Postgraduate Diploma
Unconventional CFD Techniques

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Postgraduate Diploma
Unconventional CFD Techniques

- Modality: **online**
- Duration: **6 months**
- Certiicate: **TECH Technological University**
- Schedule: **at your own pace**
- Exams: **online**

Website: www.techtitute.com/us/information-technology/postgraduate-diploma/postgraduate-diploma-unconventional-cfd-techniques

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01

Introduction

There are Advanced Methods and Unconventional Techniques within Computational Fluid Mechanics that multiply the chances of success and improving the results. But in order to be able to apply them and get the most out of them, it is necessary to have specific and in-depth knowledge of the subject, which is increasingly in demand in the IT labor market. For this reason, TECH Technological University has designed a degree that seeks to delve deeper into these alternative techniques in order to provide students with new skills that will enable them to stand out in a growing field. So the program delves into topics such as Smoothed Particle Hydrodynamics, the Finite Element Method, Convective Heat Transfer or Advantages and Disadvantages of Simulation Methods.

Learn all kinds of CFD Techniques and get the most out of them, in just a few months"

The most widely used method in Computational Fluid Mechanics is the Finite Volume Method (FVM), but there are very suitable alternative techniques with specific applications that are very useful in this field. In order to get the most out of this series of techniques, specific and very advanced knowledge is required, which means that professionals in this area are increasingly in demand.

This is the reason why TECH Technological University has created a Postgraduate Diploma in Unconventional CFD Techniques, with the aim of providing its students with the most appropriate skills and competences to be able to carry out their work with the highest quality in their jobs. Thus, throughout the syllabus, topics such as the Finite Element Method, Direct Simulation Monte Carlo (DSMC), Advanced CFD Models or Post-processing, Validation and Application in CFD, among other relevant aspects, are studied in depth.

All of this, in a 100% online modality that gives total comfort and freedom to the student, so that their usual activity is not interfered with, while they progress in their studies. Moreover, through the most complete multimedia materials, the most up-to-date information and the most innovative pedagogical tools on the academic market.

This **Postgraduate Diploma in Unconventional CFD Techniques** 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 Unconventional CFD Techniques
- The graphic, schematic, and practical contents with which they are created, provide scientific and practical information on the disciplines that are essential for professional practice
- Practical exercises where self-assessment can be used to improve learning
- Its special emphasis on innovative methodologies
- Theoretical lessons, questions to the expert, debate forums on controversial topics, and individual reflection assignments
- Availability to access content from any fixed or portable device with internet connection

Enhance your knowledge in FEM, SPH or DSMC and gain new possibilities to succeed in this field"

Thanks to TECH Technological University, you will improve your skills in Multi-physics Simulations or CFD Post processing.

Enroll now and get access to the most complete and up-to-date content on Unconventional CFD Techniques"

Access all the content from day one and a wide range of practical exercises to boost your knowledge.

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

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

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

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Objectives

The aim of this Postgraduate Diploma in Unconventional CFD Techniques is to provide students with in-depth and precise knowledge of alternative techniques with which to practice their profession in an optimal way. All this, through the most updated and dynamic theoretical and practical contents of the academic market.

Specialize in one of the most promising areas of IT and stand out in a short time"

General Objectives

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

Specific Objectives

Module 1. Advanced Methods for CFD

- Develop the Finite Element Method and the Smoothed Particle Hydrodynamics Method
- Analyze the advantages of Lagrangian versus Eulerian methods, in particular, SPH vs FVM
- Analyze the Monte-Carlo Direct Simulation method and the Lattice-Boltzmann Method
- Evaluate and interpret spatial aerodynamics and microfluidodynamics simulations
- Establish the advantages and disadvantages of LBM versus the traditional FVM method

Module 2. Advanced CFD Models

- Distinguish what type of physical interactions are to be simulated: fluid-structure, such as a wing subject to aerodynamic forces, fluid coupled with rigid body dynamics, such as simulating the motion of a buoy floating in the sea, or thermo-fluid, such as simulating the distribution of temperatures in a solid subject to air currents
- Distinguish the most common data exchange schemes between different simulation software and when one or the other can or is best to be applied
- Examine the various heat transfer models and how they can affect a fluid
- Model convection, radiation and diffusion phenomena from a fluid point of view, model sound creation by a fluid, model simulations with advection-diffusion terms to simulate continuous or particulate media and model reactive flows

Module 3. Post-processing, validation and application in CFD

- Determine the types of post-processing according to the results to be analyzed: purely numerical, visual or a mixture of both
- Analyzing the convergence of a CFD simulation
- Establish the need for CFD validation and know basic examples of CFD validation
- Examine the different tools available on the market
- To provide a foundation for the current context of CFD simulation

Take advantage of the most innovative pedagogical tools in the field of Unconventional CFD Techniques and reach your most demanding goals"

03

Course Management

In order to achieve its quest for the highest quality teaching, TECH Technological University has selected outstanding professionals with extensive backgrounds in this area, forming a team of experts to meet the highest expectations. All this has given rise to the most complete and dynamic theoretical and practical contents on the market, with which students will find their most demanding needs satisfied.

Succeed with the best experts in Unconventional CFD Techniques, thanks to TECH Technological University"

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 from The von Karman Institute for Fluid Dynamics
- Short Training Programme en The von Karman Institute for Fluid Dynamics

Professors

D. Espinoza Vásquez, Daniel

- 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
- 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

D. Mate Bueso, Enrique

- Senior Engineer for Thermal Conditioning and Aerodynamics 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 Royal Institute of Technology of Stockholm

Ms. Pérez Tainta, Maider

- Cement Fluidisation Engineer at Kemex Ingesoa
- Process Engineer at JM Jauregui
- Researcher in Hydrogen Combustion in 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

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Structure and Content

The content of this Postgraduate Diploma has been designed and structured by the experts that make up TECH Technological University team of specialists in Unconventional CFD Techniques, resulting in complete and accurate content. All of this, under the most efficient teaching methodology, Relearning, which allows the student to assimilate the essential concepts in a natural and dynamic way, without having to dedicate too much time to study.

Thanks to the pedagogical methodology of TECH Technological University Relearning, you will be able to acquire the essential concepts without spending too much time studying"

Module 1. Advanced Methods for CFD

1.1. Finite Element Method (FEM)
 1.1.1. Domain discretization. Finite Elements
 1.1.2. Form functions. Reconstruction of the continuous field
 1.1.3. Assembly of the coefficient matrix and boundary conditions
 1.1.4. Solving the system of equations
1.2. FEM Case Studies Development of a FEM simulator
 1.2.1. Form functions
 1.2.2. Assembling the coefficient matrix and applying boundary conditions
 1.2.3. Solving the system of equations
 1.2.4. Post-Process
1.3. Smoothed Particle Hydrodynamics (SPH)
 1.3.1. Fluid field mapping from particle values
 1.3.2. Evaluation of derivatives and particle interaction
 1.3.3. The smoothing function. The kernel
 1.3.4. Boundary Conditions
1.4. SPH: Development of a simulator based on SPH
 1.4.1. The kernel
 1.4.2. Storage and sorting of particles in voxels
 1.4.3. Development of boundary conditions
 1.4.4. Post-Process
1.5. Direct Simulation Monte Carlo (DSMC)
 1.5.1. Kinetic-molecular theory
 1.5.2. Statistical mechanics
 1.5.3. Molecular equilibrium
1.6. DSMC: Methodology
 1.6.1. Applicability of the DSMC method
 1.6.2. Modeling
 1.6.3. Considerations for the applicability of the method

Module 2. Advanced CFD Models

2.4. Convection Heat Transfer
- 2.4.1. Convection Heat Transfer. Advanced Aspects
- 2.4.2. Convective heat transfer equations
- 2.4.3. Methods for solving convection problems

2.5. Conduction Heat Transfer
- 2.5.1. Conduction Heat Transfer. Advanced Aspects
- 2.5.2. Conductive heat transfer equations
- 2.5.3. Methods of solving conduction problems

2.6. Radiation Heat Transfer
- 2.6.1. Radiation Heat Transfer. Advanced Aspects
- 2.6.2. Due to Radiation heat transfer equations
- 2.6.3. Methods of solving Radiation problems

2.7. Solid-fluid-heat coupling
- 2.7.1. Solid-fluid-heat coupling
- 2.7.2. Solid-fluid thermal coupling
- 2.7.3. CFD and FEM

2.8. Aeroacoustics
- 2.8.1. Computational aeroacoustics
- 2.8.2. Acoustic analogies
- 2.8.3. Resolution methods

2.9. Advection-diffusion problems
- 2.9.1. Advection-diffusion problems
- 2.9.2. Scalar Fields
- 2.9.3. Particle methods

2.10. Coupling models with reactive flow
- 2.10.1. Coupling models with reactive flow. Applications
- 2.10.2. System of differential equations. Solving the chemical reaction
- 2.10.3. CHEMKINs
- 2.10.4. Combustion: flame, spark, Wobee
- 2.10.5. Reactive flows in non-stationary regime: quasi-stationary system hypothesis
- 2.10.6. Reactive flows in turbulent flows
- 2.10.7. Catalysts

Module 3. Post-processing, validation and application in CFD

3.1. Post-processing in CFD I
- 3.1.1. Postprocessing on Plane and Surfaces
- 3.1.1. Post-Process in the Plane
- 3.1.2. Post-processing on surfaces

3.2. Post-processing in CFD II
- 3.2.1. Postprocessing Volumetric
  - 3.2.1.1. Post-processing Volumetric I
  - 3.2.1.2. Post-processing Volumetric II

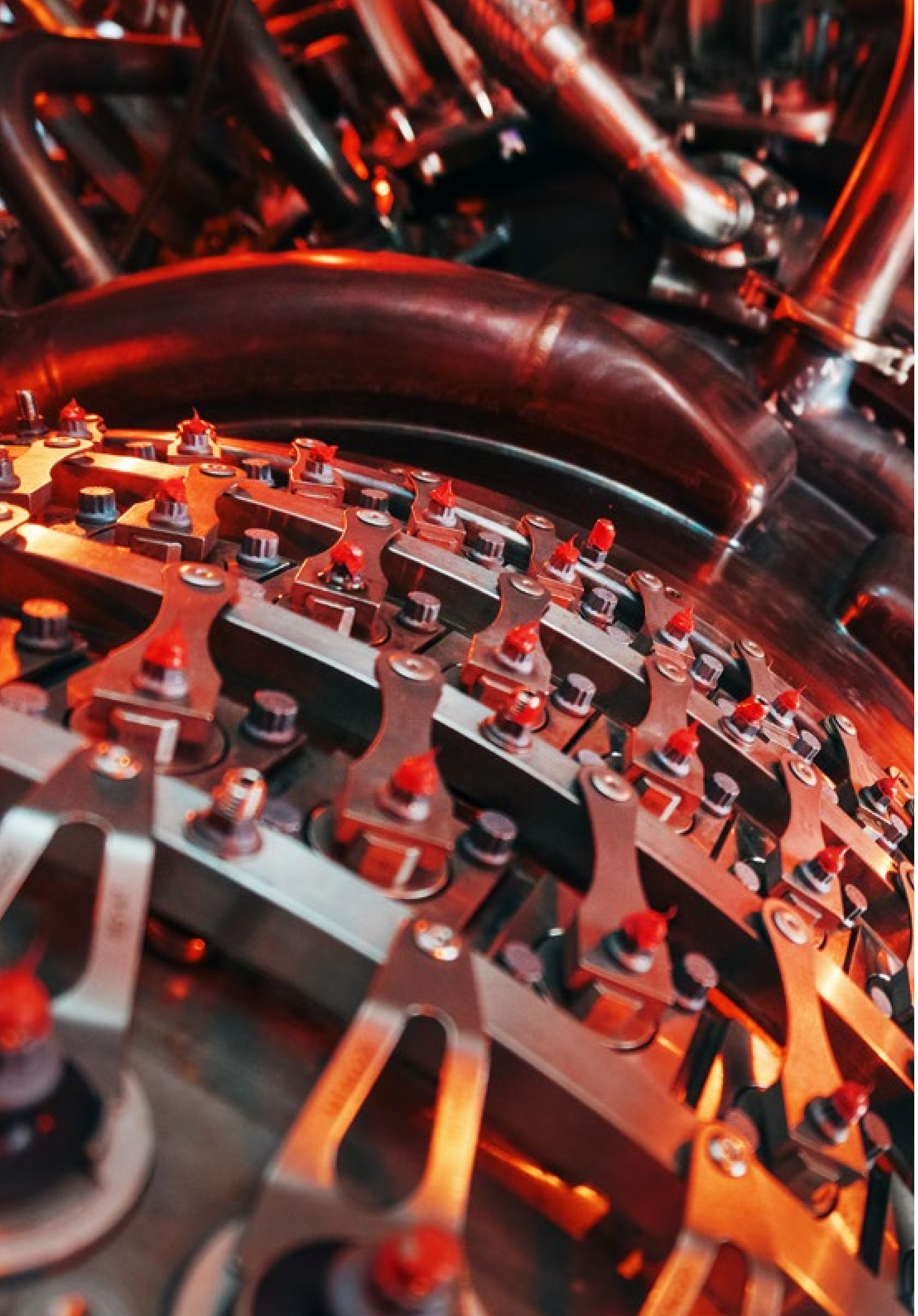
3.3. Free CFD post-processing software
- 3.3.1. Free Postprocessing Software
- 3.3.2. Paraview
- 3.3.3. Paraview usage example

3.4. Convergence of simulations
- 3.4.1. Convergence
- 3.4.2. Mesh convergence
- 3.4.3. Numerical convergence

3.5. Classification of Methods
- 3.5.1. Applications
- 3.5.2. Types of Fluid
- 3.5.3. Scales
- 3.5.4. Calculation machines

3.6. Model validation
- 3.6.1. Need for Validation
- 3.6.2. Simulation vs Experiment
- 3.6.3. Examples of validation

3.7. Simulation methods. Advantages and Disadvantages
- 3.7.1. RANS
- 3.7.2. LES, DES, DNS
- 3.7.3. Other Methods
- 3.7.4. Advantages and Disadvantages



3.8. Examples of methods and applications
 3.8.1. Case of a body subjected to aerodynamic forces
 3.8.2. Thermal case
 3.8.3. Multiphase case
3.9. Good Simulation Practices
 3.9.1. Importance of Best Practices
 3.9.2. Best Practices
 3.9.3. Simulation errors
3.10. Free and commercial software
 3.10.1. FVM Software
 3.10.2. Software for other methods
 3.10.3. Advantages and Disadvantages
 3.10.4. CFD Simulation Futures

A Postgraduate Diploma in Unconventional CFD Techniques, with a wide variety of additional material to study in depth those aspects that interest you most"

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 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

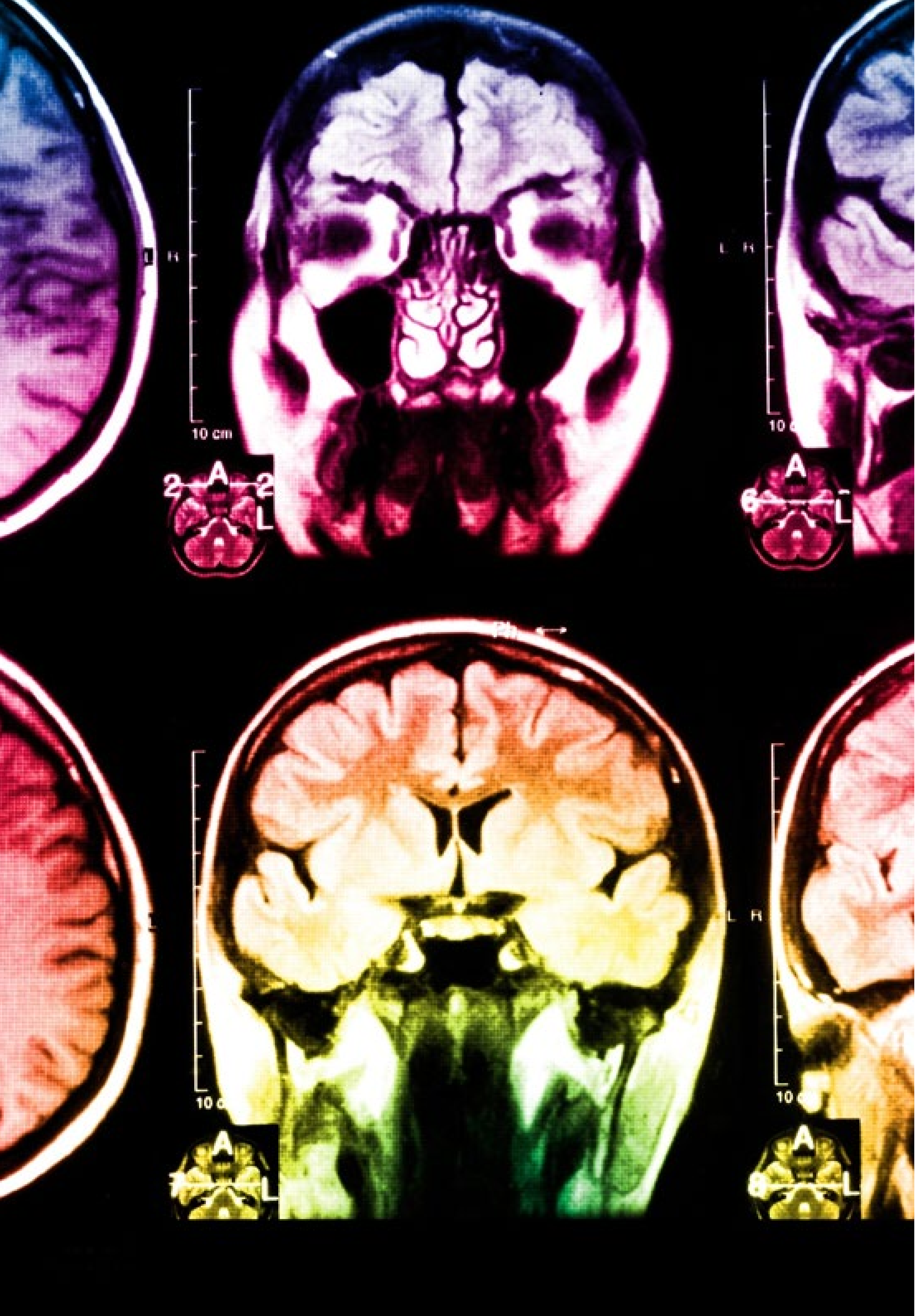
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines different teaching elements in each lesson.

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.

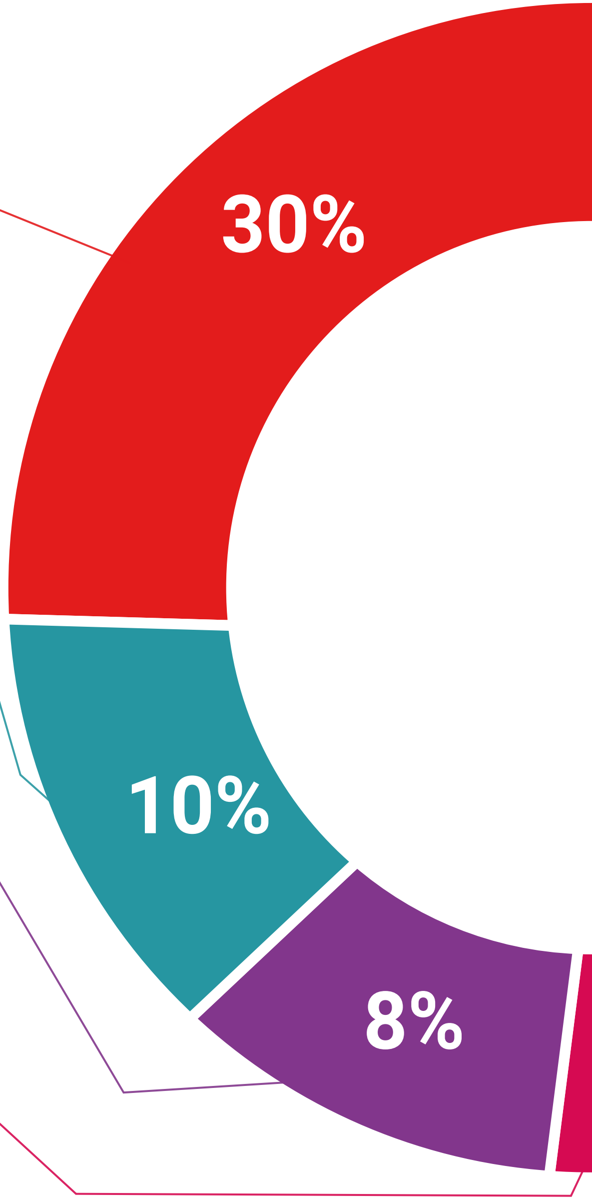
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

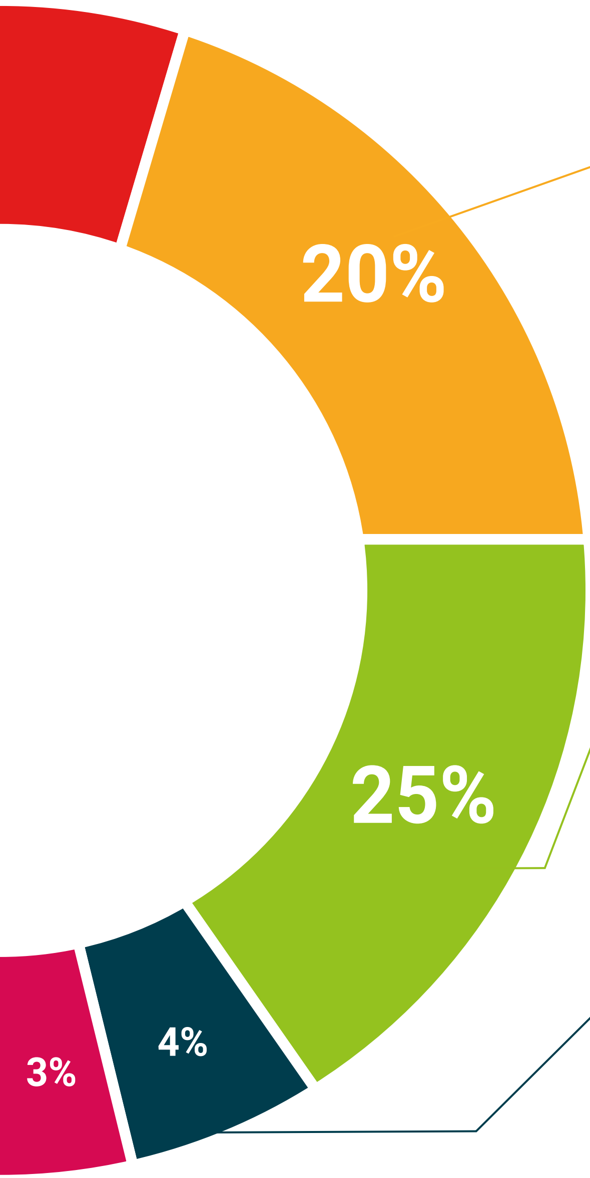
Practising Skills and Abilities

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 Diploma in Unconventional CFD Techniques guarantees students, in addition to the most rigorous and up-to-date education, access to a Postgraduate Diploma issued by TECH Technological University.

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

This **Postgraduate Diploma in Unconventional CFD Techniques** contains the most complete and up-to-date scientific on the market.

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

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

Program: **Postgraduate Diploma in Unconventional CFD Techniques**

No. of Official Hours: **450 h.**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Awards the following

DIPLOMA

to

Mr./Ms. _______________, with identification number ___________.

For having passed and accredited the following program

POSTGRADUATE DIPLOMA

in

Unconventional CFD Techniques

This is a qualification awarded by this University, equivalent to 450 hours, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

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

June 17, 2020

Tere Guevara Navarro

Dean

Unique TECH Code: AFWORD23S techtitute.com/certificates

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

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Postgraduate Diploma
Unconventional CFD Techniques

» Modality: **online**
» Duration: **6 months**
» Certificate: **TECH Technological University**
» Schedule: **at your own pace**
» Exams: **online**

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