

# Postgraduate Certificate Course in Compressible Fluids Simulation



## Postgraduate Certificate Course in Compressible Fluids Simulation

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

Website: [www.techtute.com/pk/information-technology/postgraduate-certificate/course-compressible-fluids-simulation](http://www.techtute.com/pk/information-technology/postgraduate-certificate/course-compressible-fluids-simulation)

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# 01

# Introduction

Training in Compressible Fluids Simulation can enable a computer science student to work on interdisciplinary projects, in collaboration with other engineers, to design and develop more efficient and accurate applications and systems. For this reason, TECH Technological University has designed a degree that allows students to maximize their knowledge of aspects such as Equation of State, Shock Waves, Riemann Problem or Solution Strategies, among others. All this, through a 100% online modality and with the most dynamic and practical multimedia materials on the academic market.





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*Acquire new skills in Compressible Fluids, thanks to the best online university in the world according to Forbes, thanks to TECH Technological University"*

The Compressible Fluids Simulation is a constantly evolving field, driven by advances in computer technology. Students specializing in this area have the opportunity to contribute to the research and development of new techniques and algorithms that improve the accuracy and efficiency of Compressible Fluids Simulation.

For this reason, TECH Technological University has designed a Postgraduate Certificate Course in Compressible Fluids Simulation with the aim of providing students with the necessary skills and knowledge to be able to carry out their work as specialists with the maximum possible efficiency in their jobs. Thus, topics such as the Supersonic Wedge, the Importance of Meshing, Non-Homogeneous Equations or Conservative Numerical Methods will be dealt with throughout this Postgraduate Course.

And all this through a convenient 100% online mode that allows students to organize their timetables and studies, combining them with their other work and obligations. In addition, this program has the most complete theoretical and practical materials on the market, which facilitates the student's study process and allows them to achieve their objectives quickly and efficiently.

This **Postgraduate Certificate Course in Compressible Fluids Simulation** 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 Fluids Simulation Compressible
- ◆ The graphic, schematic and eminently practical content of the book provides sporting and practical information on those 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



*Become an expert in Higher Order Methods and Riemann Solution Strategies, in only 6 weeks and with total freedom of organization"*

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*Enhance your professional profile in one of the most promising areas of the IT sector, thanks to TECH Technological University and the most innovative materials”*

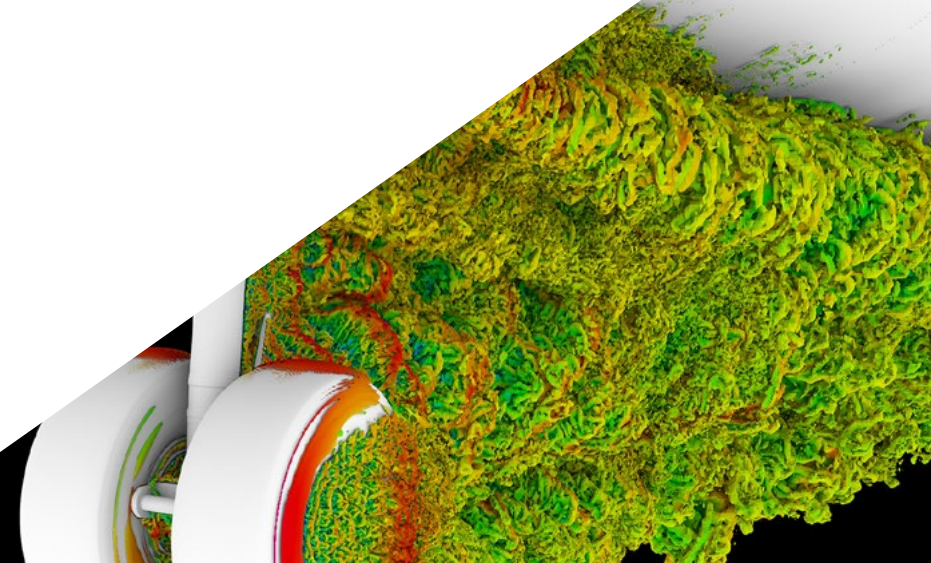
The program's teaching staff includes professionals from the sector who contribute their work experience to this program, in addition to renowned specialists from leading societies and prestigious universities.

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

*Access all the content on Flux Vector Splitting, from your tablet, mobile or computer.*

*Delve deeper into aspects such as the Supersonic Wedge or the Sod Problem, from the comfort of your home and at any time of the day.*





# 02 Objectives

The final objective of this Postgraduate Certificate Course in Compressible Fluids Simulation is for the student to acquire a precise update of their knowledge in this area. An update that will allow the student to work with the highest possible quality. All of this, thanks to TECH Technological University and a 100% online modality that gives students total freedom of organization and timetables, so that they can study in the way that suits them best.







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*Delve into all the essentials of Compressible Fluids Applications or Non-Homogeneous Equations, from the comfort of your home or work office"*



## 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 multi-physics and thermal analysis
- ◆ Interpret the results obtained by correct Post-Processing-processing







## Specific Objectives

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- ◆ To 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
- ◆ To present the applicability of these methodologies to the Euler / Navier-Stokes equations, showing classical examples



*Exceed your highest expectations, thanks to a unique program with the most complete theoretical and practical materials on the academic market"*



# 03

# Course Management

In its constant search to provide a qualification of the highest quality and usefulness, TECH Technological University has selected professionals specialized in Compressible Fluids Simulation as part of this teaching staff, who have been in charge of the design of the most advanced contents. Thus, you will study the learn from the best the keys to your professional development in a field that adapts to new technologies and the latest market advances.



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*The most experienced faculty will provide you with the latest updates on Shock Fitting Methods and Applications to the Navier-Stokes Equations, preparing you to face the current challenges in this area”*

## Management



### Dr. García Galache, José Pedro

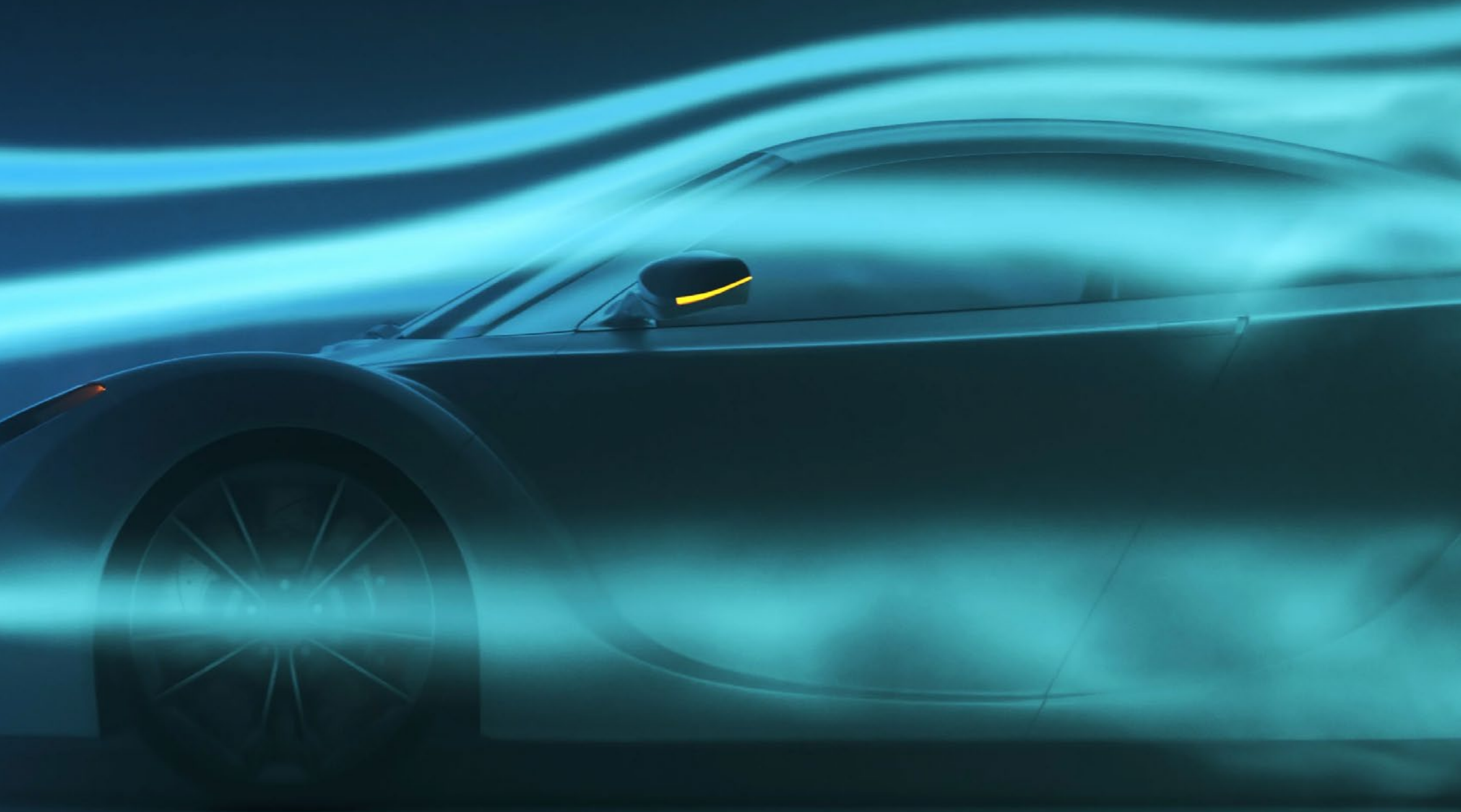
- ♦ XFlow Development Engineer at Dassault Systèmes
- ♦ Doctor in Aeronautical Engineering from the Polytechnic University of Valencia
- ♦ Degree in Aeronautical Engineering from the Polytechnic University of Valencia
- ♦ Research Master's Degree in Fluid Mechanics by the Von Kármán Institute for Fluid Dynamics
- ♦ Programa de formación breve en el Instituto Von Kármán de Dinámica de Fluidos

## Professors

### Dr. Espinoza Vásquez, Daniel

- ♦ Consultant Aeronautical Engineer at Alten SAU
- ♦ 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
- ♦ D. in Aeronautical Engineering from the University of Strathclyde
- ♦ Master's degree in Computational Fluid Mechanics from Cranfield University
- ♦ Degree in Aeronautical Engineering from the Polytechnic University of Madrid





# 04

# Structure and Content

The didactic resources of this syllabus have been designed by the renowned professionals that make up TECH Technological University team of experts in the area of Computer Science. These specialists have drawn on their extensive experience and state-of-the-art knowledge to create practical, dynamic and completely up-to-date content. All this, based on the most efficient pedagogical methodology, the Relearning of TECH Technological University.





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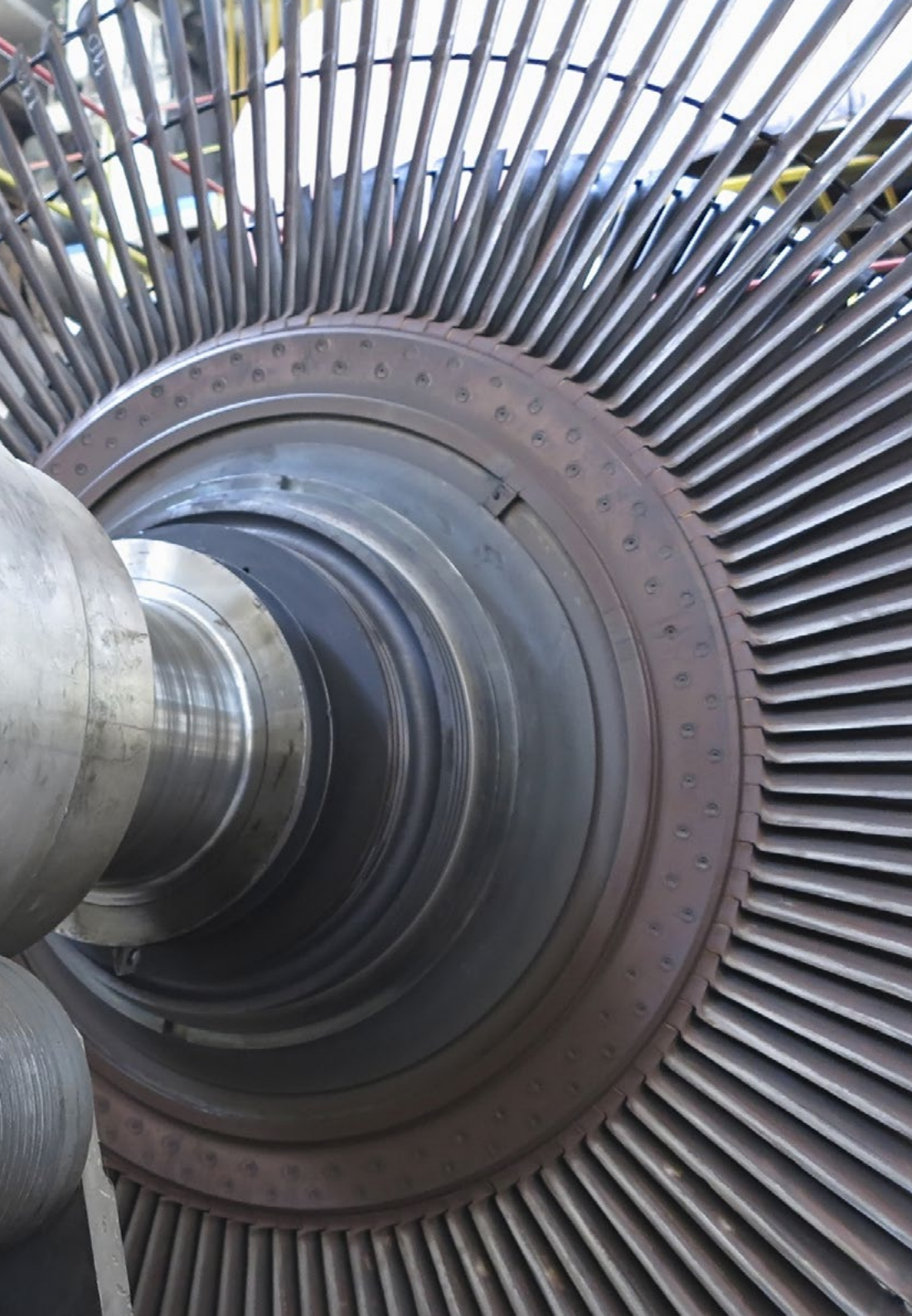
*Broaden your knowledge in those aspects of the syllabus that interest you most, thanks to a wide range of additional material available on the Virtual Campus"*



## Module 1. Compressible Fluids

- 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 problem
  - 1.3.1. The Riemann 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 Riemann problem
  - 1.5.1. Exact solution
  - 1.5.2. Conservation 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. Would you like to master 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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*Thanks to the most efficient teaching methodology, TECH Technological University Relearning, you will be able to acquire new knowledge in a precise way and in only 150 hours"*



# 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.

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*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 has been the most widely used learning system among the world's leading Information Technology schools for as long as they have existed. 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 course, students 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 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.

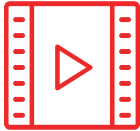
*Relearning will allow you to learn with less effort and better performance, involving you more in your training, developing a critical mindset, defending arguments, and contrasting opinions: a direct equation for success.*

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.



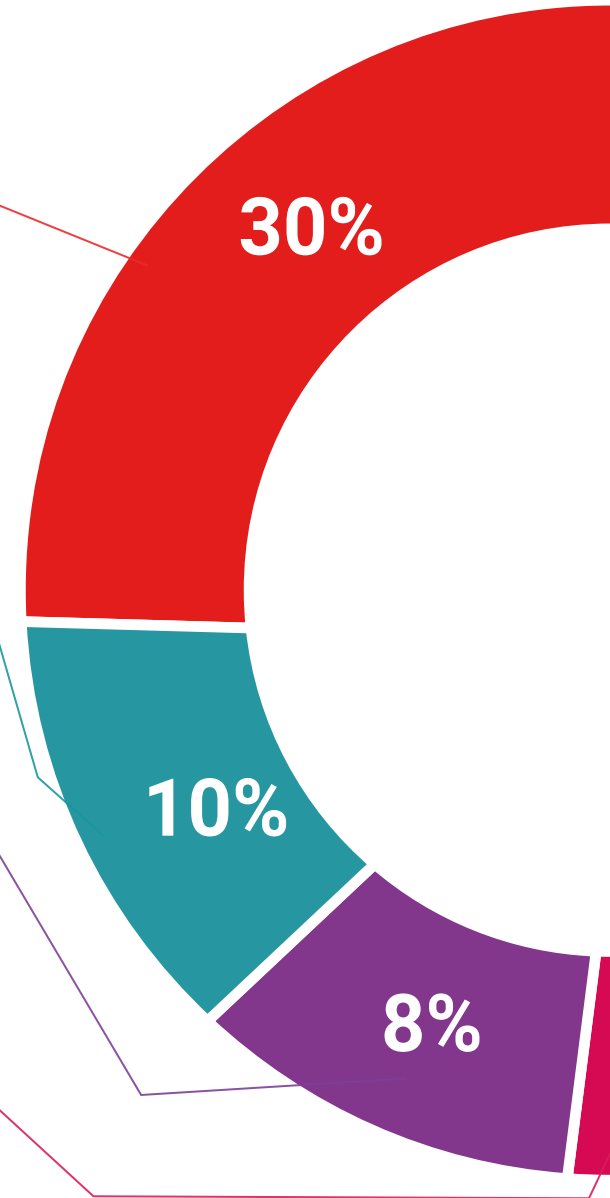
### Practising Skills and Abilities

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.

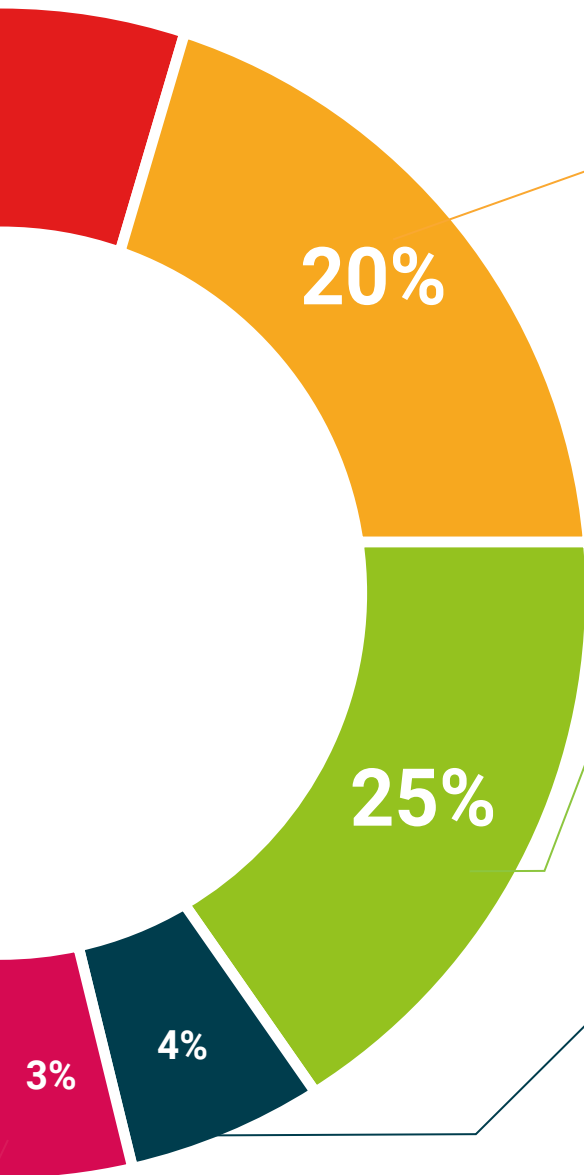


### Additional Reading

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



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



This **Postgraduate Certificate Course in Compressible Fluids Simulation** 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 professionals from career evaluation committees.

Title: **Postgraduate Certificate in Course in Compressible Fluids Simulation**

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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- » Schedule: **at your own pace**
- » Exams: **online**

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