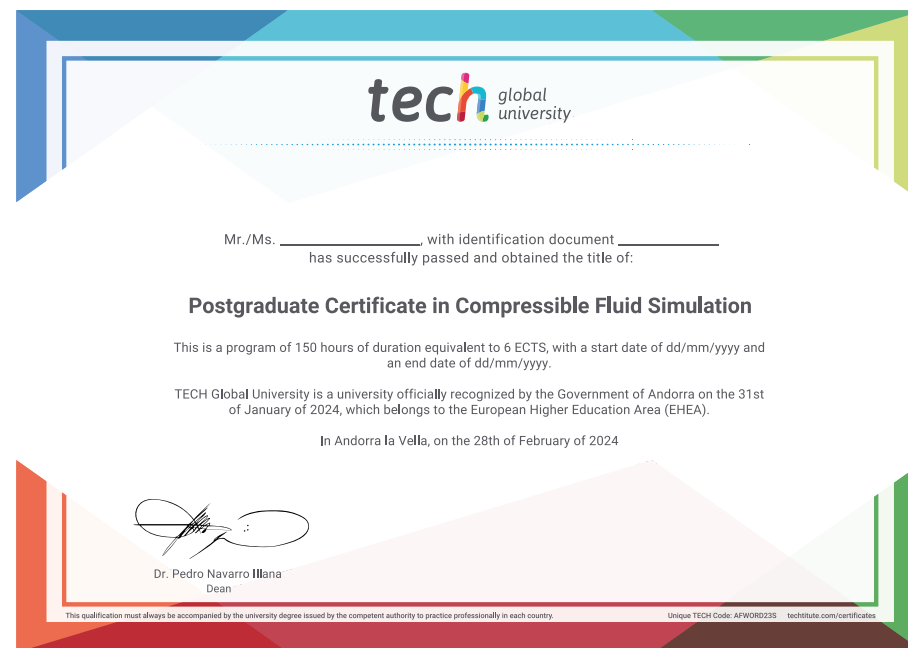
This **TECH Global University** title is a European program of continuing education and professional updating that guarantees the acquisition of competencies in its area of knowledge, providing a high curricular value to the student who completes the program.

Title: **Postgraduate Certificate in Compressible Fluid Simulation**

Modality: **online**

Duration: **6 weeks**

Accreditation: **6 ECTS**





## Postgraduate Certificate Compressible Fluid Simulation

- » Modality: online
- » Duration: 6 weeks
- » Certificate: TECH Global University
- » Credits: 6 ECTS
- » Schedule: at your own pace
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