

# Postgraduate Certificate

## Finite Volumes Applied to CFD





## Postgraduate Certificate

Finite Volumes

Applied to CFD

- » Modality: online
- » Duration: 6 weeks
- » Certificate: TECH Technological University
- » Dedication: 16h/week
- » Schedule: at your own pace
- » Exams: online

Website: [www.techtitute.com/in/engineering/postgraduate-certificate/finite-volumes-applied-cfd](http://www.techtitute.com/in/engineering/postgraduate-certificate/finite-volumes-applied-cfd)

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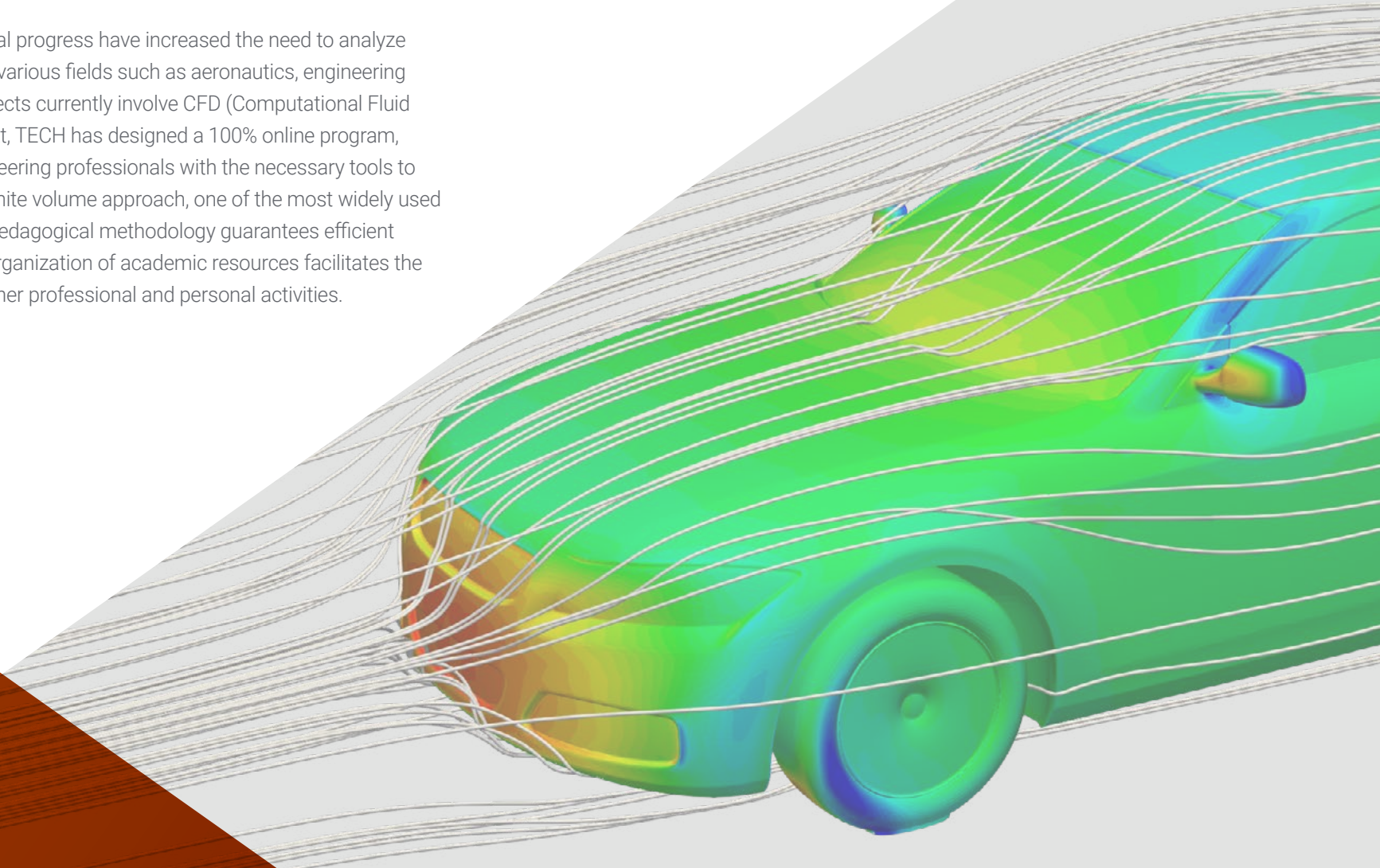
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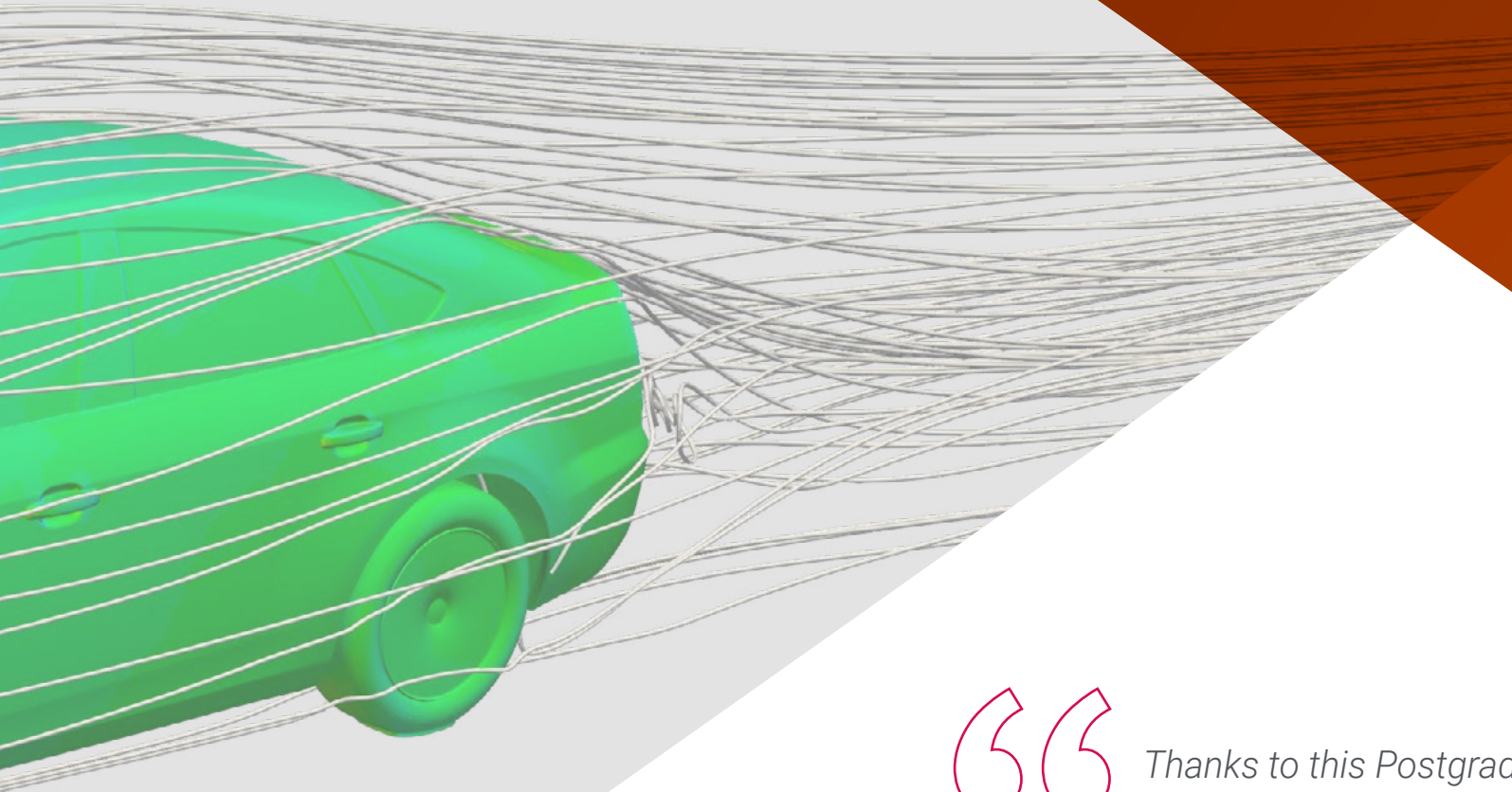


# 01

# Introduction

The rise of industry and technological progress have increased the need to analyze and simulate complex fluid flows in various fields such as aeronautics, engineering and energy. 85% of engineering projects currently involve CFD (Computational Fluid Dynamics) techniques. In this context, TECH has designed a 100% online program, with the objective of providing engineering professionals with the necessary tools to face these challenges through the finite volume approach, one of the most widely used techniques in CFD. The Relearning pedagogical methodology guarantees efficient teaching, while the flexibility in the organization of academic resources facilitates the compatibility of the program with other professional and personal activities.





“

*Thanks to this Postgraduate Certificate you will acquire skills in the application of boundary conditions, from inputs to condition and wall models”*

In modern engineering, fluid analysis and modeling play a critical role in the optimization of processes and systems in various industries. The growing demand for innovative and sustainable solutions in fields such as energy, automotive, aerospace and climate change mitigation has driven the development of advanced computational modeling techniques. Thus, Computational Fluid Dynamics (CFD) and the Finite Volume method have become essential tools to face these challenges.

TECH's Postgraduate Certificate in Finite Volumes Applied to CFD program offers solid training in the use and application of the Finite Volume method in CFD.

The syllabus covers fundamental aspects such as definitions, historical background and applications in structures. In addition, thanks to a highly specialized teaching team, students will learn more about source terms, applications of boundary conditions and different types of boundary conditions.

This program also addresses advanced techniques in the field, such as moving contours, remeshing, mapping and the Immersed boundary method. All this in only 150 hours of intensive study and through a 100% online platform that allows participants to access content and activities anywhere and at any time.

Relearning's pedagogical methodology, based on the constant reiteration of concepts and adaptation to individual learning needs, guarantees an efficient and personalized educational experience. Flexibility in the organization of academic resources offers the possibility of adapting the course to the student's pace and availability, facilitating the program to the student's pace and availability, making it easier to reconcile the program with other professional and personal commitments.

Upon completion of this program, professionals will be able to address engineering challenges in their fields of expertise, efficiently applying the Finite Volume method in CFD and contributing to the development of innovative and sustainable solutions.

This **Postgraduate Certificate in Finite Volumes Applied to CFD** contains the most complete and up-to-date program on the market. The most important features include:

- ◆ The development of case studies presented by experts in 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 the self-assessment process can be carried out 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



*Discover remeshing techniques and moving reference systems to tackle problems with moving contours with this unique program”*



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*You will have 24-hour access to a library full of valuable content for you to specialize in from the comfort of wherever you choose, only with TECH”*

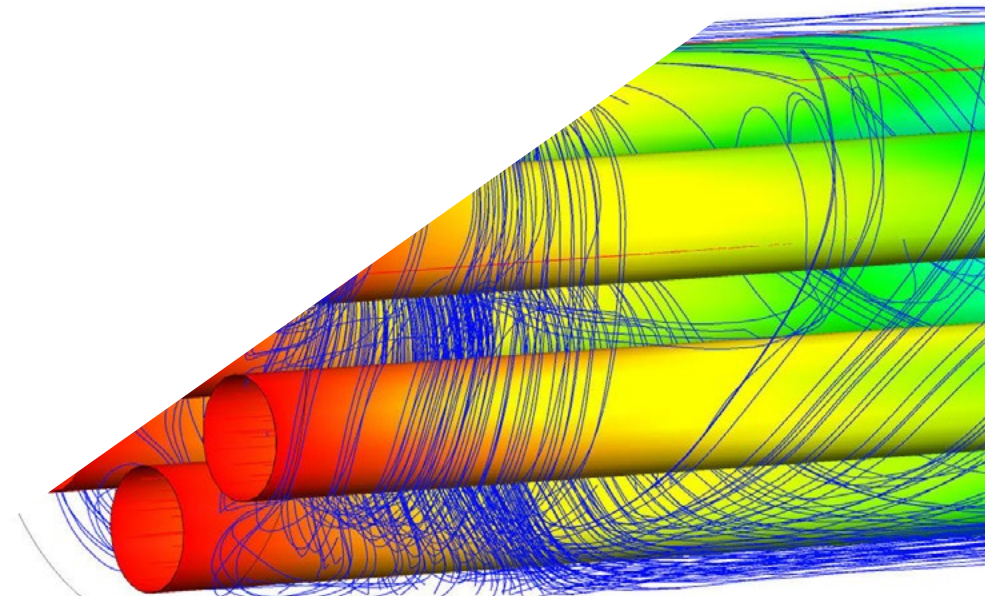
The program's teaching staff includes professionals from the sector who bring the experience of their work to this training, as well as recognised specialists from leading societies and prestigious universities.

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, students will be assisted by an innovative interactive video system developed by renowned experts.

*Become familiar with pressure-velocity convergence loops such as PISO, SIMPLE and PIMPLE for more accurate and effective simulations.*

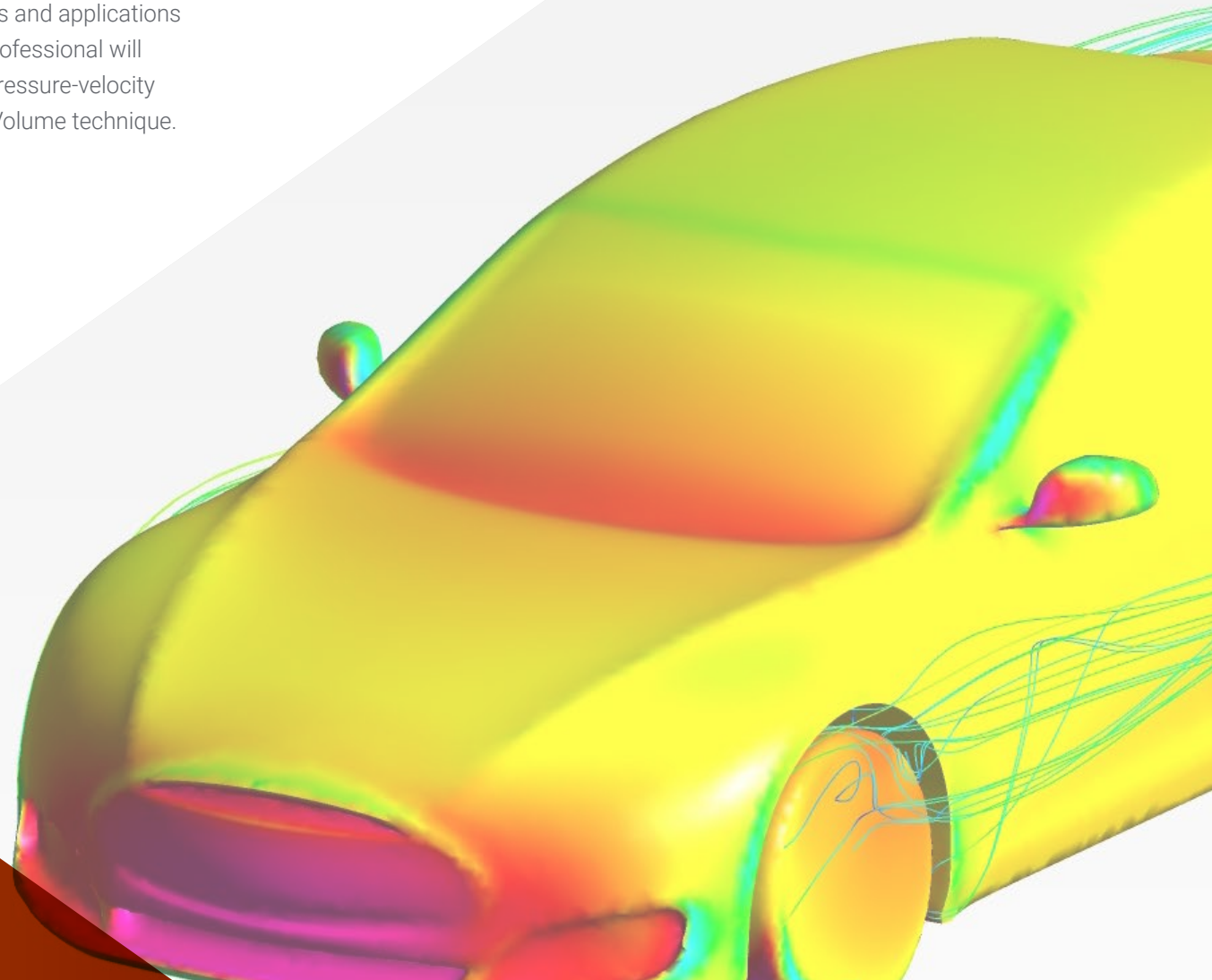
*You will master time integration with Euler, Lax-Wendroff and multi-stage Rung-Kutta methods to perform accurate transient calculations.*



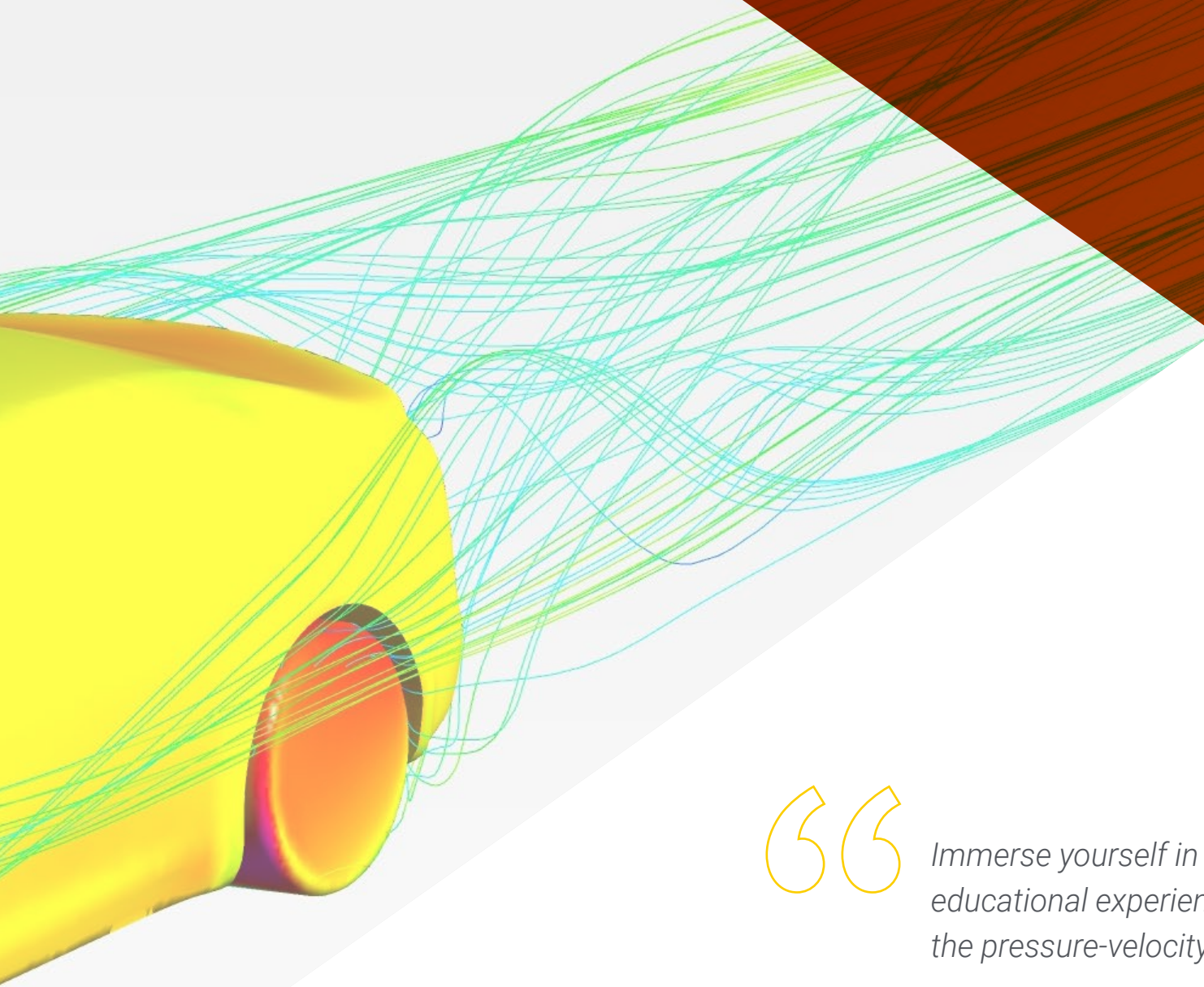
# 02

# Objectives

During the 150 hours of instruction of this university degree, engineering professionals will be able to acquire in-depth knowledge of Finite Volume methods applied to CFD. Thus, the syllabus has been designed by a teaching team specialized in the subject, which will present the definitions, historical background, source terms and applications of boundary conditions in a dynamic and visual way. Therefore, the professional will learn about time integration, upwind schemes, high order schemes, pressure-velocity convergence loops, and other essential aspects to master the Finite Volume technique.







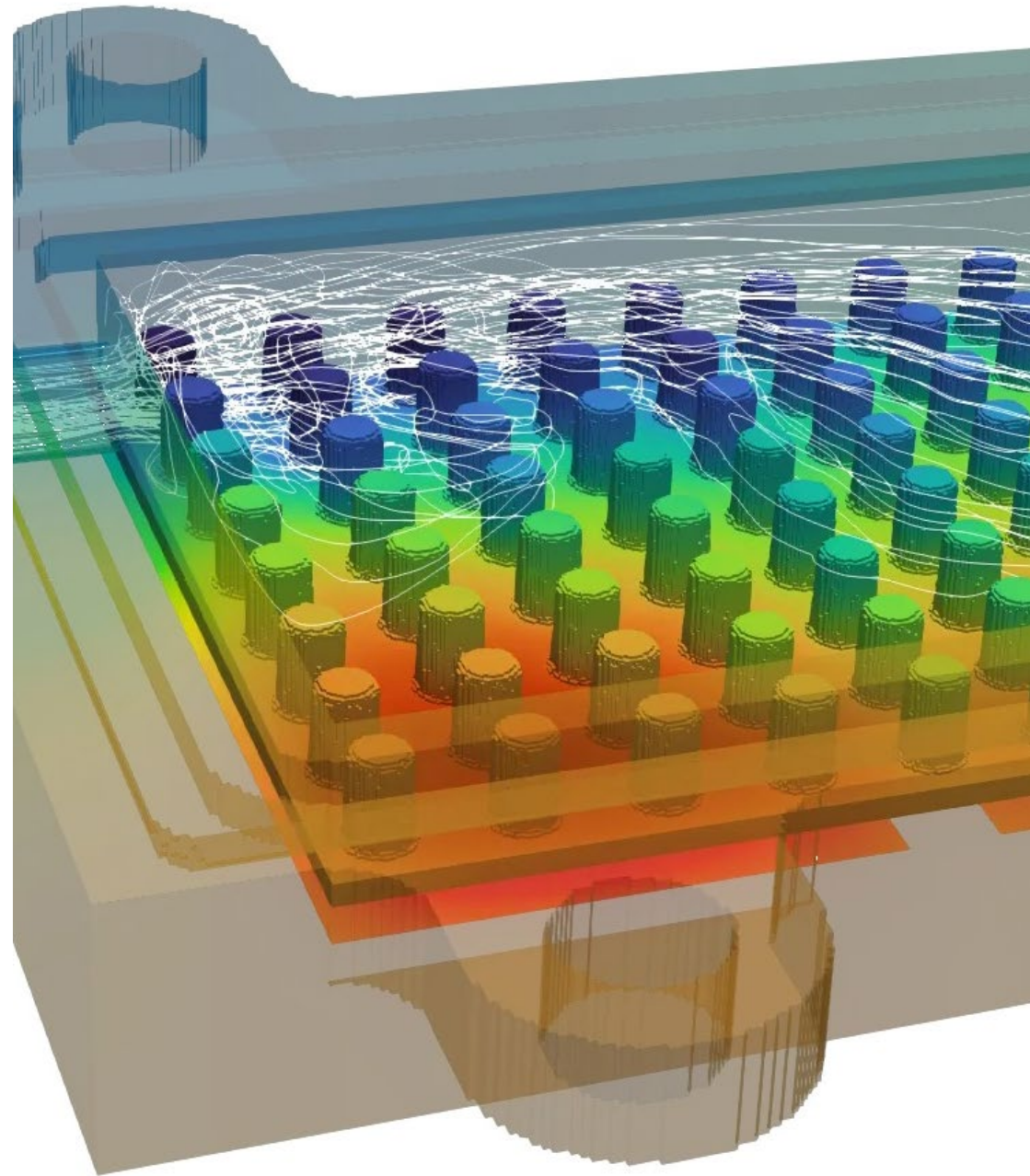
“Immerse yourself in a dynamic educational experience and delve into the pressure-velocity convergence loop”



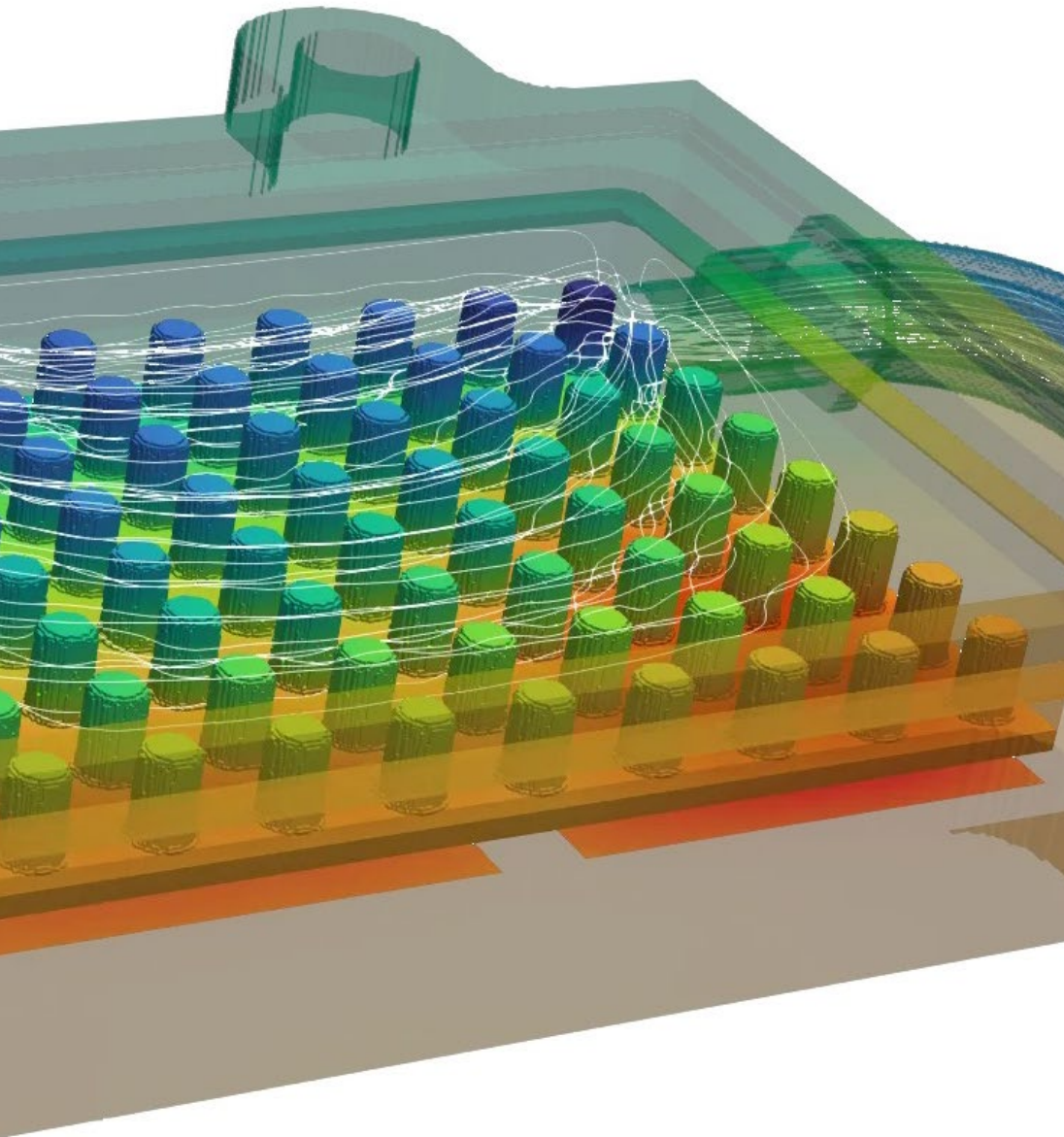
## General Objectives

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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 the multiple models and methods in multiphysics and thermal analysis
- ◆ Interpret the results obtained by correct post-processing







## Specific Objectives

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- ◆ Analyze the FEM or MVE environment
- ◆ Specify what, where and how the boundary conditions can be defined
- ◆ Determine possible time steps
- ◆ Concretizing and designing Upwind schemes
- ◆ Develop high order schemes
- ◆ Examine convergence loops and in which cases to use each one
- ◆ Expose the imperfections of CFD results

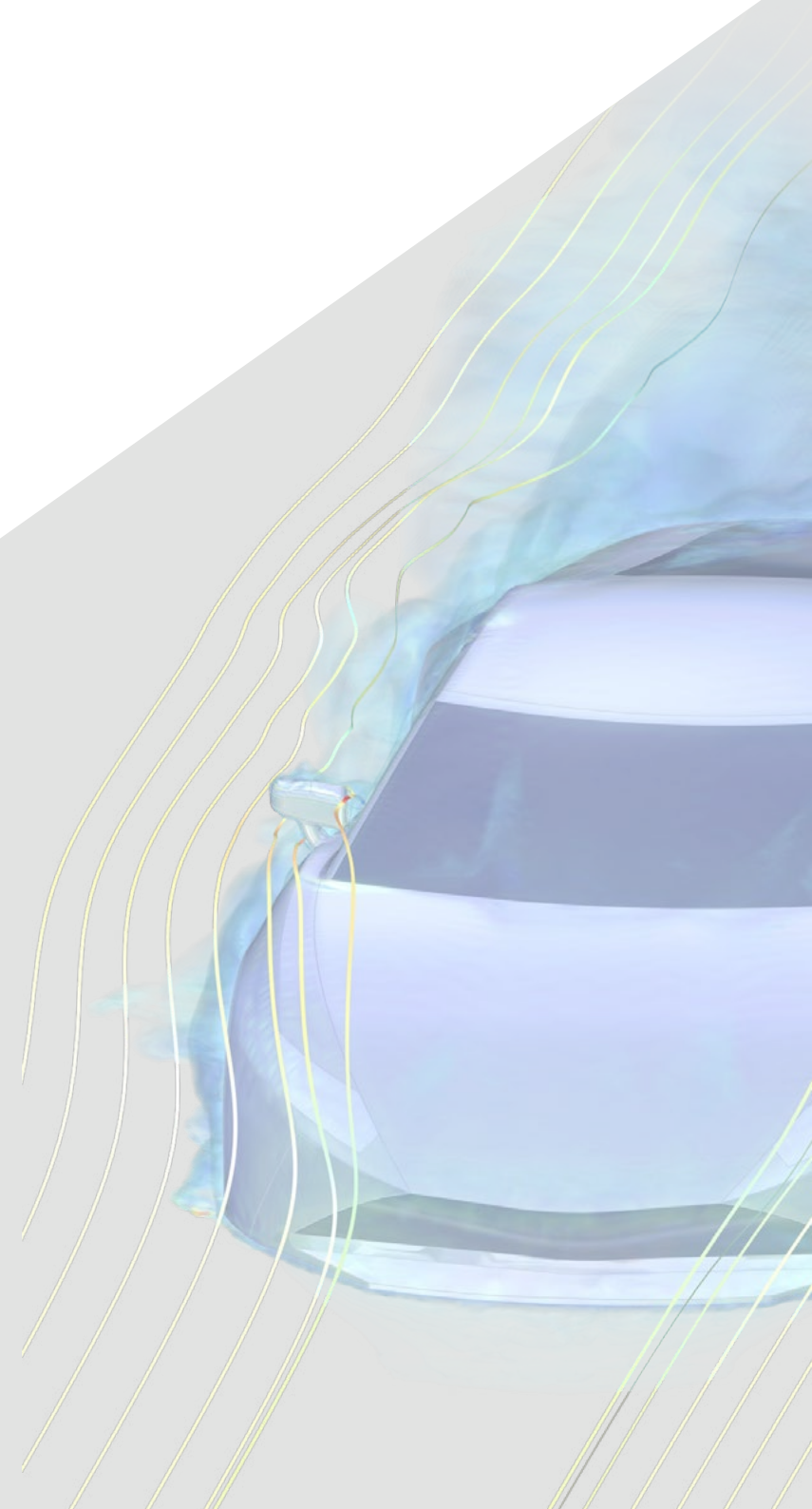
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*Don't miss the opportunity to achieve your professional goals by acquiring the skills this program provides to take your career to the next level. Enroll now!"*

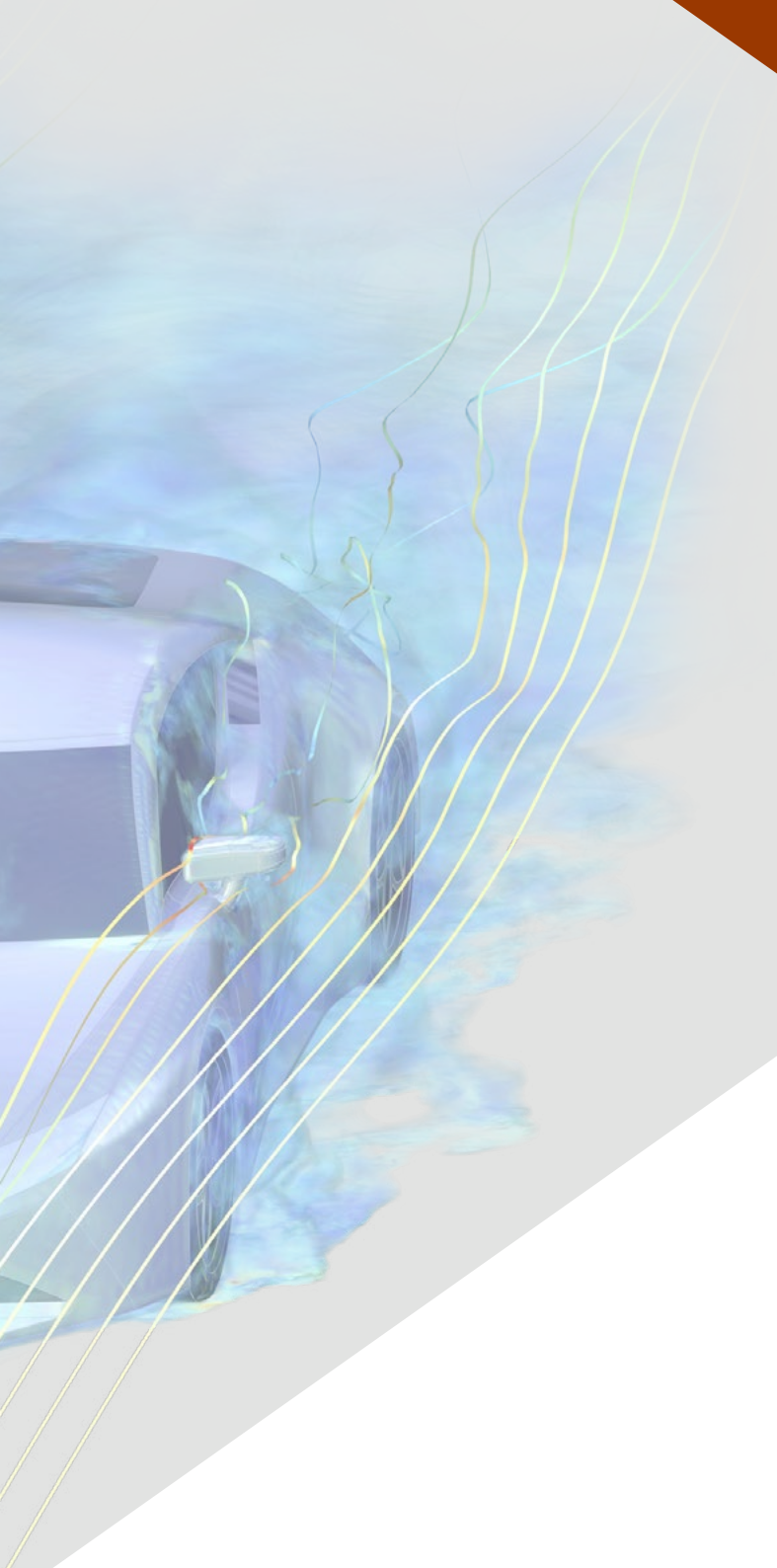
# 03

# Course Management

The TECH Postgraduate Certificate in Finite Volumes Applied to CFD stands out for its highly qualified teaching staff in the area of Computational Fluid Mechanics. The selected professionals have extensive experience and expertise in the field, guaranteeing students access to the most innovative and relevant content. The teaching methodology used, Relearning, allows an efficient and effective acquisition of specific skills and competencies by the graduates, without the need to dedicate time to memorization. In addition, the program is completely online and therefore provides convenience and flexibility in its implementation.







“

*Learn from top experts in the field of Computational Fluid Mechanics and master finite volumes in a 100% online program”*

## Management



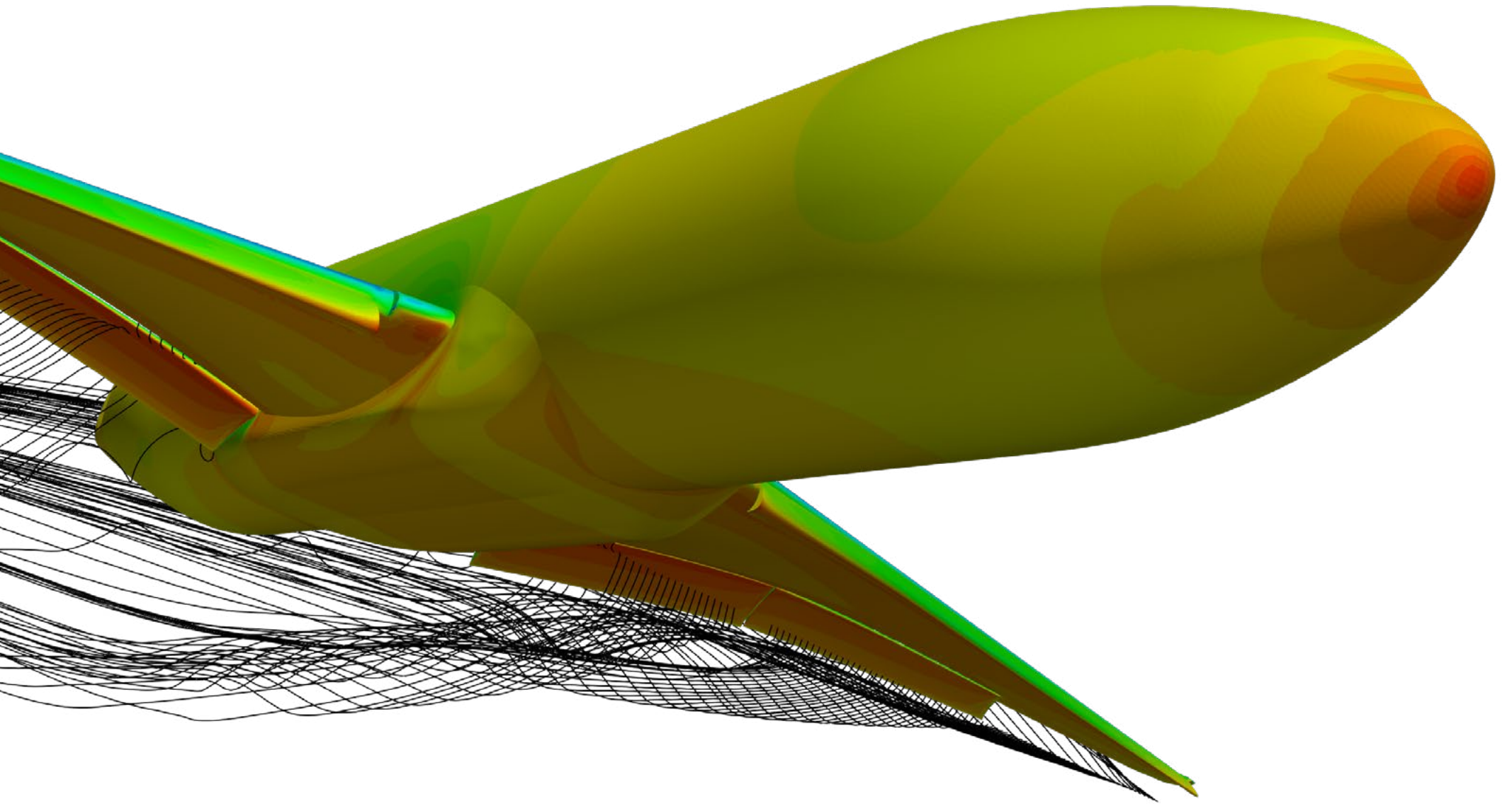
### Dr. José Pedro García Galache

- ♦ XFlow Development Engineer at Dassault Systèmes
- ♦ 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

### Ms. Maider Pérez Tainta

- ♦ Cement fluidization engineer at Kemex Ingesoa
- ♦ Process Engineer at J.M. Jauregui
- ♦ Researcher in hydrogen combustion at Ikerlan
- ♦ Mechanical Engineer at Idom
- ♦ Graduate in Mechanical Engineering from the University of the Basque Country (UPV)
- ♦ Master's Degree in Mechanical Engineering
- ♦ Interuniversity Master's Degree in Fluid Mechanics
- ♦ Python programming program program program



# 04

## Structure and Content

TECH's Postgraduate Certificate in Finite Volumes Applied to CFD is a highly innovative and complete didactic option. Its teaching methodology based on Relearning allows students to acquire skills and competencies in a dynamic and effective way, without the need to invest time in memorization. In addition, the program is developed entirely online and has the most updated theoretical and practical contents in the market, which guarantees a solid and deep didactic experience in the applications of boundary conditions.





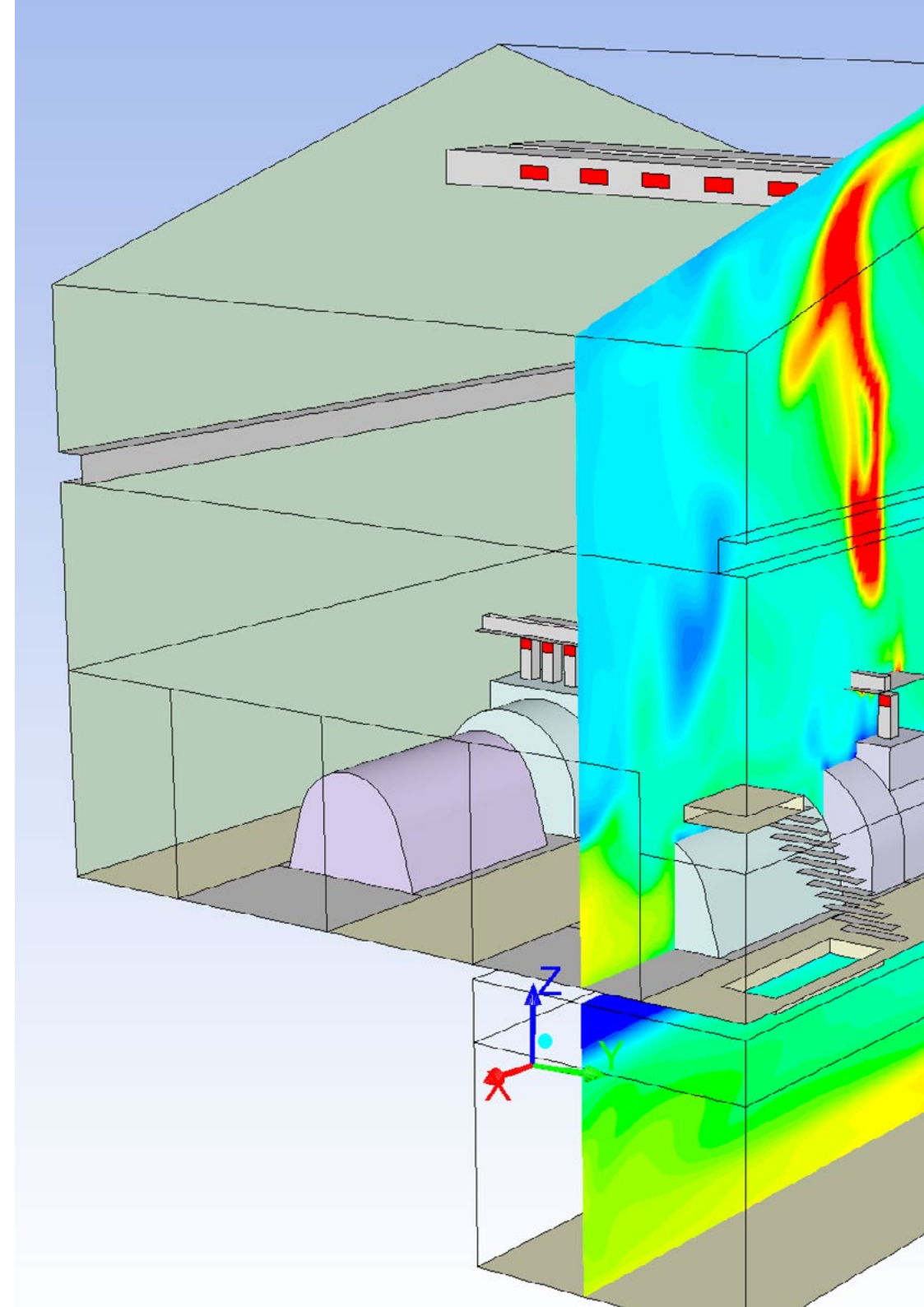


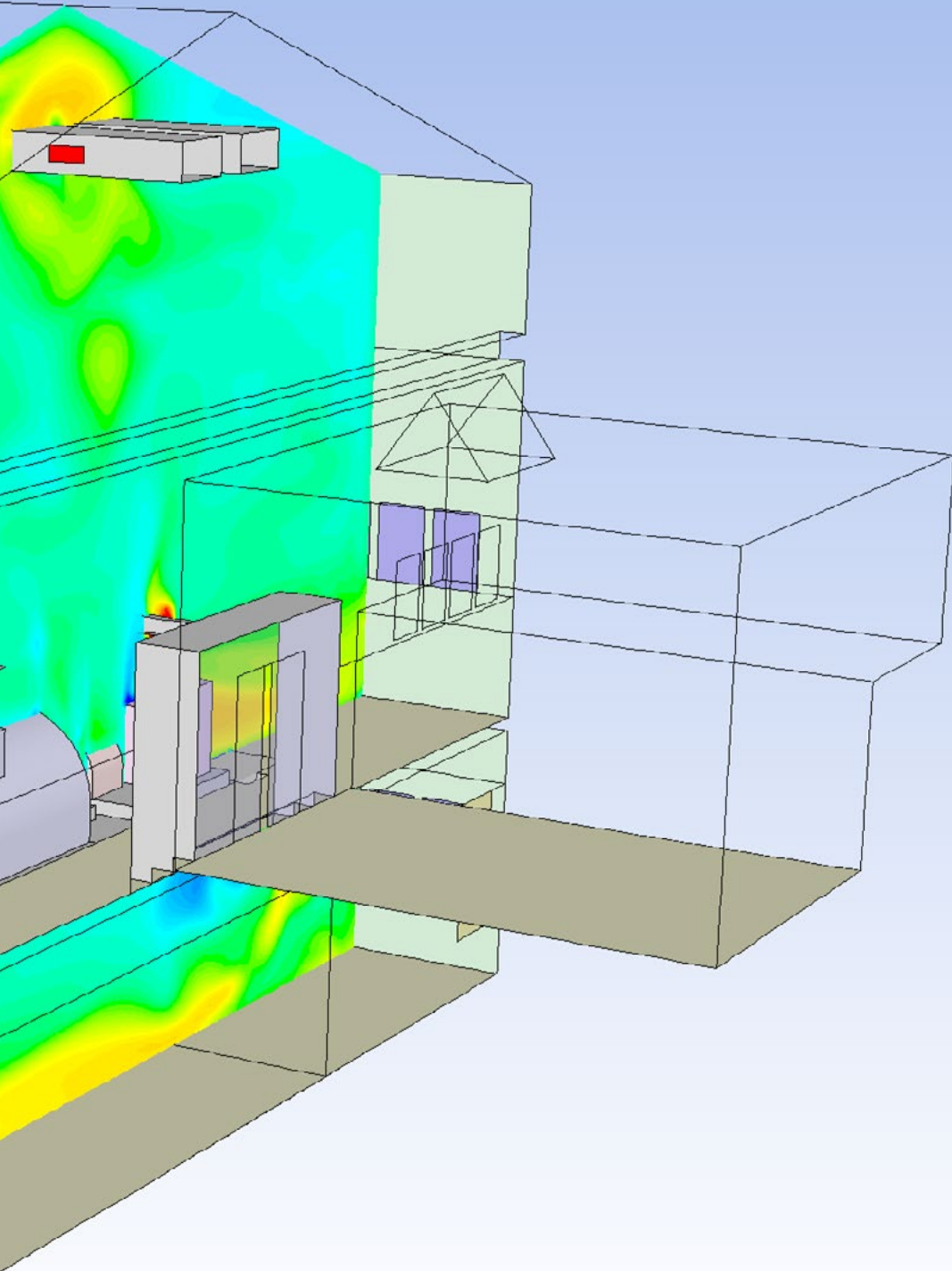
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*You will handle the source terms in CFD, such as gravity and centrifugal force to apply them to various fluid problems”*

## Module 1. CFD in Application Environments: Finite Volume Methods

- 1.1. Finite Volume Methods
  - 1.1.1. Definitions in FVM
  - 1.1.2. Historical Background
  - 1.1.3. MVF in Structures
- 1.2. Source Terms
  - 1.2.1. External volumetric forces
    - 1.2.1.1. Gravity, centrifugal force
  - 1.2.2. Volumetric (mass) and pressure source term (evaporation, cavitation, chemical)
  - 1.2.3. Scalar source term
    - 1.2.3.1. Temperature, species
- 1.3. Applications of boundary conditions
  - 1.3.1. Input and Output
  - 1.3.2. Symmetry condition
  - 1.3.3. Wall condition
    - 1.3.3.1. Tax values
    - 1.3.3.2. Values to be solved by parallel calculation
    - 1.3.3.3. Wall Models
- 1.4. Boundary Conditions
  - 1.4.1. Known boundary conditions: Dirichlet
    - 1.4.1.1. Scalars
    - 1.4.1.2. Vectoriales
  - 1.4.2. Boundary conditions with known derivative: Neumann
    - 1.4.2.1. Zero gradient
    - 1.4.2.2. Finite gradient
  - 1.4.3. Cyclic boundary conditions: Born-von Karman
  - 1.4.4. Other boundary conditions: Robin
- 1.5. Temporary integration
  - 1.5.1. Explicit and implicit Euler
  - 1.5.2. Lax-Wendroff time step and variants (Richtmyer and MacCormack)
  - 1.5.3. Runge-Kutta multi-stage time step





- 1.6. Upwind Schematics
  - 1.6.1. Riemman's Problem
  - 1.6.2. Main upwind schemes: MUSCL, Van Leer, Roe, AUSM
  - 1.6.3. Design of an upwind spatial scheme
- 1.7. High order schemes
  - 1.7.1. High-order discontinuous Galerkin
  - 1.7.2. ENO and WENO
  - 1.7.3. High Order Schemes. Advantages and Disadvantages
- 1.8. Pressure-velocity convergence loop
  - 1.8.1. PISO
  - 1.8.2. SIMPLE, SIMPLER and SIMPLEC
  - 1.8.3. PIMPLE
  - 1.8.4. Transient loops
- 1.9. Moving contours
  - 1.9.1. Overlocking techniques
  - 1.9.2. Mapping: mobile reference system
  - 1.9.3. Immersed boundary method
  - 1.9.4. Overlapping meshes
- 1.10. Errors and uncertainties in CFD modeling
  - 1.10.1. Precision and accuracy
  - 1.10.2. Numerical errors
  - 1.10.3. Input and physical model uncertainties

“ You will develop specific skills and competencies in a natural and efficient way, without the need to memorize thanks to the *Relearning teaching methodology*”



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.







“

*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.



06

# Certificate

The Postgraduate Certificate in Finite Volumes Applied to CFD guarantees students, in addition to the most rigorous and up-to-date education, access to a Postgraduate Certificate issued by TECH Technological University.



“

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



This **Postgraduate Certificate in Finite Volumes Applied to CFD** contains the most complete and up-to-date program on the market.

After the student has passed the assessments, they will receive their corresponding **Postgraduate Certificate** issued by **TECH Technological University** via tracked delivery\*.

The certificate issued by **TECH Technological University** will reflect the qualification obtained in the Postgraduate Certificate, and meets the requirements commonly demanded by labor exchanges, competitive examinations, and professional career evaluation committees.

Program: **Postgraduate Certificate in Finite Volumes Applied to CFD**

Official N° of Hours: **150 h.**



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

future  
health confidence people  
education information tutors  
guarantee accreditation teaching  
institutions technology learning  
community commitment  
personalized service innovation  
knowledge present  
development languages  
virtual classroom



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Finite Volumes

Applied to CFD

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