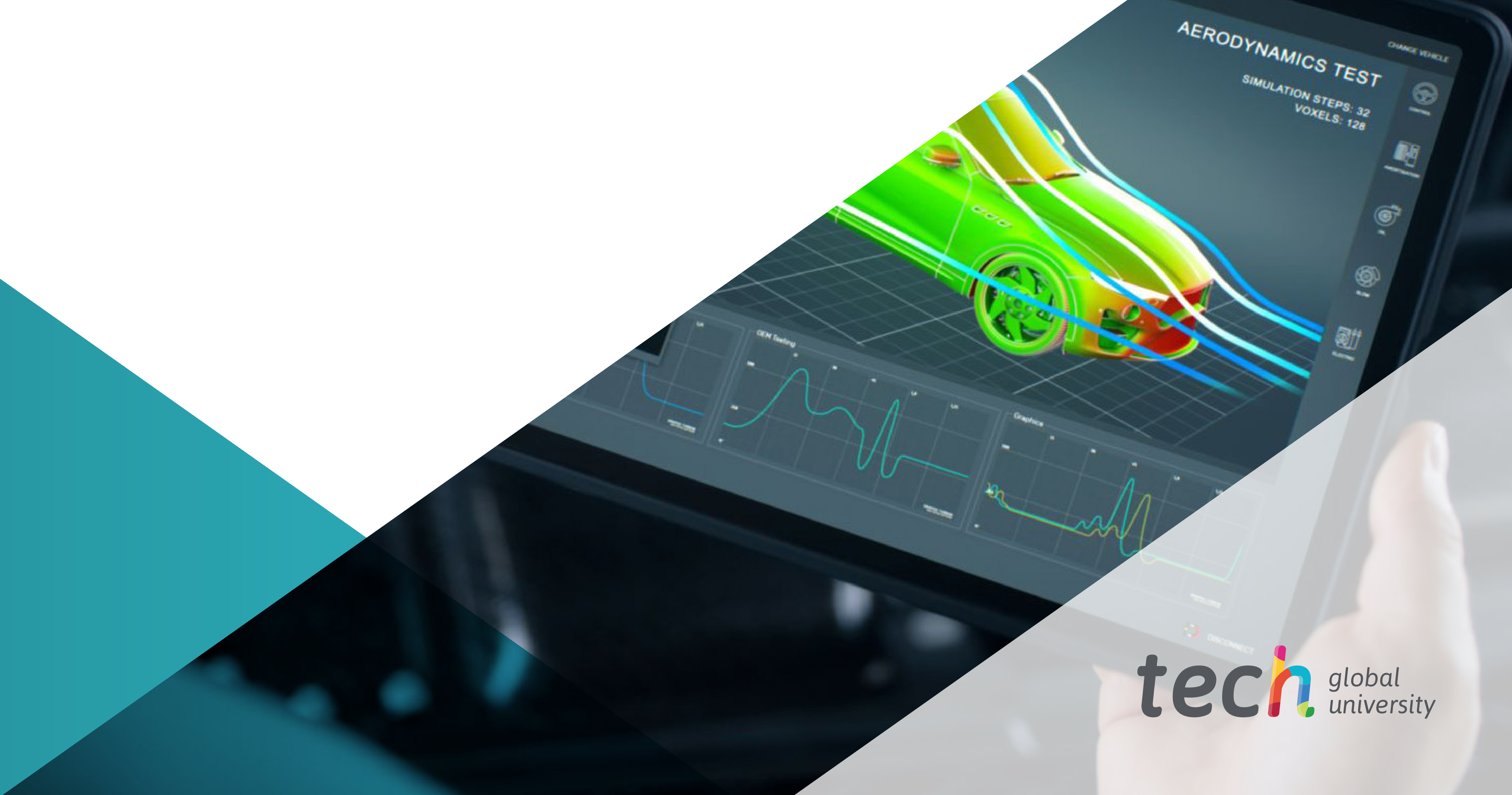
Hybrid Master's Degree
Computational Fluid Dynamics



tech global university

tech global university

Hybrid Master's Degree
Computational Fluid Dynamics

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

Index

01

Introduction to the Program

Computational Fluid Dynamics (CFD) has become an essential tool for simulating fluid transport and dynamic phenomena. Its increasing use in areas such as multiphase flow modeling, aerodynamics, and heat transfer has created new opportunities for Information Technology professionals involved in simulation and modeling technologies. As a result, experts need to acquire advanced skills to master advanced numerical methods and manage highly complex simulations in parallel computing architectures. With this in mind, TECH has developed an innovative university degree focused on the most modern strategies in Computational Fluid Dynamics.

With this Hybrid Master's Degree, you will master the use of parallel computing systems to efficiently run large-scale simulations"

In recent years, the integration of Machine Learning algorithms into Computational Fluid Dynamics has shown a reduction of up to 90% in simulation times for certain flow pattern prediction problems. This synergy between Computational Fluid Dynamics and Artificial Intelligence requires in-depth knowledge of numerical methods for flow resolution, the processing of large volumes of data, and techniques for training and validating predictive models.

In this context, TECH has created a pioneering Hybrid Master's Degree in Computational Fluid Dynamics. Designed by renowned specialists in this sector, the educational program will delve into the most modern finite volume techniques. The syllabus will also cover advanced methods such as coefficient matrix assembly and fluid field mapping based on particle values. In addition, the teaching materials will explore the use of specialized post-processing software. As a result, graduates will be fully equipped to develop high-fidelity simulations, accurately interpret complex results, and apply CFD solutions in demanding industrial contexts.

The teaching methodology of this university program is based on Relearning, which promotes active learning by allowing students to learn at their own pace and according to their study needs. In addition, they will enjoy the flexibility offered by the 100% online delivery mode, which allows them to balance their personal and professional responsibilities with their studies. Furthermore, graduates will enjoy a 3-week Internship Program at a renowned institution specializing in Computational Fluid Dynamics.

This **Hybrid Master's Degree in Computational Fluid Dynamics** contains the most complete and up-to-date program on the market. The most important features include:

- Development of more than 100 practical cases presented by professionals in Computational Fluid Dynamics
- Its graphic, schematic and practical contents provide essential information on those disciplines that are indispensable for professional practice
- All of this will be complemented by theoretical lessons, questions to the expert, debate forums on controversial topics, and individual reflection assignments
- Content that is accessible from any fixed or portable device with an Internet connection
- Furthermore, you will be able to carry out an internship in one of the best companies

You will adjust the meshes to the specific requirements of flow phenomena”

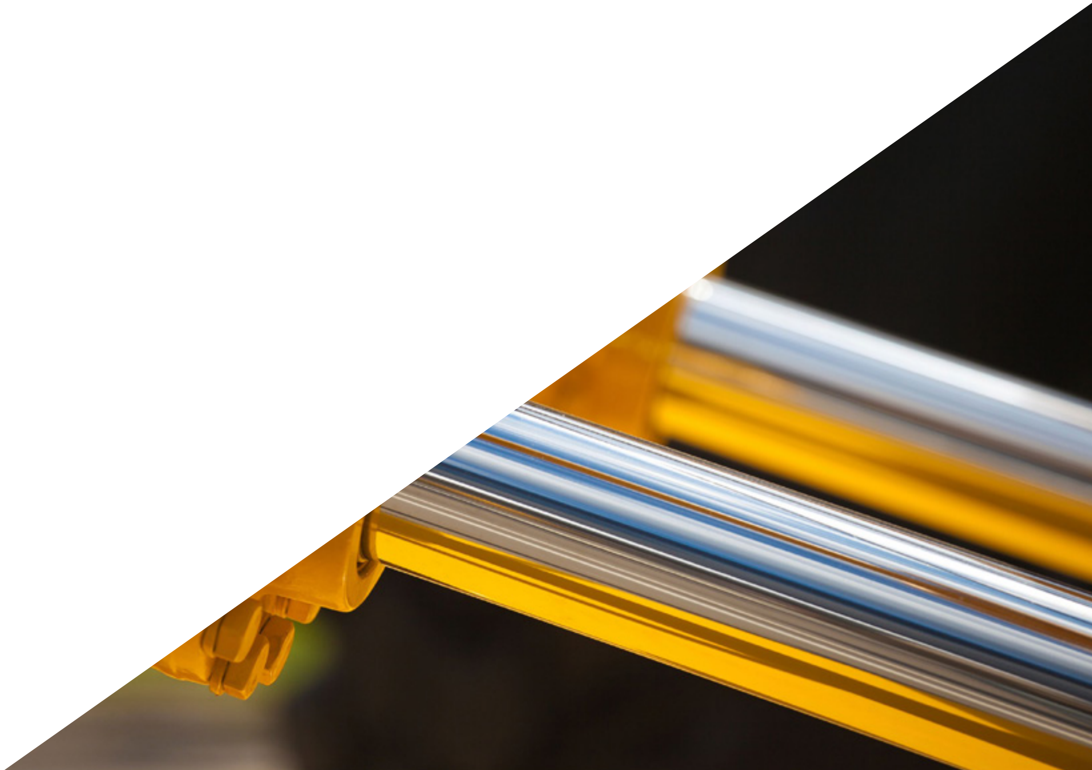
You will have comprehensive knowledge of turbulence modeling, multiphase flows, and heat transfer in the context of Computational Fluid Dynamics"

You will automate simulation processes, optimizing workflow from configuration to post-processing.

You will be able to integrate emerging technological tools such as Machine Learning in the field of Fluid Simulation.

This Hybrid Master's Degree is designed for the advanced training and upskilling of IT professionals seeking a high level of specialization. The content is based on the latest scientific evidence and is taught in a way that integrates theoretical knowledge with practical IT skills, while the theoretical and practical elements facilitate the updating of knowledge.

Thanks to its multimedia content elaborated with the latest educational technology, it will allow the IT professional a situated and contextual learning, that is to say, a simulated environment that will provide an immersive learning programmed to train in real situations. The design of this program is based on Problem-Based Learning, by means of which the student must try to solve the different professional practice situations that arise during the program. For this purpose, students will be assisted by an innovative interactive video system created by renowned experts.



02
Why Study at TECH?

TECH is the world's largest online university. With an impressive catalog of more than 14,000 university programs, available in 11 languages, it is positioned as a leader in employability, with a 99% job placement rate. In addition, it has a huge faculty of more than 6,000 professors of the highest international prestige.

Study at the largest online university in the world and ensure your professional success. The future begins at TECH"

The world's best online university, according to FORBES

The prestigious Forbes magazine, specialized in business and finance, has highlighted TECH as "the best online university in the world" This is what they have recently stated in an article in their digital edition in which they echo the success story of this institution, "thanks to the academic offer it provides, the selection of its teaching staff, and an innovative learning method oriented to form the professionals of the future".

The best top international faculty

TECH's faculty is made up of more than 6,000 professors of the highest international prestige. Professors, researchers and top executives of multinational companies, including Isaiah Covington, performance coach of the Boston Celtics; Magda Romanska, principal investigator at Harvard MetaLAB; Ignacio Wistumba, chairman of the department of translational molecular pathology at MD Anderson Cancer Center; and D.W. Pine, creative director of TIME magazine, among others.

The world's largest online university

TECH is the world's largest online university. We are the largest educational institution, with the best and widest digital educational catalog, one hundred percent online and covering most areas of knowledge. We offer the largest selection of our own degrees and accredited online undergraduate and postgraduate degrees. In total, more than 14,000 university programs, in ten different languages, making us the largest educational institution in the world.

The most complete syllabuses on the university scene

TECH offers the most complete syllabuses on the university scene, with programs that cover fundamental concepts and, at the same time, the main scientific advances in their specific scientific areas. In addition, these programs are continuously updated to guarantee students the academic vanguard and the most demanded professional skills. and the most in-demand professional competencies. In this way, the university's qualifications provide its graduates with a significant advantage to propel their careers to success.

A unique learning method

TECH is the first university to use Relearning in all its programs. This is the best online learning methodology, accredited with international teaching quality certifications, provided by prestigious educational agencies. In addition, this innovative academic model is complemented by the "Case Method", thereby configuring a unique online teaching strategy. Innovative teaching resources are also implemented, including detailed videos, infographics and interactive summaries.

The official online university of the NBA

TECH is the official online university of the NBA. Thanks to our agreement with the biggest league in basketball, we offer our students exclusive university programs, as well as a wide variety of educational resources focused on the business of the league and other areas of the sports industry. Each program is made up of a uniquely designed syllabus and features exceptional guest hosts: professionals with a distinguished sports background who will offer their expertise on the most relevant topics.

Leaders in employability

TECH has become the leading university in employability. Ninety-nine percent of its students obtain jobs in the academic field they have studied within one year of completing any of the university's programs. A similar number achieve immediate career enhancement. All this thanks to a study methodology that bases its effectiveness on the acquisition of practical skills, which are absolutely necessary for professional development.

Google Partner
PREMIER 2025

The Official Online University of the NBA

4.9/5
global score

99%
maximun employability guaranteed

Google Premier Partner

The American technology giant has awarded TECH the Google Premier Partner badge. This award, which is only available to 3% of the world's companies, highlights the efficient, flexible and tailored experience that this university provides to students. The recognition not only accredits the maximum rigor, performance and investment in TECH's digital infrastructures, but also places this university as one of the world's leading technology companies.

The top-rated university by its students

Students have positioned TECH as the world's top-rated university on the main review websites, with a highest rating of 4.9 out of 5, obtained from more than 1,000 reviews. These results consolidate TECH as the benchmark university institution at an international level, reflecting the excellence and positive impact of its educational model.

03
Syllabus

The teaching materials that make up this university degree have been designed by leading experts in Computational Fluid Dynamics. The syllabus will delve into topics ranging from the use of specialized software in parallel architectures and algebraic problem-solving methods to turbulence modeling. Graduates will therefore acquire advanced skills in implementing high-precision simulations, analyzing complex flows in turbulent regimes, and validating results with experimental data.

You will delve into the fundamental principles of Fluid Mechanics and its mathematical formulation for Computational treatment"

Module 1. Fluid Mechanics and High-Performance Computing

1.1. Computational Fluid Dynamics
 1.1.1. The Origin of the Turbulence
 1.1.2. The Need for Modeling
 1.1.3. CFD Work Process
1.2. The Equations of Fluid Mechanics
 1.2.1. The Continuity Equation
 1.2.2. The Navier-Stokes Equation
 1.2.3. The Energy Equation
 1.2.4. The Reynolds Averaged Equations
1.3. The Problem of Closing Equations
 1.3.1. The Bousinesq Hypothesis
 1.3.2. Turbulent Viscosity in a Spray
 1.3.3. CFD Modeling
1.4. Dimensionless Numbers and Dynamic Similarity
 1.4.1. Dimensionless Numbers in Fluid Mechanics
 1.4.2. The Principle of Dynamic Similarity
 1.4.3. Practical Example: Wind Tunnel Modeling
1.5. Turbulence Modeling
 1.5.1. Direct Numerical Simulations
 1.5.2. Large Eddy Simulation
 1.5.3. RANS Methods
 1.5.4. Other Methods
1.6. Experimental Techniques
 1.6.1. PIV
 1.6.2. Hot Wire
 1.6.3. Wind and Water Tunnels
1.7. Supercomputing Environments
 1.7.1. Supercomputing. Ide Future
 1.7.2. Supercomputer Operation
 1.7.3. Tools for Use
1.8. Software in Parallel Architectures
 1.8.1. Distributed Environments: MPI (Message Passing Interface)
 1.8.2. Shared Memory: GPU
 1.8.3. Data Engraving: HDF5
1.9. *Grid Computing*
 1.9.1. Description of Computer Farms
 1.9.2. Parametric Problems
 1.9.3. Queuing Systems in Grid Computing
1.10. GPU, the Future of CFD
 1.10.1. GPU Environments
 1.10.2. GPU Programming
 1.10.3. Practical Example: Artificial Intelligence in Fluids using GPUs

Module 2. Advanced Mathematics for CFD

2.1. Fundamentals of Mathematics
 2.1.1. Gradients, Divergences and Rotations. Total Derivative
 2.1.2. Ordinary Differential Equations
 2.1.3. Partial Derivative Equations
2.2. Statistics
 2.2.1. Averages and Moments
 2.2.2. Probability Density Functions
 2.2.3. Correlation and Energy Spectra
2.3. Strong and Weak Solutions of a Differential Equation
 2.3.1. Function Bases. Strong and Weak Solutions
 2.3.2. The Finite Volume Method. The Heat Equation
 2.3.3. The finite volume method. Navier-Stokes
2.4. Taylor's Theorem and Discretization in Time and Space
 2.4.1. Finite Differences in 1 Dimension. Error Order
 2.4.2. Finite Differences in 2 Dimensions
 2.4.3. From Continuous Equations to Algebraic Equations
2.5. Algebraic Problem Solving, LU method
 2.5.1. Algebraic Problem Solving Methods
 2.5.2. The LU Method on Full Matrices
 2.5.3. The LU Method in Sparse Matrices

2.6. Algebraic Problem Solving, Iterative Methods I
- 2.6.1. Iterative methods. Waste
- 2.6.2. Jacobi's Method
- 2.6.3. Generalization of Jacobi's Method

2.7. Algebraic Problem Solving, Iterative Methods II
- 2.7.1. Multi-grid Methods: V-cycle: Interpolation
- 2.7.2. Multi-grid Methods: V-cycle: Extrapolation
- 2.7.3. Multi-grid Methods: W-cycle
- 2.7.4. Error Estimation

2.8. Eigenvalues and Eigenvectors
- 2.8.1. The Algebraic Problem
- 2.8.2. Application to the Heat Equation
- 2.8.3. Stability of Differential Equations

2.9. Non-linear Evolution Equations
- 2.9.1. Heat Equation: Explicit Methods
- 2.9.2. Heat Equation: Implicit Methods
- 2.9.3. Heat Equation: Runge-Kutta Methods

2.10. Stationary Non-linear Equations
- 2.10.1. The Newton-Raphson Method
- 2.10.2. 1D Applications
- 2.10.3. 2D Applications

Module 3. CFD in Research and Modeling Environments

3.1. Research in Computational Fluid Dynamics (CFD)
- 3.1.1. Challenges in Turbulence
- 3.1.2. Advances in RANS
- 3.1.3. Artificial Intelligence

3.2. Finite Differences
- 3.2.1. Presentation and Application to a 1D Problem. Taylor's Theorem
- 3.2.2. 2D Applications
- 3.2.3. Boundary Conditions

3.3. Compact Finite Differences
- 3.3.1. Objective. SK Lele's Article
- 3.3.2. Obtaining Coefficients
- 3.3.3. Application to a 1D Problem

3.4. The Fourier Transform
- 3.4.1. The Fourier Transform. From Fourier to the Present Day
- 3.4.2. The FFTW Package
- 3.4.3. Cosine Transform: Tchebycheff

3.5. Spectral Methods
- 3.5.1. Application to a Fluid Problem
- 3.5.2. Pseudo-spectral Methods: Fourier + CFD
- 3.5.3. Placement Methods

3.6. Advanced Time Discretization Methods
- 3.6.1. The Adams-Bamsford Method
- 3.6.2. The Crack-Nicholson Method
- 3.6.3. Runge-Kutta

3.7. Structures in Turbulence
- 3.7.1. The Vortex
- 3.7.2. The Life Cycle of a Turbulent Structure
- 3.7.3. Visualization Techniques

3.8. The Characteristics Method
- 3.8.1. Compressible Fluids
- 3.8.2. Application: A Breaking Wave
- 3.8.3. Application: Burguers Equation

3.9. CFD and Supercomputing
- 3.9.1. The Memory Problem and the Evolution of Computers
- 3.9.2. Parallelization Techniques
- 3.9.3. Domain Decomposition

3.10. Open Problems in Turbulence
- 3.10.1. Modeling and the Von-Karma Constant
- 3.10.2. Aerodynamics: Boundary Layers
- 3.10.3. Noise in CFD Problems

Module 4. CFD in Application Environments: Finite Volume Methods

4.1. Finite Volume Methods
- 4.1.1. Definitions in FVM
- 4.1.2. Historical Background
- 4.1.3. FVM in Structures

4.2. Source Terms
- 4.2.1. External Volumetric Forces
  - 4.2.1.1. Gravity, Centrifugal Force
- 4.2.2. Volumetric (Mass) and Pressure Source Term (Evaporation, Cavitation, Chemical)
- 4.2.3. Scalar Source Term
  - 4.2.3.1. Temperature, Species

4.3. Applications of Boundary Conditions
- 4.3.1. Inputs and Outputs
- 4.3.2. Symmetry Condition
- 4.3.3. Wall Condition
  - 4.3.3.1. Tax Values
  - 4.3.3.2. Values to be Solved by Parallel Calculation
  - 4.3.3.3. Wall Models

4.4. Boundary Conditions
- 4.4.1. Known Boundary Conditions: Dirichlet
  - 4.4.1.1. Scalars
  - 4.4.1.2. Vector
- 4.4.2. Boundary Conditions with Known Derivative: Neumann
  - 4.4.2.1. Zero Gradient
  - 4.4.2.2. Finite Gradient
- 4.4.3. Cyclic Boundary Conditions: Born-von Karman
- 4.4.4. Other Boundary Conditions: Robin

4.5. Temporary Integration
- 4.5.1. Explicit and Implicit Euler
- 4.5.2. Lax-Wendroff Time Step and Variants (Richtmyer and MacCormack)
- 4.5.3. Runge-Kutta Multi-Stage Time Step

4.6. Upwind Schematics
- 4.6.1. Riemman's Problem
- 4.6.2. Main Upwind Schemes: MUSCL, Van Leer, Roe, AUSM
- 4.6.3. Design of an Upwind Spatial Scheme

4.7. High-Order Schemes
- 4.7.1. High-Order Discontinuous Galerkin
- 4.7.2. ENO and WENO
- 4.7.3. High-Order Schemes. Advantages and Disadvantages

4.8. Pressure-Velocity Convergence Loop
- 4.8.1. PISO
- 4.8.2. SIMPLE, SIMPLER and SIMPLEC
- 4.8.3. PIMPLE
- 4.8.4. Transient Loops

4.9. Moving Contours
- 4.9.1. Overlocking Techniques
- 4.9.2. Mapping: Mobile Reference System
- 4.9.3. *Immersed Boundary Method*
- 4.9.4. Overlapping Meshes

4.10. Errors and Uncertainties in CFD Modeling
- 4.10.1. Precision and Accuracy
- 4.10.2. Numerical Errors
- 4.10.3. Input and Physical Model Uncertainties

Module 5. Advanced Methods for CFD

5.1. Finite Element Method (FEM)
- 5.1.1. Domain Discretization. Finite Elements
- 5.1.2. Form Functions. Reconstruction of the Continuous Field
- 5.1.3. Assembly of the Coefficient Matrix and Boundary Conditions
- 5.1.4. Solving Systems of Equations

5.2. FEM: Case Studies Development of a FEM Simulator
- 5.2.1. Form Functions
- 5.2.2. Assembling the Coefficient Matrix and Applying Boundary Conditions
- 5.2.3. Solving Systems of Equations
- 5.2.4. Post-Process

5.3. Smoothed Particle Hydrodynamics (SPH)
- 5.3.1. Fluid Field Mapping from Particle Values
- 5.3.2. Evaluation of Derivatives and Particle Interaction
- 5.3.3. The Smoothing Function. The Kernel
- 5.3.4. Boundary Conditions

5.4. SPH: Development of a Simulator Based on SPH
- 5.4.1. The kernel
- 5.4.2. Storage and Sorting of Particles in Voxels
- 5.4.3. Development of Boundary Conditions
- 5.4.4. Post-Process

5.5. Direct Simulation Monte Carlo (DSMC)
- 5.5.1. Kinetic-Molecular Theory
- 5.5.2. Statistical Mechanics
- 5.5.3. Molecular Equilibrium

5.6. DSMC: Study Methodology
- 5.6.1. Applicability of the DSMC Method
- 5.6.2. Modeling
- 5.6.3. Considerations for the Applicability of the Method

5.7. DSMC: Applications
- 5.7.1. Example in 0-D: Thermal Relaxation
- 5.7.2. Example in 1-D: Normal Shock Wave
- 5.7.3. Example in 2-D: Supersonic Cylinder
- 5.7.4. Example in 3-D: Supersonic Corner
- 5.7.5. Complex Example: *Space Shuttle*

5.8. Lattice-Boltzmann Method (LBM)
- 5.8.1. Boltzmann Equation and Equilibrium Distribution
- 5.8.2. From Boltzmann to Navier-Stokes. Chapman-Enskog Expansion
- 5.8.3. From Probabilistic Distribution to Physical Magnitude
- 5.8.4. Conversion of Units. From Physical Quantities to Lattice Quantities

5.9. LBM: Numerical Approximation
- 5.9.1. The LBM Algorithm. Transfer Step and Collision Step
- 5.9.2. Collision Operators and Momentum Normalization
- 5.9.3. Boundary Conditions

5.10. LBM: Case Study
- 5.10.1. Development of a Simulator Based on LBM
- 5.10.2. Experimentation with Various Collision Operators
- 5.10.3. Experimentation with Various Turbulence Models

Module 6. Turbulence Modeling in Fluids

6.1. Turbulence. Key Features
- 6.1.1. Dissipation and Diffusivity
- 6.1.2. Characteristic Scales. Orders of Magnitude
- 6.1.3. Reynolds Numbers

6.2. Definitions of Turbulence. From Reynolds to the Present Day
- 6.2.1. The Reynolds Problem. The Boundary Layer
- 6.2.2. Meteorology, Richardson and Smagorinsky
- 6.2.3. The Problem of Chaos

6.3. The Energy Cascade
- 6.3.1. Smaller Scales of Turbulence
- 6.3.2. Kolmogorov's Hypothesis
- 6.3.3. The Cascade Exponent

6.4. The Closure Problem Revisited
- 6.4.1. 10 Unknowns and 4 Equations
- 6.4.2. The Turbulent Kinetic Energy Equation
- 6.4.3. The Turbulence Cycle

6.5. Turbulent Viscosity
- 6.5.1. Historical Background and Parallels
- 6.5.2. Initiation Problem: Jets
- 6.5.3. Turbulent Viscosity in CFD Problems

6.6. RANS Methods
- 6.6.1. The Turbulent Viscosity Hypothesis
- 6.6.2. The RANS Equations
- 6.6.3. RANS Methods. Examples of Use

6.7. The Evolution of LES
- 6.7.1. Historical Background
- 6.7.2. Spectral Filters
- 6.7.3. Spatial Filters. The Problem in the Wall

6.8. Wall Turbulence I
 6.8.1. Characteristic Scales
 6.8.2. The Momentum Equations
 6.8.3. The Regions of a Turbulent Wall Flow
6.9. Wall Turbulence II
 6.9.1. Boundary Layers
 6.9.2. Dimensionless Numbers of a Boundary Layer
 6.9.3. The Blasius Solution
6.10. The Energy Equation
 6.10.1. Passive Scalars
 6.10.2. Active Scalars. The Bousinesq Approach
 6.10.3. Fanno and Rayleigh Flows

Module 7. Compressible Fluids

7.1. Compressible Fluids
 7.1.1. Compressible and Incompressible Fluids. Differences
 7.1.2. Equation of State
 7.1.3. Differential Equations of Compressible Fluids
7.2. Practical Examples of the Compressible Regime
 7.2.1. Shock Waves
 7.2.2. Prandtl-Meyer Expansion
 7.2.3. Nozzles
7.3. Riemann's Problem
 7.3.1. Riemann's Problem
 7.3.2. Solution of the Riemann Problem by Characteristics
 7.3.3. Non-linear Systems: Shock Waves Rankine-Hugoniot Condition
 7.3.4. Non-linear Systems: Waves and Expansion Fans. Entropy Condition
 7.3.5. Riemannian Invariants
7.4. Euler Equations
 7.4.1. Invariants of the Euler Equations
 7.4.2. Conservative vs. Primitive Variables
 7.4.3. Solution Strategies
7.5. Solutions to the Riemann Problem
 7.5.1. Exact Solution
 7.5.2. Conservative Numerical Methods
 7.5.3. Godunov's Method
 7.5.4. Flux Vector Splitting
7.6. Approximate Riemann Solvers
 7.6.1. HLLC
 7.6.2. Roe
 7.6.3. AUSM
7.7. Higher Order Methods
 7.7.1. Problems of Higher Order Methods
 7.7.2. Limiters and TVD Methods
 7.7.3. Practical Examples
7.8. Additional Aspects of the Riemann Problem
 7.8.1. Non-Homogeneous Equations
 7.8.2. Splitting Dimensional
 7.8.3. Applications to the Navier-Stokes Equations
7.9. Regions with High Gradients and Discontinuities
 7.9.1. Importance of Meshing
 7.9.2. Automatic Mesh Refinement (AMR)
 7.9.3. Shock Fitting Methods
7.10. Compressible Flow Applications
 7.10.1. Sod Problem
 7.10.2. Supersonic Wedge
 7.10.3. Convergent-Divergent Nozzle

Module 8. Multiphase Flow

8.1. Flow Regimes
- 8.1.1. Continuous Phases
- 8.1.2. Discrete Phase
- 8.1.3. Discrete Phase Populations

8.2. Continuous Phases
- 8.2.1. Properties of the Liquid-Gas Interface
- 8.2.2. Each Phase a Domain
  - 8.2.2.1. Phase Resolution Independently
- 8.2.3. Coupled Solution
  - 8.2.3.1. Fluid Fraction as a Descriptive Phase Scalar
- 8.2.4. Reconstruction of the Gas-Liquid Interface

8.3. Marine Simulation
- 8.3.1. Wave Regimes. Wave Height vs. Depth
- 8.3.2. Input Boundary Condition. Wave Simulation
- 8.3.3. Non-Reflective Output Boundary Condition. Numerical Beach
- 8.3.4. Lateral Boundary Conditions. Lateral Wind and Drift

8.4. Surface Tension
- 8.4.1. Physical Phenomenon of the Surface Tension
- 8.4.2. Modeling
- 8.4.3. Interaction with surfaces. Angle of Wetting

8.5. Phase Shift
- 8.5.1. Source and Sink Terms Associated with Phase Change
- 8.5.2. Evaporation Models
- 8.5.3. Condensation and Precipitation Models. Nucleation of Droplets
- 8.5.4. Cavitation

8.6. Discrete Phase: Particles, Droplets and Bubbles
- 8.6.1. Resistance Strength
- 8.6.2. The Buoyancy Force
- 8.6.3. Inertia
- 8.6.4. Brownian Motion and Turbulence Effects
- 8.6.5. Other Forces

8.7. Interaction with the Surrounding Fluid
- 8.7.1. Generation from Continuous Phase
- 8.7.2. Aerodynamic Drag
- 8.7.3. Interaction with Other Entities, Coalescence and Rupture
- 8.7.4. Boundary Conditions

8.8. Statistical Description of Particle Populations. Packages
- 8.8.1. Transportation of Stocks
- 8.8.2. Stock Boundary Conditions
- 8.8.3. Stock Interactions
- 8.8.4. Extending the Discrete Phase to Populations

8.9. Water Film
- 8.9.1. Water Sheet Hypothesis
- 8.9.2. Equations and Modeling
- 8.9.3. Source Term from Particles

8.10. Example of an Application with OpenFOAM
- 8.10.1. Description of an Industrial Problem
- 8.10.2. Setup and Simulation
- 8.10.3. Visualization and Interpretation of Results

Module 9. Advanced CFD Models

9.1. Multiphysics
- 9.1.1. Multiphysics Simulations
- 9.1.2. System Types
- 9.1.3. Application Examples

9.2. Unidirectional Cosimulation
- 9.2.1. Unidirectional Cosimulation. Advanced Aspects
- 9.2.2. Information Exchange Schemes
- 9.2.3. Applications

9.3. Bidirectional Cosimulation
- 9.3.1. Bidirectional Cosimulation. Advanced Aspects
- 9.3.2. Information Exchange Schemes
- 9.3.3. Applications

9.4. Convection Heat Transfer
- 9.4.1. Heat Transfer by Convection. Advanced Aspects
- 9.4.2. Convective Heat Transfer Equations
- 9.4.3. Methods for Solving Convection Problems

9.5. Conduction Heat Transfer
- 9.5.1. Conduction Heat Transfer. Advanced Aspects
- 9.5.2. Conductive Heat Transfer Equations
- 9.5.3. Methods of Solving Driving Problems

9.6. Radiative Heat Transfer
- 9.6.1. Radiative Heat Transfer. Advanced Aspects
- 9.6.2. Radiation Heat Transfer Equations
- 9.6.3. Radiation Troubleshooting Methods

9.7. Solid-Fluid-Heat Coupling
- 9.7.1. Solid-fluid-heat coupling
- 9.7.2. Solid-Fluid Thermal Coupling
- 9.7.3. CFD and FEM

9.8. Aeroacoustics
- 9.8.1. Computational Aeroacoustics
- 9.8.2. Acoustic Analogies
- 9.8.3. Resolution Methods

9.9. Advection-Diffusion Problems
- 9.9.1. Diffusion-Advection Problems
- 9.9.2. Scalar Fields
- 9.9.3. Particle Methods

9.10. Coupling Models with Reactive Flow
- 9.10.1. Coupling Models with Reactive Flow. Applications
- 9.10.2. System of Differential Equations. Solving the Chemical Reaction
- 9.10.3. CHEMKINs
- 9.10.4. Combustion: Flame, Spark, Wobee
- 9.10.5. Reactive Flows in a Non-Stationary Regime: Quasi-Stationary System Hypothesis
- 9.10.6. Reactive Flows in Turbulent Flows
- 9.10.7. Catalysts

Module 10. Post-Processing, Validation and Application in CFD

10.1. Post-processing in CFD I
- 10.1.1. Post-processing on Plane and Surfaces
  - 10.1.1.1. Post-processing on the Plane
  - 10.1.1.2. Post-processing on Surfaces

10.2. Post-processing in CFD II
- 10.2.1. Volumetric Post-processing
  - 10.2.1.1. Volumetric Post-processing I
  - 10.2.1.2. Volumetric Post-processing II

10.3. Free CFD Post-processing Software
- 10.3.1. Free Post-processing Software
- 10.3.2. *Paraview*
- 10.3.3. Paraview Usage Example

10.4. Convergence of Simulations
- 10.4.1. Convergence
- 10.4.2. Mesh Convergence
- 10.4.3. Numerical Convergence

10.5. Classification of Methods
- 10.5.1. Applications
- 10.5.2. Types of Fluid
- 10.5.3. Scales
- 10.5.4. Calculation Machines

10.6. Model Validation
- 10.6.1. Need for Validation
- 10.6.2. Simulation vs Experiment
- 10.6.3. Validation Examples

10.7. Simulation Methods. Advantages and Disadvantages
- 10.7.1. RANS
- 10.7.2. LES, DES, DNS
- 10.7.3. Other Methods
- 10.7.4. Advantages and Disadvantages

10.8. Examples of Methods and Applications
- 10.8.1. Case of a Body Subjected to Aerodynamic Forces
- 10.8.2. Thermal Case
- 10.8.3. Multiphase Case

10.9. Good Simulation Practices
- 10.9.1. Importance of Good Practices
- 10.9.2. Good Practices
- 10.9.3. Simulation errors

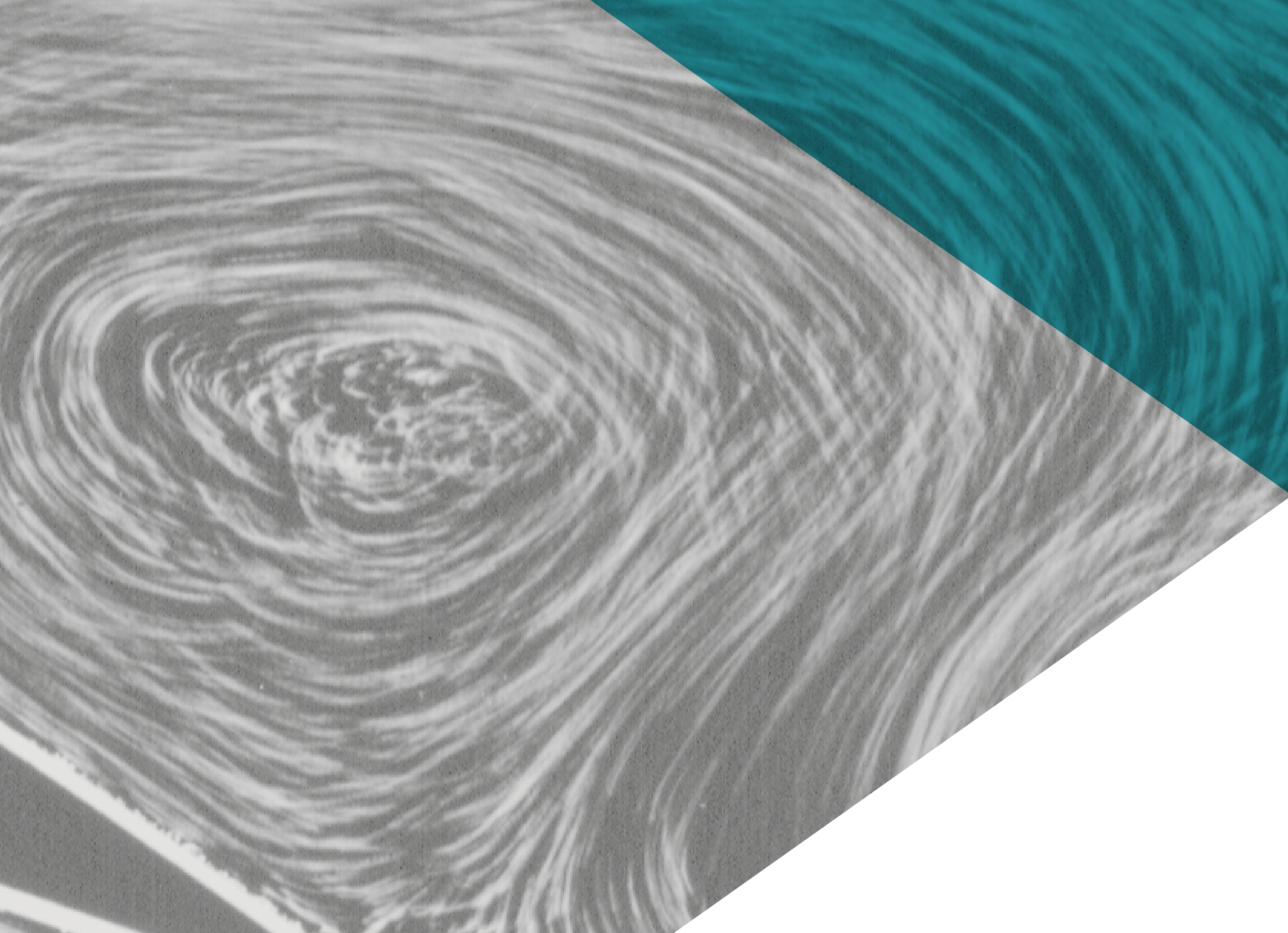
10.10. Free and Commercial Software
- 10.10.1. FVM Software
- 10.10.2. Software for Other Methods
- 10.10.3. Advantages and Disadvantages
- 10.10.4. CFD Simulation Futures

The interactive summaries for each module will allow you to consolidate your understanding of the application of the finite volume method in a more dynamic way"

04

Teaching Objectives

The design of this Hybrid Master's Degree will enable students to acquire the necessary skills to specialize in fluid modeling and simulation, delving into the key aspects of Computational dynamics. In turn, the knowledge imparted in each module will give professionals a global perspective, fully equipping them to tackle challenges in industrial and technological sectors. As a result, graduates will experience a significant leap in quality in their careers as computer scientists and will gain access to more strategic roles.



You will manage the numerical methods used in solving Fluid equations, including finite volumes"

General Objective

- The overall objective of the Hybrid Master's Degree is to enable professionals to hone their skills in Fluid simulation and modeling through intensive practical training in collaboration with leading technology centers. Through a practical Internship Program designed with academic and scientific rigor, students will work alongside specialists in real-world environments, tackling highly complex projects that will enable them to optimize processes and solve fluid dynamics challenges accurately and efficiently

Specific Objectives

Module 1. Fluid Mechanics and High-Performance Computing
- Analyze the fundamental principles of Fluid Mechanics
- Implement highly efficient computational methods for fluid simulation
- Study high-performance computing tools in CFD
- Evaluate the integration of advanced techniques to optimize computational performance

Module 2. Advanced Mathematics for CFD
- Solve differential equations in the context of fluid mechanics
- Apply advanced numerical methods for the discretization of CFD problems
- Develop mathematical techniques for stability and convergence in simulations
- Use advanced linear algebra in solving large systems of equations

Module 3. CFD in Research and Modeling Environments
- Apply CFD in the simulation of complex phenomena in research environments
- Model experimental scenarios to predict results and validate hypotheses
- Develop numerical models for specific applications in research
- Integrate CFD into interdisciplinary simulation and modeling projects

Module 4. CFD in Application Environments: Finite Volume Methods
- Implement the finite volume method in fluid simulations
- Study the practical applications of this method in different fields of engineering
- Apply method optimization techniques in high-resolution simulations
- Validate results obtained using the finite volume method

Module 5. Advanced Methods for CFD
- Apply advanced methods in solving non-linear problems in CFD
- Use high-precision discretization techniques for flow simulation
- Develop error control methods in complex simulations
- Analyze the implementation of optimization algorithms in fluid simulations

Module 6. Turbulence Modeling in Fluids
- Understand the most advanced theories and models in turbulence simulation
- Apply turbulence models in industrial flow simulations
- Study turbulence parameterization and modeling methods
- Validate turbulent simulations with experiments and real data

Module 7. Compressible Fluids
- Model the behavior of compressible fluids under various conditions
- Analyze the equations of state of compressible fluids in simulations
- Apply specific techniques for simulating flows in compression and expansion
- Evaluate the effects of compressibility in transonic and supersonic flows

Module 8. Multiphase Flow
- Develop models for simulating multiphase flows
- Study the interaction between liquid, gas, and solid phases in complex flows
- Apply modeling and simulation techniques for multiphase systems
- Analyze computational and methodological challenges in multiphase flows

Module 9. Advanced CFD Models

- Implement advanced models for reactive and heat transfer flows
- Study the interaction between flow, chemistry, and heat transfer in simulations
- Develop numerical techniques for modeling complex physical phenomena
- Apply advanced models to specific industrial applications

Module 10. Post-Processing, Validation and Application in CFD

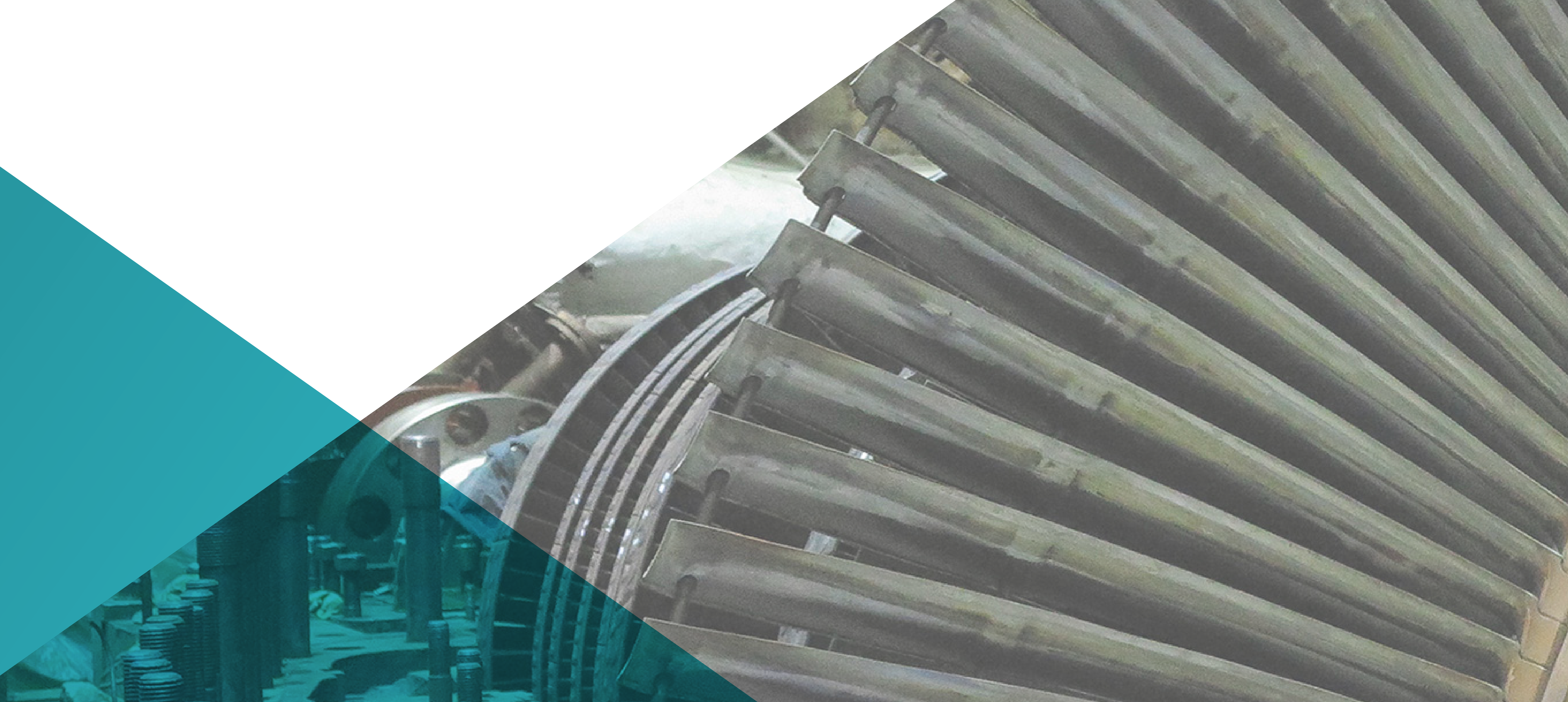
- Develop advanced techniques for post-processing CFD results
- Validate simulations by comparing them with experimental data
- Apply visualization techniques to interpret simulation results
- Evaluate the applicability of CFD results in improving industrial processes

“Take advantage of all the benefits of TECH's Relearning methodology, which allows you to set your own schedule and pace of study. Enroll now!”

05

Internship

Once the online theoretical stage has been completed, the academic program includes an Internship Program at a renowned institution specializing in Computational Fluid Dynamics. Throughout this immersive experience, graduates will have the support of a tutor who will assist them throughout the process, both in the preparation and in the development of the internship.



You will complete your Internship Program at a renowned institution specializing in Computational Fluid Dynamics"

The Internship Program in Computational Fluid Dynamics consists of a 3-week placement at a prestigious institution, from Monday to Friday with 8-hour consecutive shifts of hands-on training alongside a supervising specialist. This Internship Program will enable students to apply their knowledge in areas such as programming, modeling, and data analysis for CFD simulation development.

In addition, this training program is entirely practical, with activities aimed at developing and perfecting the skills necessary for professional performance in the field of computational fluid simulation. In line with this, this experience will enable graduates to acquire advanced skills for the implementation, analysis, and validation of CFD models in environments that require a high level of technical specialization.

This is undoubtedly a unique opportunity to learn by working in an environment of technological innovation, where advanced fluid simulation and Computational modeling are at the heart of the digital culture of its professionals.

The practical part will be carried out with the active participation of the student performing the activities and procedures of each area of competence (learning to learn and learning to do), with the support and guidance of teachers and other training colleagues who facilitate teamwork and multidisciplinary integration as cross-cutting skills for the practice of Computational Fluid Dynamics (learning to be and learning to relate).

The procedures described below will be the basis of the practical part of the Internship Program, and its realization will be subject to the center's own availability and workload, being the proposed activities the following:

Module	Practical Activity
Finite Volume Method	Develop and program custom CFD codes based on the finite volume method
	Optimize numerical solution algorithms, improving the efficiency of iterative methods such as SIMPLE, PISO, etc.
	Create advanced CFD result visualization modules using libraries such as ParaView, VTK, or matplotlib
	Integrate machine learning or model reduction techniques to accelerate CFD simulations or improve predictions
Fluid turbulence simulation	Optimize turbulence calculation algorithms, accelerating their convergence or reducing computational cost
	Program and adapt closure schemes for turbulence equations
	Develop high-fidelity simulations in supercomputing environments
	Create and validate specific wall functions for turbulent flows near solid surfaces
Multiphase flow	Implement multiphase flow models in CFD software
	Program phase interface tracking algorithms (e.g., Level Set, Front Tracking, or VOF methods)
	Develop and optimize numerical schemes that handle sudden changes in properties between phases
	Create fluid-structure interaction simulations in multiphase systems, such as moving bubbles or droplets
Results processing and quality control	Master automatic post-processing tools to extract relevant results such as pressure, velocity, and temperature
	Program CFD data analysis scripts using Python, MATLAB, or tools such as ParaView and Tecplot
	Implement feature extraction algorithms such as vortex detection or recirculation zone analysis
	Automate the generation of technical reports and graphs from simulation results

Civil Liability Insurance

The university's main concern is to guarantee the safety of the interns, other collaborating professionals involved in the internship process at the center. Among the measures dedicated to achieve this is the response to any incident that may occur during the entire teaching-learning process.

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

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

General Conditions of the Internship Program

The general terms and conditions of the internship agreement for the program are as follows:

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

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

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

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

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

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

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

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

06

Internship Centers

This Hybrid Master's Degree includes an Internship Program at a prestigious institution specializing in Computational Fluid Dynamics. This will give students the opportunity to put everything they have learned into practice in a real-world work setting. In this regard, and to make this degree more accessible to professionals, TECH offers students the opportunity to complete it at different centers, globally. In this way, this institution strengthens its commitment to quality and affordable education for all.

You will complete an Internship Program at a leading company in Computational Fluid Dynamics"

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

Computing

Meler

Country	City
Spain	Navarra

Address: Pol. Ind. Arazuri-Orcoyen, c/B, nº3 A (31170 Arazuri-Navarra)

Private company specializing in the development and optimization of adhesive bonding processes.

Related internship programs:

- Computational Fluid Dynamics

Boost your professional career with a holistic education that allows you to advance both on a theoretical and practical level"

07

Career Opportunities

This TECH university degree is an exceptional opportunity for all IT professionals who wish to specialize in the field of Computational Fluid Dynamics. Through mastery of advanced simulation, modeling, and flow analysis techniques, graduates will be able to advance their careers in strategic industries such as automotive, energy, and technology, significantly expanding their job opportunities in highly technical environments.

Are you looking to work as a Numerical Fluid Modeling Expert? Achieve it with this program in just 12 months"

Graduate Profile

Graduates of this Hybrid Master's Degree will be professionals trained to apply advanced CFD simulation techniques in industrial and research environments. At the same time, they will have the skills to design, implement, and optimize complex flow models using cutting-edge numerical methods. In addition, they will be able to validate results with experimental data, manage high-performance computing projects, and tackle challenges in multiphase and turbulent dynamics. These professionals will also be able to lead technological innovation initiatives and contribute to the development of efficient solutions in strategic sectors such as energy, automotive, and aeronautics.

You will build mathematical models to represent flow phenomena, heat transfer, and multiphase dynamics in computational environments.

- **Technological Adaptation in Industrial Environments:** Ability to integrate CFD simulation tools and advanced computational technologies into industrial processes, optimizing efficiency in the analysis and design of fluid systems
- **Fluid Dynamics Problem-Solving:** Ability to apply critical thinking and analytical skills to identify and solve complex challenges in fluid mechanics, using numerical models and high-fidelity simulations
- **Commitment to Accuracy and Scientific Validation:** Responsibility for rigorous data management, ensuring the accuracy of simulations through numerical validation techniques and experimental comparison
- **Interdisciplinary Collaboration:** Ability to work effectively with engineers, data scientists, and technical specialists, promoting the development of integrated solutions in multidisciplinary fluid simulation and modeling projects

After completing the university program, you will be able to apply your knowledge and skills in the following positions:

1. **Industrial CFD Simulation Specialist:** Responsible for designing, implementing, and analyzing fluid dynamics simulations in sectors such as automotive, energy, aerospace, and advanced manufacturing.
2. **Fluid Numerical Modeling Engineer:** Responsible for building and adapting mathematical models to represent flow phenomena, heat transfer, and multiphase dynamics in computational environments.
3. CFD Software Developer: Focuses on the design and improvement of fluid simulation tools, integrating new numerical methodologies and optimizing the performance of existing codes.
4. **Fluid Process Optimization Consultant:** Collaborate with industrial companies to improve the efficiency of thermal, hydraulic, or aerodynamic systems through advanced CFD simulations.
5. **High-Performance Computing Specialist for CFD:** Work on the execution of large-scale simulations using supercomputers or parallel architectures optimized for fluid dynamics.
6. **Fluid Dynamics Data Analyst:** Responsible for processing and extracting critical information from large volumes of data generated in CFD simulations.

You will lead comprehensive research projects that will contribute to the development of new techniques in the field of Computational Fluid Dynamics”

08

Study Methodology

TECH is the world's first university to combine the **case study** methodology with **Relearning**, a 100% online learning system based on guided repetition.

This disruptive pedagogical strategy has been conceived to offer professionals the opportunity to update their knowledge and develop their skills in an intensive and rigorous way. A learning model that places students at the center of the educational process giving them the leading role, adapting to their needs and leaving aside more conventional methodologies.

TECH will prepare you to face new challenges in uncertain environments and achieve success in your career”

The student: the priority of all TECH programs

In TECH's study methodology, the student is the main protagonist.
The teaching tools of each program have been selected taking into account the demands of time, availability and academic rigor that, today, not only students demand but also the most competitive positions in the market.

With TECH's asynchronous educational model, it is students who choose the time they dedicate to study, how they decide to establish their routines, and all this from the comfort of the electronic device of their choice. The student will not have to participate in live classes, which in many cases they will not be able to attend. The learning activities will be done when it is convenient for them. They can always decide when and from where they want to study.

At TECH you will NOT have live classes (which you might not be able to attend)"

The most comprehensive study plans at the international level

TECH is distinguished by offering the most complete academic itineraries on the university scene. This comprehensiveness is achieved through the creation of syllabi that not only cover the essential knowledge, but also the most recent innovations in each area.

By being constantly up to date, these programs allow students to keep up with market changes and acquire the skills most valued by employers. In this way, those who complete their studies at TECH receive a comprehensive education that provides them with a notable competitive advantage to further their careers.

And what's more, they will be able to do so from any device, pc, tablet or smartphone.

TECH's model is asynchronous, so it allows you to study with your pc, tablet or your smartphone wherever you want, whenever you want and for as long as you want"

Case Studies and Case Method

The case method has been the learning system most used by the world's best business schools. Developed in 1912 so that law students would not only learn the law based on theoretical content, its function was also to present them with real complex situations. In this way, they could make informed decisions and value judgments about how to resolve them. In 1924, Harvard adopted it as a standard teaching method.

With this teaching model, it is students themselves who build their professional competence through strategies such as Learning by Doing or Design Thinking, used by other renowned institutions such as Yale or Stanford.

This action-oriented method will be applied throughout the entire academic itinerary that the student undertakes with TECH. Students will be confronted with multiple real-life situations and will have to integrate knowledge, research, discuss and defend their ideas and decisions. All this with the premise of answering the question of how they would act when facing specific events of complexity in their daily work.

Relearning Methodology

At TECH, case studies are enhanced with the best 100% online teaching method: Relearning.

This method breaks with traditional teaching techniques to put the student at the center of the equation, providing the best content in different formats. In this way, it manages to review and reiterate the key concepts of each subject and learn to apply them in a real context.

In the same line, and according to multiple scientific researches, reiteration is the best way to learn. For this reason, TECH offers between 8 and 16 repetitions of each key concept within the same lesson, presented in a different way, with the objective of ensuring that the knowledge is completely consolidated during the study process.

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

A 100% online Virtual Campus with the best teaching resources

In order to apply its methodology effectively, TECH focuses on providing graduates with teaching materials in different formats: texts, interactive videos, illustrations and knowledge maps, among others. All of them are designed by qualified teachers who focus their work on combining real cases with the resolution of complex situations through simulation, the study of contexts applied to each professional career and learning based on repetition, through audios, presentations, animations, images, etc.

The latest scientific evidence in the field of Neuroscience points to the importance of taking into account the place and context where the content is accessed before starting a new learning process. Being able to adjust these variables in a personalized way helps people to remember and store knowledge in the hippocampus to retain it in the long term. This is a model called Neurocognitive context-dependent e-learning that is consciously applied in this university qualification.

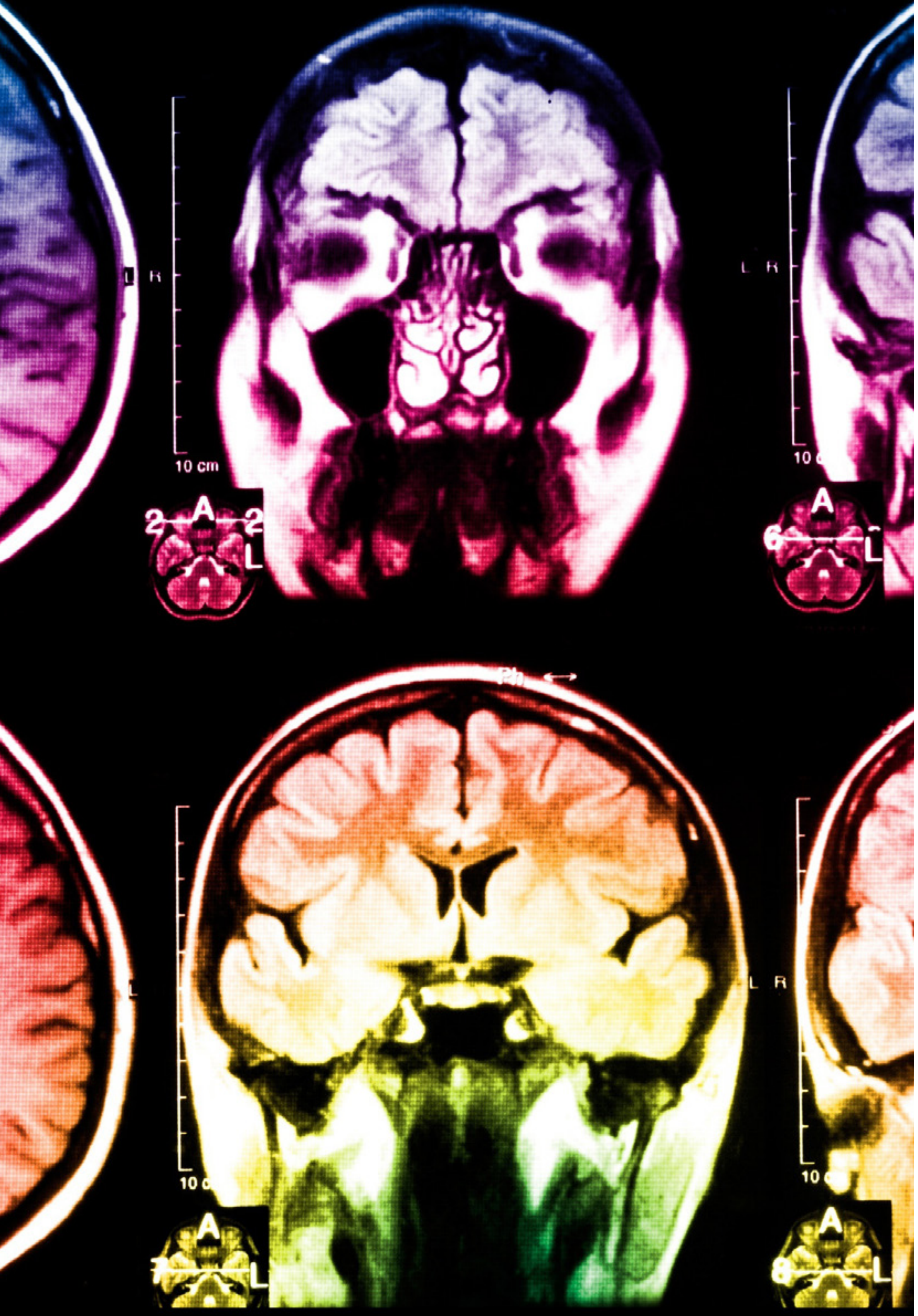
In order to facilitate tutor-student contact as much as possible, you will have a wide range of communication possibilities, both in real time and delayed (internal messaging, telephone answering service, email contact with the technical secretary, chat and videoconferences).

Likewise, this very complete Virtual Campus will allow TECH students to organize their study schedules according to their personal availability or work obligations. In this way, they will have global control of the academic content and teaching tools, based on their fast-paced professional update.

> *The online study mode of this program will allow you to organize your time and learning pace, adapting it to your schedule"*

The effectiveness of the method is justified by four fundamental achievements:

1. Students who follow this method not only achieve the assimilation of concepts, but also a development of their mental capacity, through exercises that assess real situations and the application of knowledge.
2. Learning is solidly translated into practical skills that allow the student to better integrate into the real world.
3. Ideas and concepts are understood more efficiently, given that the example situations are based on real-life.
4. Students like to feel that the effort they put into their studies is worthwhile. This then translates into a greater interest in learning and more time dedicated to working on the course.



The university methodology top-rated by its students

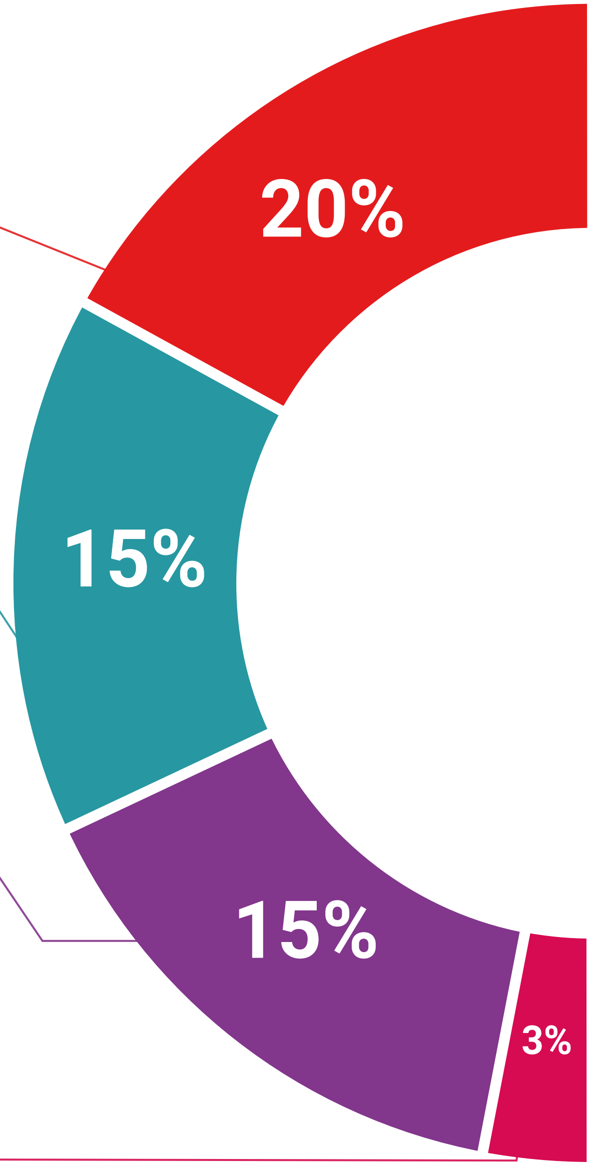
The results of this innovative teaching model can be seen in the overall satisfaction levels of TECH graduates.

The students' assessment of the teaching quality, the quality of the materials, the structure of the program and its objectives is excellent. Not surprisingly, the institution became the top-rated university by its students according to the global score index, obtaining a 4.9 out of 5.

Access the study contents from any device with an Internet connection (computer, tablet, smartphone) thanks to the fact that TECH is at the forefront of technology and teaching.

You will be able to learn with the advantages that come with having access to simulated learning environments and the learning by observation approach, that is, Learning from an expert.

As such, the best educational materials, thoroughly prepared, will be available in this program:



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.

This content is then adapted in an audiovisual format that will create our way of working online, with the latest techniques that allow us to offer you high quality in all of the material that we provide you with.

Practicing Skills and Abilities

You will carry out activities to develop specific competencies and skills in each thematic field. Exercises and activities to acquire and develop the skills and abilities that a specialist needs to develop within the framework of the globalization we live in.

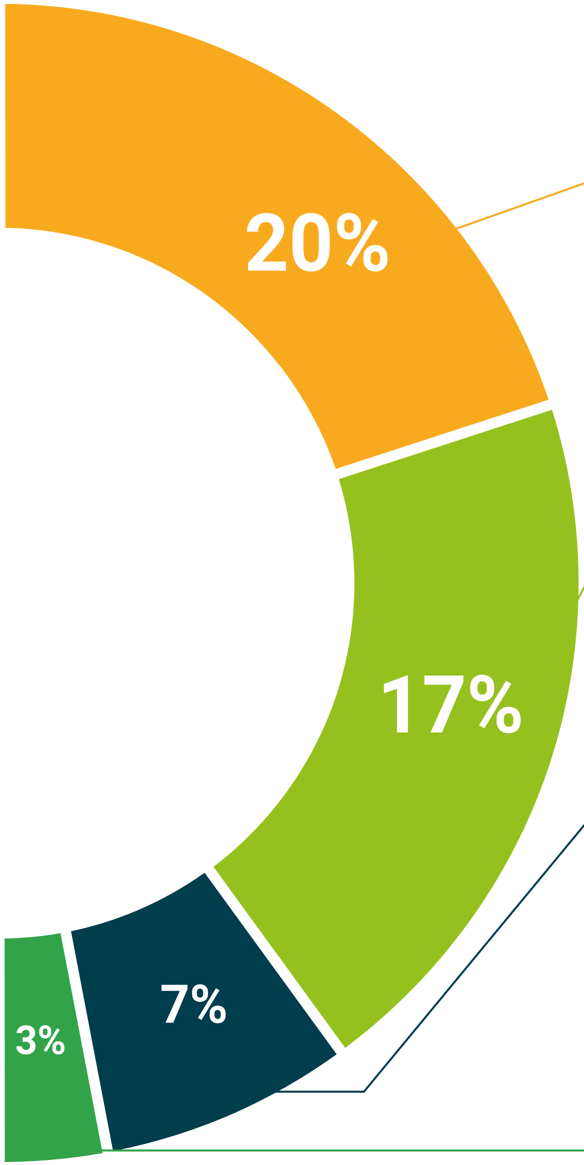
Interactive Summaries

We present 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".

Additional Reading

Recent articles, consensus documents, international guides... In our virtual library you will have access to everything you need to complete your education.



Case Studies

Students will complete a selection of the best case studies in the field. Cases that are presented, analyzed, and supervised by the best specialists in the world.

Testing & Retesting

We periodically assess and re-assess your knowledge throughout the program. We do this on 3 of the 4 levels of Miller's Pyramid.

Classes

There is scientific evidence suggesting that observing third-party experts can be useful.

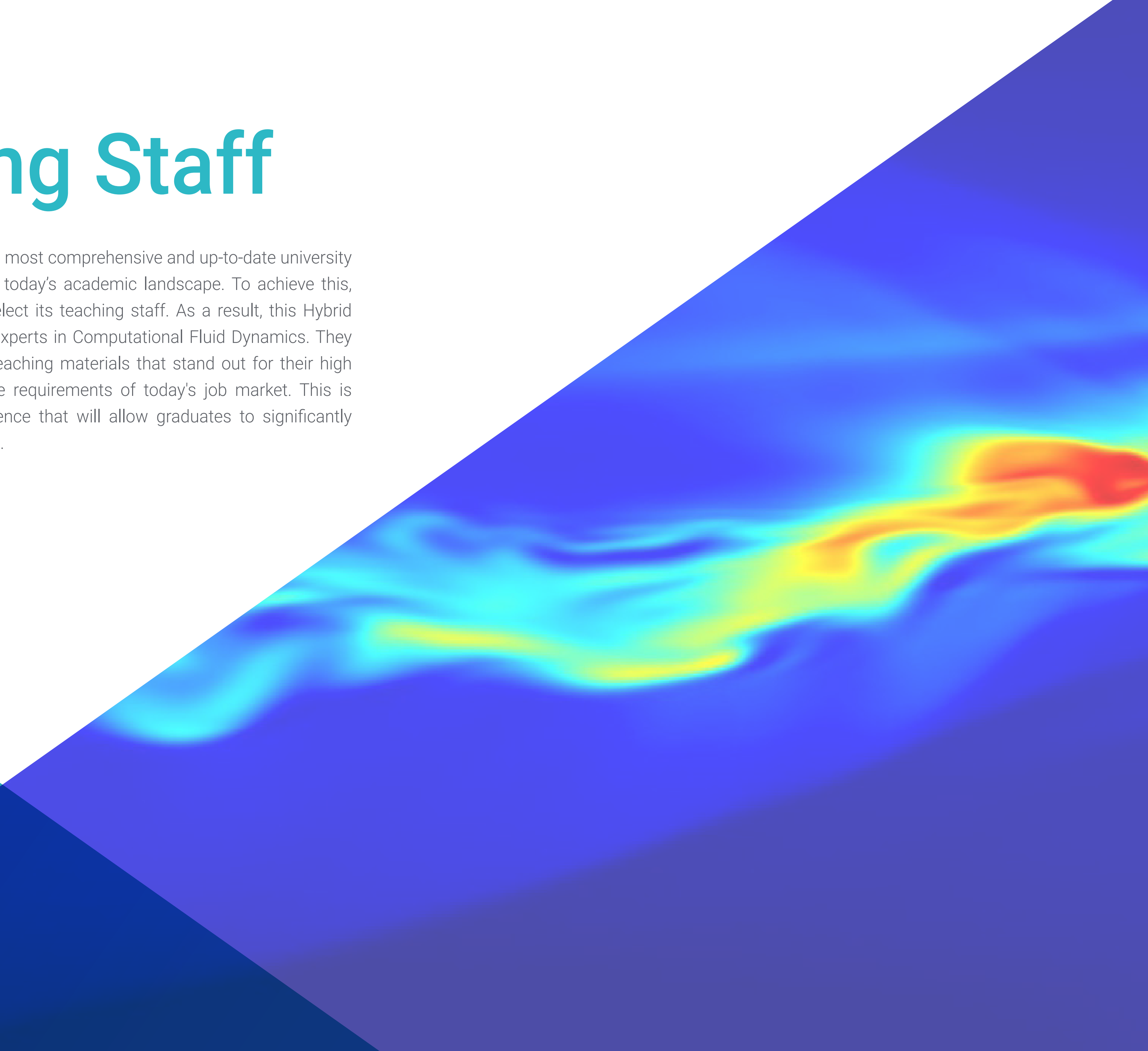
Learning from an expert strengthens knowledge and memory, and generates confidence for future difficult decisions.

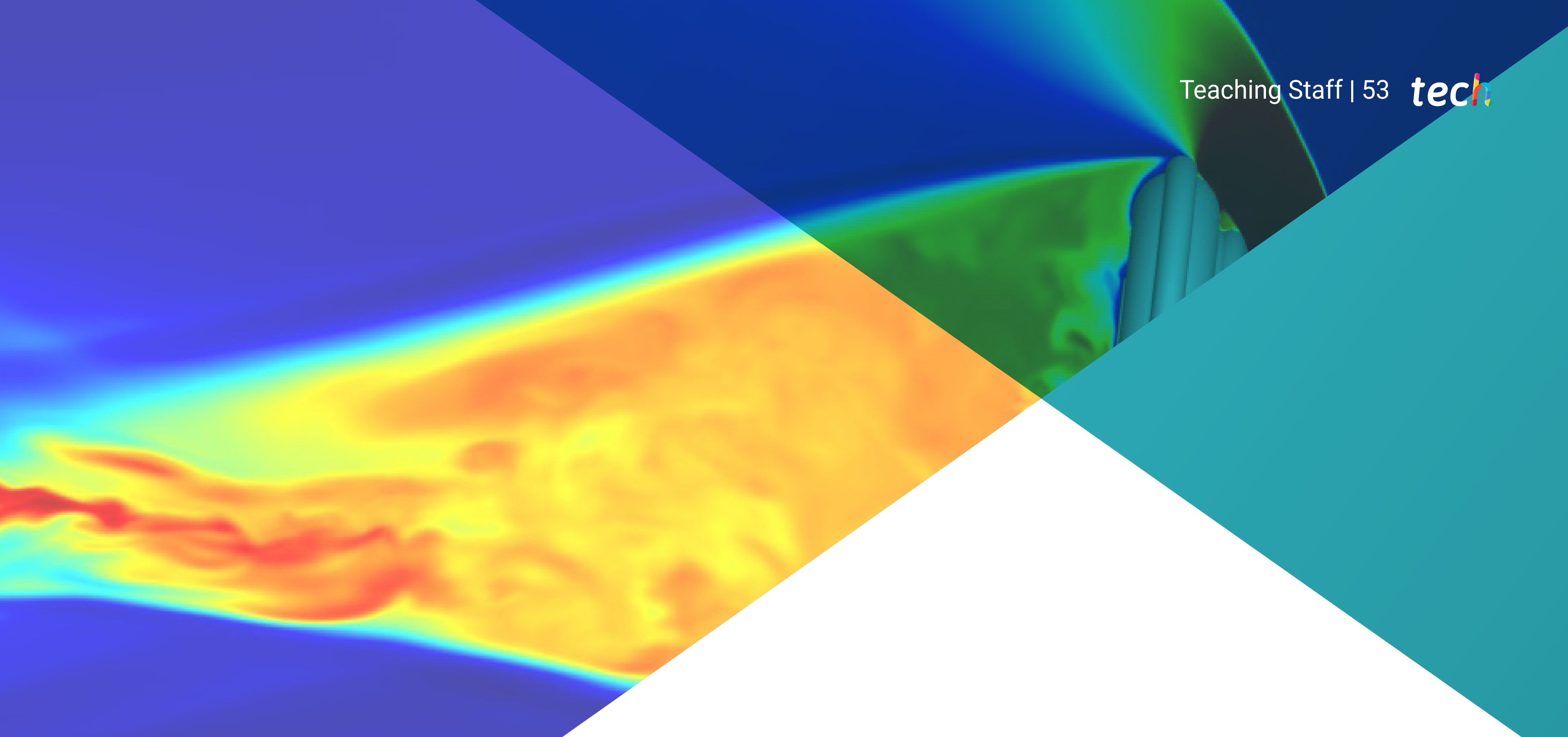
Quick Action Guides

TECH offers the most relevant contents of the course in the form of worksheets or quick action guides. A synthetic, practical and effective way to help students progress in their learning.

09
Teaching Staff

TECH's core mission is to make the most comprehensive and up-to-date university programs available to everyone in today's academic landscape. To achieve this, it follows a rigorous process to select its teaching staff. As a result, this Hybrid Master's Degree features leading experts in Computational Fluid Dynamics. They have developed a wide range of teaching materials that stand out for their high quality and their adaptation to the requirements of today's job market. This is undoubtedly an immersive experience that will allow graduates to significantly broaden their professional horizons.





You will enjoy a syllabus designed by a renowned teaching team specializing in Computational Fluid Mechanics, which will guarantee your success"

Management

Dr. García Galache, José Pedro

- Development Engineer at XFlow at Dassault Systèmes
- PhD in Aeronautical Engineering from the Polytechnic University of Valencia
- Bachelor's Degree in Aeronautical Engineering from the Polytechnic University of Valencia
- Master's Degree in Fluid Mechanics Research from The von Karman Institute for Fluid Dynamics
- Short Training Programme at The von Karman Institute for Fluid Dynamics

Professors

Dr. Daniel Espinoza Vásquez

- Consultant Aeronautical Engineer at Alten SAU
- Freelance CFD and Programming Consultant
- CFD Specialist at Particle Analytics Limited
- Research Assistant at the University of Strathclyde
- Teaching Assistant in Fluid Mechanics at the University of Strathclyde
- Dr. in Aeronautical Engineering from the University of Strathclyde
- Master's Degree in Computational Fluid Mechanics from the Cranfield University
- Degree in Aeronautical Engineering from the Polytechnic University of Madrid

Mr. Mata Bueso, Enrique

- Senior Thermal Conditioning and Aerodynamics Engineer at Siemens Gamesa
- Application Engineer and CFD R&D Manager at Dassault Systèmes
- Thermal Conditioning and Aerodynamics Engineer in Gamesa-Altran
- Fatigue and Damage Tolerance Engineer at Airbus-Atos
- R&D CFD Engineer at UPM
- Aeronautical Technical Engineer with specialization in Aircraft by UPM
- Master's Degree in Aerospace Engineering from the Royal Institute of Technology in Stockholm

Ms. Pérez Tainta, Maider

- Cement Fluidization Engineer at Kemex Ingesoa
- Process Engineer at JM Jauregui
- Researcher in Hydrogen Combustion at Ikerlan
- Mechanical Engineer at Idom
- Graduate in Mechanical Engineering from the University of the Basque Country
- Master's Degree in Mechanical Engineering
- Interuniversity Master's Degree in Fluid Mechanics
- Python Programming Course

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

10
Certificate

The Hybrid Master's Degree in Computational Fluid Dynamics guarantees students, in addition to the most rigorous and up-to-date education, access to a diploma for the Hybrid Master's Degree issued by TECH Global University.

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

This private qualification will allow you to obtain a diploma for the **Hybrid Master's Degree in Computational Fluid Dynamics** endorsed by TECH Global University, the world's largest online university.

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

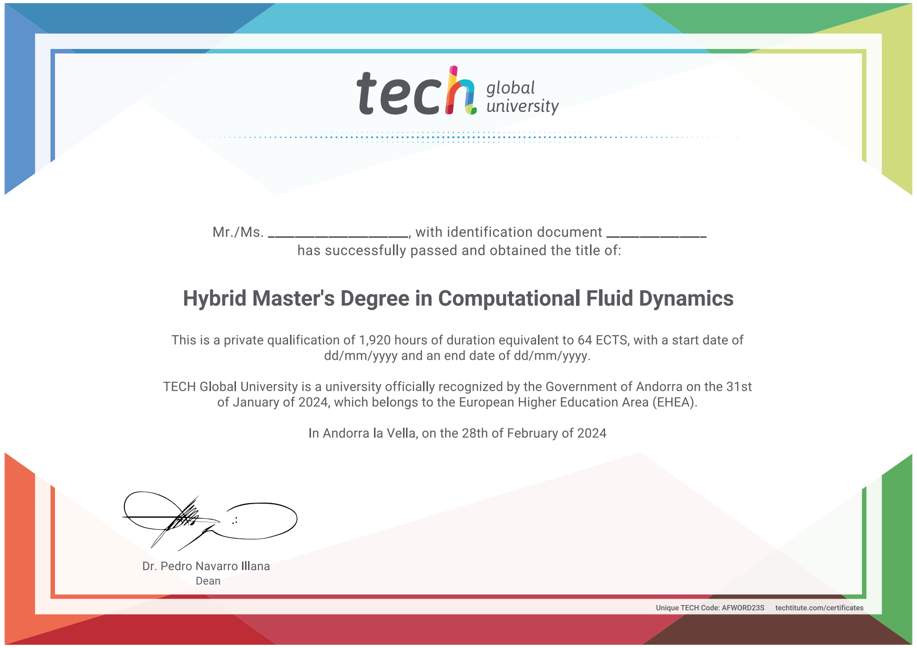
This **TECH Global University** private qualification, is a European program of continuing education and professional updating that guarantees the acquisition of competencies in its area of knowledge, providing a high curricular value to the student who completes the program.

Title: **Hybrid Master's Degree in Computational Fluid Dynamics**

Modality: **online**

Duration: **12 months**

Accreditation: **60 + 4 ECTS**



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

Hybrid Master's Degree in Computational Fluid Dynamics

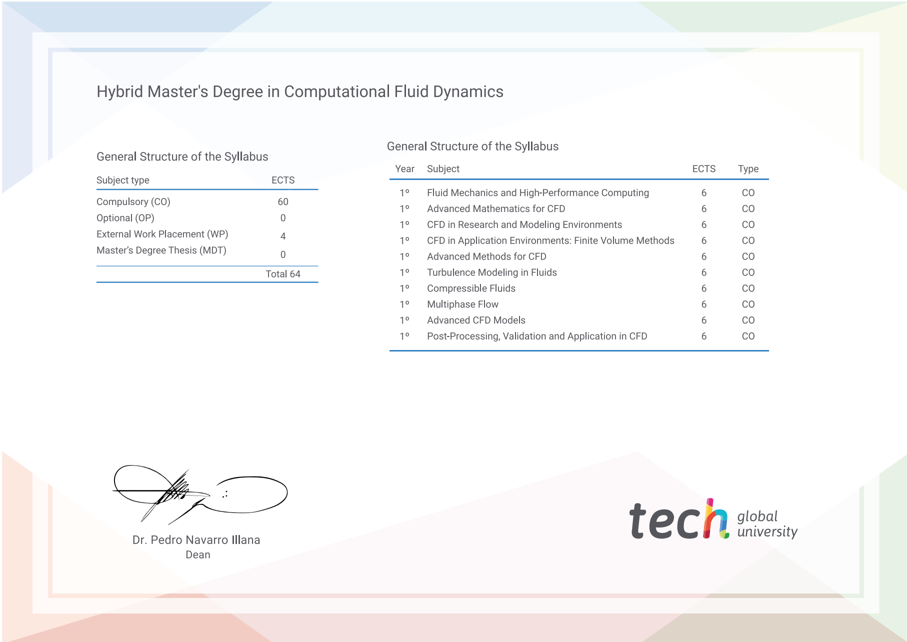
This is a private qualification of 1,920 hours of duration equivalent to 64 ECTS, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

TECH Global University is a university officially recognized by the Government of Andorra on the 31st of January of 2024, which belongs to the European Higher Education Area (EHEA).

In Andorra la Vella, on the 28th of February of 2024

Dr. Pedro Navarro Illana
Dean

Unique TECH Code: AFWORD23S techtitute.com/certificates



Hybrid Master's Degree in Computational Fluid Dynamics

General Structure of the Syllabus

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

General Structure of the Syllabus

Year	Subject	ECTS	Type
1º	Fluid Mechanics and High-Performance Computing	6	CO
1º	Advanced Mathematics for CFD	6	CO
1º	CFD in Research and Modeling Environments	6	CO
1º	CFD in Application Environments: Finite Volume Methods	6	CO
1º	Advanced Methods for CFD	6	CO
1º	Turbulence Modeling in Fluids	6	CO
1º	Compressible Fluids	6	CO
1º	Multiphase Flow	6	CO
1º	Advanced CFD Models	6	CO
1º	Post-Processing, Validation and Application in CFD	6	CO

Dr. Pedro Navarro Illana
Dean

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

Hybrid Master's Degree
Computational Fluid Dynamics

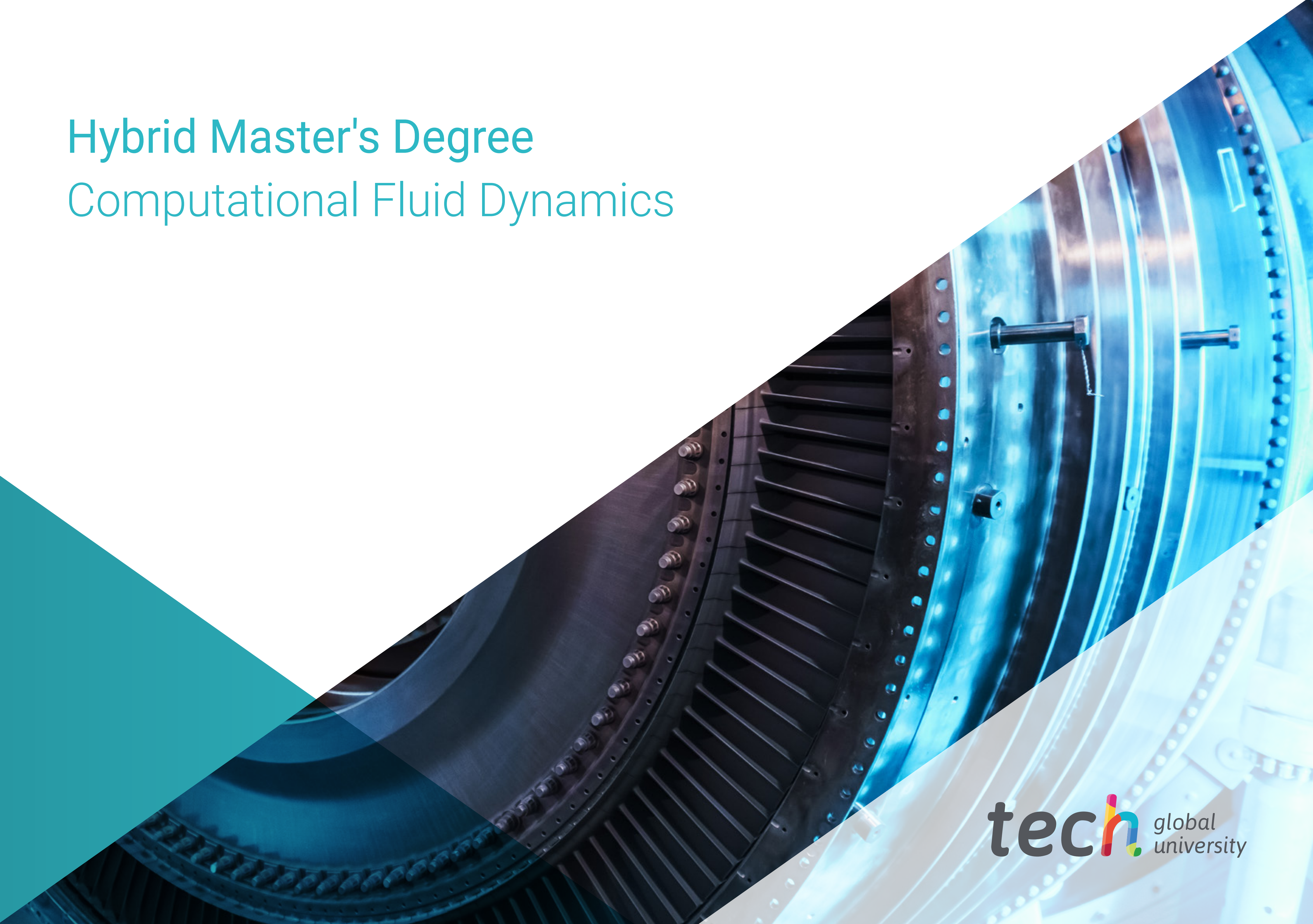
Modality: **Hybrid (Online + Internship)**

Duration: **12 months**

Certificate: **TECH Global University**

Credits: **60 + 4 ECTS**

Hybrid Master's Degree
Computational Fluid Dynamics



tech global university