Postgraduate Certificate
Thermodynamics

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Postgraduate Certificate
Thermodynamics

- Modality: **online**
- Duration: **12 weeks**
- Certificate: **TECH Technological University**
- Dedication: **16h/week**
- Schedule: **at your own pace**
- Exams: **online**

Website: **www.techtitute.com/us/engineering/postgraduate-certificate/thermodynamics**

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01

Introduction

Solar panels, wind turbines or eco-efficient heaters are just some of the inventions that use thermodynamics as the basis for their operation. The science of energy is present in the industrial, automotive and aeronautical fields, as well as in everyday life. Its relevance means that any engineering professional must master its concepts and laws in order to create devices that make the most of energy. That is why TECH has created this 100% online program, which will lead students to delve into its principles and functions, into the kinetic-molecular theory of gases or macrocanonical collectivity. All this, in addition, with multimedia teaching resources that can be easily accessed, 24 hours a day, from any electronic device with internet connection.

With this 100% online program, you will be able to master the laws of thermodynamics in only 12 weeks"

Thanks to the contributions of Carnot, Mayer, Joule, Clausius or Kelvin in the development of the concepts, functions and laws of thermodynamics, means of transport, hydraulic turbines, refrigerators and solar panels have emerged. All of these inventions make efficient use of energy. One of the main objectives of every engineering professional is to know how to optimize energy economically and environmentally for human purposes, whether generating electricity, heating or combustion.

That is why mastering the concepts and calculations necessary to apply thermodynamics properly is essential to achieve success in industrial projects, in the design of new equipment or machinery. Given this reality, TECH has created this Postgraduate Certificate in Thermodynamics, which offers the graduates the most advanced knowledge of this science in just 12 weeks.

A program where students will be able to delve into the mathematical tools that are essential to apply thermodynamics, the keys to calorimetry, gases or magnetic systems. Furthermore, the innovative pedagogical resources of this program will lead students to delve in a much more dynamic way into the concepts of collectivity, the different types and to acquire basic notions of the Ising model.

A teaching with a theoretical but at the same time practical approach, which will lead the graduates to solve problems in the field of Thermodynamics. This will be possible thanks to the case studies, provided by the teaching team specialized in this field, which are part of this instruction.

Therefore, engineering professionals are facing an excellent opportunity to advance in their career thanks to a Postgraduate Certificate, which they can study comfortably whenever and wherever they wish. All that is required is an electronic device (computer, tablet or cell phone) with Internet connection to access, at any time, the syllabus hosted on the virtual platform. In addition, with the Relearning system, students will be able to advance through the program content in a much more natural way and even reduce the long hours of study.

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

- Practical case studies are presented by experts in Physics
- The graphic, schematic and practical contents with which it is designed provide advanced and practical information on those disciplines that are essential for professional practice
- Practical exercises where self-assessment can be used to improve learning
- Its special emphasis on innovative methodologies
- Theoretical lessons, questions to the expert, debate forums on controversial topics, and individual reflection assignments
- Content that is accessible from any fixed or portable electronic device with an Internet connection

Gain the knowledge you need to efficiently solve any thermodynamic problem"

Access the most advanced knowledge about Thermodynamics and the differences between boson and baryon statistics"

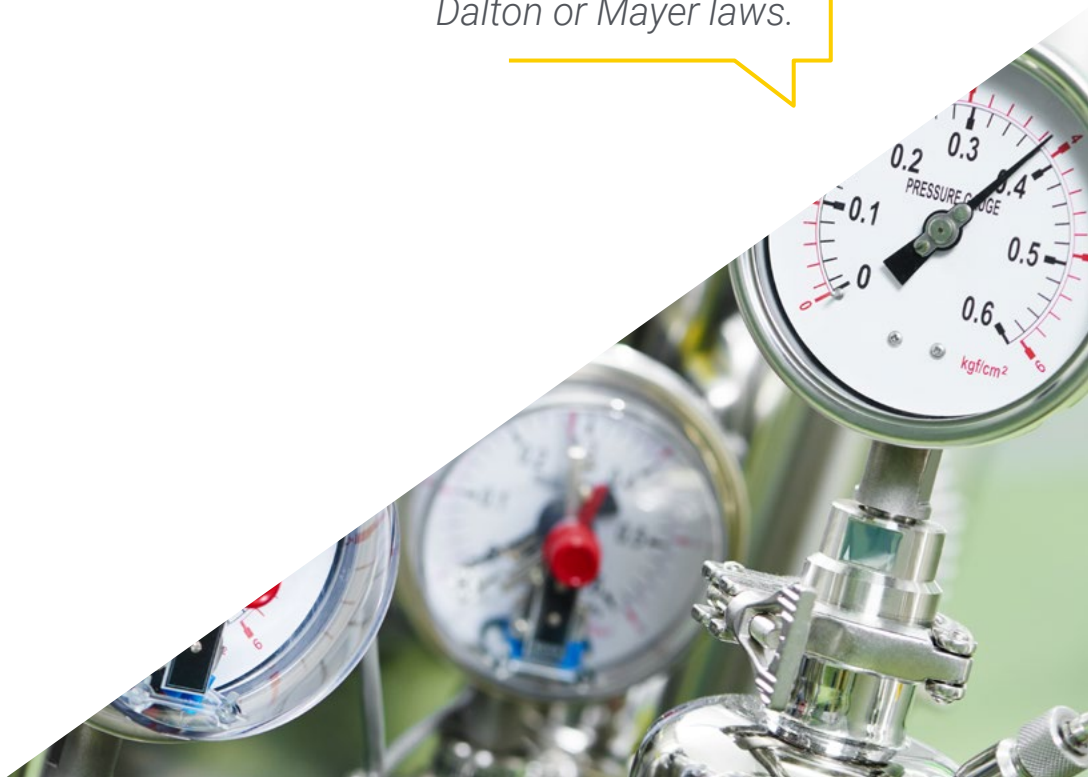
Enroll now in a 100% online university program that is compatible with the most demanding professional responsibilities.

Thanks to this Postgraduate Certificate, you will perfectly understand the Joule, Boyle-Mariotte, Charles, Gay-Lussac, Dalton or Mayer laws.

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

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

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



02

Objectives

The syllabus of this Postgraduate Certificate has been designed with the main objective of providing students with the most advanced knowledge on Thermodynamics At the end of the 300 teaching hours, the students will have the necessary skills to apply the different laws and concepts to the problems to be solved in each situation. The case studies provided by the specialists who teach this program will also help you to approach in a practical way the use of the different methods.

This Postgraduate Certificate will allow you to delve into the concepts of entropy, probability and Boltzmann's Law"

General Objectives

- Solve problems effectively in the field of thermodynamics
- Understand the concepts of collectivity and be able to differentiate among the different types
- Know how to distinguish which collectivity will be more useful to the study of a given system depending on the type of thermodynamic system

A specialized teaching team will guide you over the 300 hours of this Postgraduate Certificate, so that you can successfully achieve your objectives"

Specific Objectives

- Acquire basic notions of statistical mechanics
- Be able to analyze different contexts and environments in the field of physics based on a solid mathematical basis
- Understand and use mathematical and numerical methods commonly used in thermodynamics
- Advance in the principles of thermodynamics
- Know the basics of the Ising model
- Gain knowledge of the difference between boson and baryon statistics

03

Structure and Content

The video summaries, videos in detail, schemes or complementary readings make up the library of multimedia resources to which the students of this program will have access. Thanks to them, they will be able to delve into the main mathematical concepts, laws, functions and theories that make up Thermodynamics. Theoretical and practical knowledge that will lead you to obtain the necessary learning to be able to advance firmly in your career in the field of Engineering.

Enroll now in a program that allows you to access its content 24 hours a day, using any electronic device with internet connection"

Module 1. Thermodynamics

1.1. Mathematical Tools: Review
- 1.1.1. Review of the Logarithm and Exponential Functions
- 1.1.2. Review of Derivatives
- 1.1.3. Integrals
- 1.1.4. Derivative of a Function of Several Variables

1.2. Calorimetry. Zero Principle in Thermodynamics
- 1.2.1. Introduction and General Concepts
- 1.2.2. Thermodynamic Systems
- 1.2.3. Zero Principle in Thermodynamics
- 1.2.4. Temperature Scales. Absolute Temperature
- 1.2.5. Reversible and Irreversible Processes
- 1.2.6. Sign Criteria
- 1.2.7. Specific Heat
- 1.2.8. Molar Heat
- 1.2.9. Phase Changes
- 1.2.10. Thermodynamic Coefficients

1.3. Thermodynamic Work. First Principle of Thermodynamics
- 1.3.1. Heat and Thermodynamic Work
- 1.3.2. State Functions and Internal Energy
- 1.3.3. First Principle of Thermodynamics
- 1.3.4. Work of a Gas System
- 1.3.5. Joule's Law
- 1.3.6. Heat of Reaction and Enthalpy

1.4. Ideal Gases
- 1.4.1. Ideal Gas Laws
  - 1.4.1.1. Boyle-Mariotte's Law
  - 1.4.1.2. Charles and Gay-Lussac's Laws
  - 1.4.1.3. Equation of State of Ideal Gases
    - 1.4.1.3.1. Dalton's Law
    - 1.4.1.3.2. Mayer's Law
- 1.4.2. Calorimetric Equations of the Ideal Gas
- 1.4.3. Adiabatic Processes
  - 1.4.3.1. Adiabatic Transformations of an Ideal Gas
    - 1.4.3.1.1. Relationship between Isotherms and Adiabatics
    - 1.4.3.1.2. Work in Adiabatic Processes
- 1.4.5. Polytropic Transformations

1.5. Real Gases
- 1.5.1. Motivation
- 1.5.2. Ideal and Real Gases
- 1.5.3. Description of Real Gases
- 1.5.4. Equations of State of Series Development
- 1.5.5. Van der Waals Equation and Series Development
- 1.5.6. Andrews Isotherms
- 1.5.7. Metastable States
- 1.5.8. Van der Waals Equation: Consequences

1.6. Entropy
- 1.6.1. Introduction and Objectives
- 1.6.2. Entropy: Definition and Units
- 1.6.3. Entropy of an Ideal Gas
- 1.6.4. Entropic Diagram
- 1.6.5. Clausius Inequality
- 1.6.6. Fundamental Equation of Thermodynamics
- 1.6.7. Carathéodory's Theorem

1.7. Second Principle of Thermodynamics
- 1.7.1. Second Principle of Thermodynamics
- 1.7.2. Transformations between Two Thermal Focuses
- 1.7.3. Carnot Cycle
- 1.7.4. Real Thermal Machines
- 1.7.5. Clausius Theorem

1.8. Thermodynamic Functions. Third Principle of Thermodynamics
- 1.8.1. Thermodynamic Functions
- 1.8.2. Thermodynamic Equilibrium Conditions
- 1.8.3. Maxwell's Equations
- 1.8.4. Thermodynamic Equation of State
- 1.8.5. Internal Energy of a Gas
- 1.8.6. Adiabatic Transformations in a Real Gas
- 1.8.7. Third Principle of Thermodynamics and Consequences

1.9. Kinetic-Molecular Theory of Gases
- 1.9.1. Hypothesis of the Kinetic-Molecular Theory
- 1.9.2. Kinetic Theory of the Pressure of a Gas
- 1.9.3. Adiabatic Evolution of a Gas
- 1.9.4. Kinetic Theory of Temperature
- 1.9.5. Mechanical Argument for Temperature
- 1.9.6. Principle of Equipartition of Energy
- 1.9.7. Virial Theorem

1.10. Introduction to Statistical Mechanics
- 1.10.1. Introduction and Objectives
- 1.10.2. General Concepts
- 1.10.3. Entropy, Probability and Boltzmann's Law
- 1.10.4. Maxwell-Boltzmann Distribution Law
- 1.10.5. Thermodynamic and Partition Functions

Module 2. Advanced Thermodynamics

2.1. Formalism of Thermodynamics
- 2.1.1. Laws of Thermodynamics
- 2.1.2. The Fundamental Equation
- 2.1.3. Internal Energy: Euler's Form
- 2.1.4. Gibbs-Duhem Equation
- 2.1.5. Legendre Transformations
- 2.1.6. Thermodynamic Potentials
- 2.1.7. Maxwell's Relations for a Fluid
- 2.1.8. Stability Conditions

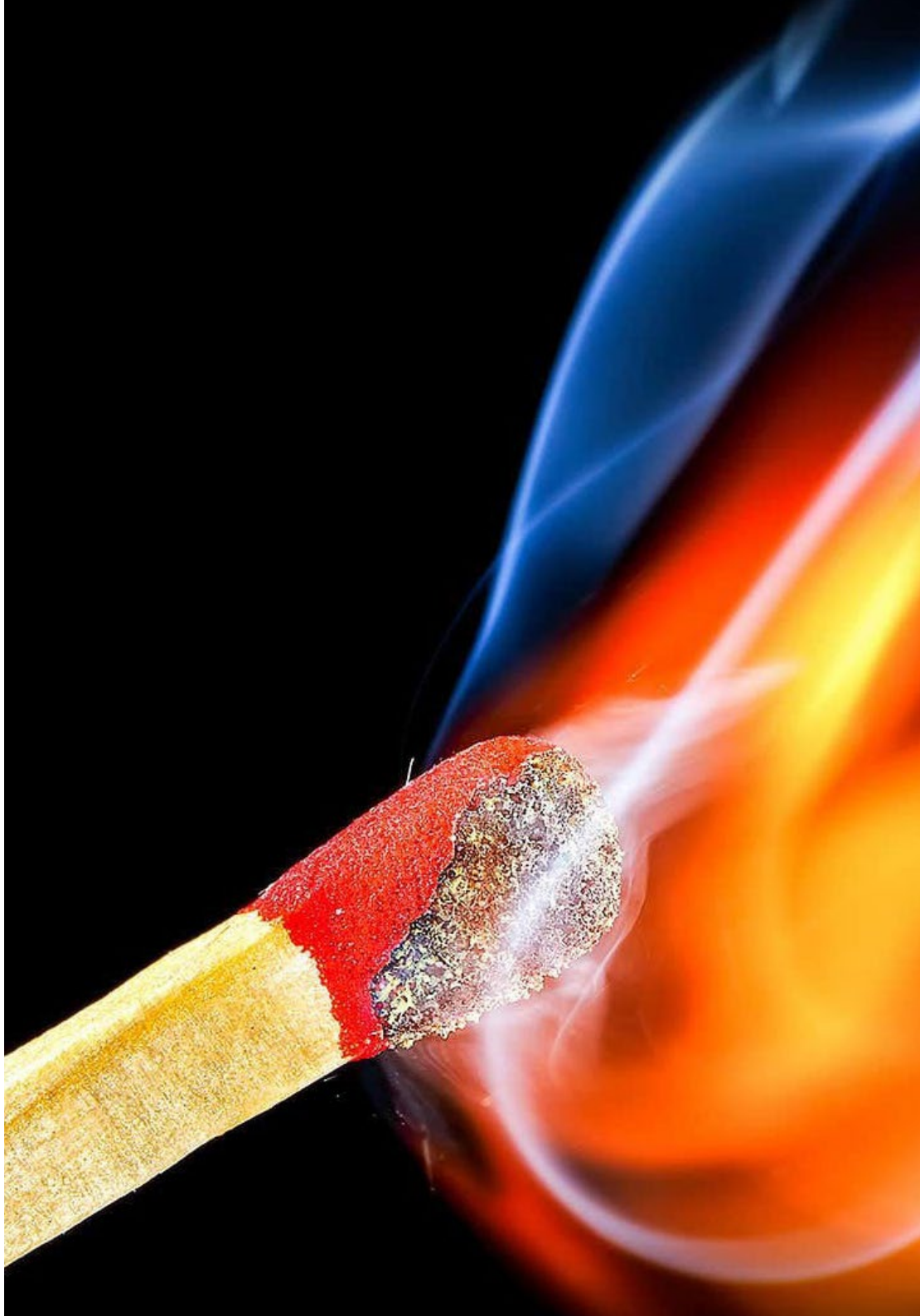
2.2. Microscopic Description of Macroscopic Systems I
- 2.2.1. Microstates and Macrostates: Introduction
- 2.2.2. Phase Space
- 2.2.3. Collectivities
- 2.2.4. Microcanonical Collectivity
- 2.2.5. Thermal Equilibrium

2.3. Microscopic Description of Macroscopic Systems II
- 2.3.1. Discrete Systems
- 2.3.2. Statistical Entropy
- 2.3.3. Maxwell-Boltzmann Distribution
- 2.3.4. Pressure
- 2.3.5. Effusion

2.4. Canonical Collectivity
- 2.4.1. Partition Function
- 2.4.2. Ideal Systems
- 2.4.3. Energy Degeneration
- 2.4.4. Behavior of the Monoatomic Ideal Gas at a Potential
- 2.4.5. Energy Equipartition Theorem
- 2.4.6. Discrete Systems

2.5. Magnetic Systems
- 2.5.1. Thermodynamics of Magnetic Systems
- 2.5.2. Classical Paramagnetism
- 2.5.3. ½ Spin Paramagnetism
- 2.5.4. Adiabatic Demagnetization

2.6. Phase Transitions
- 2.6.1. Classification of Phase Transitions
- 2.6.2. Phase Diagrams
- 2.6.3. Clapeyron Equation
- 2.6.4. Vapor-Condensed Phase Equilibrium
- 2.6.5. The Critical Point
- 2.6.6. Ehrenfest's Classification of Phase Transitions
- 2.6.7. Landau's Theory



2.7. Ising's Model
- 2.7.1. Introduction
- 2.7.2. One-Dimensional Chain
- 2.7.3. Open One-Dimensional Chain
- 2.7.4. Mean Field Approximation

2.8. Real Gases
- 2.8.1. Comprehensibility Factor. Virial Development
- 2.8.2. Interaction Potential and Configurational Partition Function
- 2.8.3. Second Virial Coefficient
- 2.8.4. Van der Waals Equation
- 2.8.5. Lattice Gas
- 2.8.6. Corresponding States Law
- 2.8.7. Joule and Joule-Kelvin Expansions

2.9. Photon Gas
- 2.9.1. Boson Statistics vs. Fermion Statistics
- 2.9.2. Energy Density and Degeneracy of States
- 2.9.3. Planck Distribution
- 2.9.4. Equations of State of a Photon Gas

2.10. Macrocanonical Collectivity
- 2.10.1. Partition Function
- 2.10.2. Discrete Systems
- 2.10.3. Fluctuations
- 2.10.4. Ideal Systems
- 2.10.5. The Monoatomic Gas
- 2.10.6. Vapor-Solid Equilibrium

Upon completion of this program, you will have a complete mastery of the laws of thermodynamics and their application in the field of engineering"

04

Methodology

This academic program offers students a different way of learning. Our methodology uses a cyclical learning approach: **Relearning.**

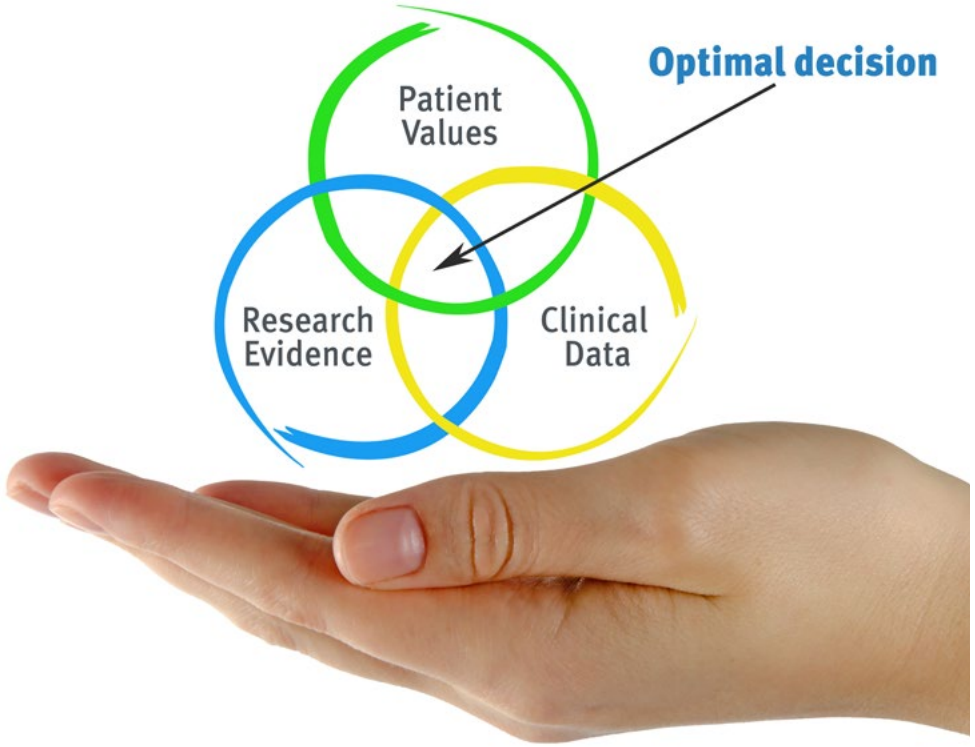
This teaching system is used, for example, in the most prestigious medical schools in the world, and major publications such as the **New England Journal of Medicine** have considered it to be one of the most effective.

Discover Relearning, a system that abandons conventional linear learning, to take you through cyclical teaching systems: a way of learning that has proven to be extremely effective, especially in subjects that require memorization"

Case Study to contextualize all content

Our program offers a revolutionary approach to developing skills and knowledge. Our goal is to strengthen skills in a changing, competitive, and highly demanding environment.

At TECH, you will experience a learning methodology that is shaking the foundations of traditional universities around the world"



You will have access to a learning system based on repetition, with natural and progressive teaching throughout the entire syllabus.

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

A learning method that is different and innovative

This TECH program is an intensive educational program, created from scratch, which presents the most demanding challenges and decisions in this field, both nationally and internationally. This methodology promotes personal and professional growth, representing a significant step towards success. The case method, a technique that lays the foundation for this content, ensures that the most current economic, social and professional reality is taken into account.

> *Our program prepares you to face new challenges in uncertain environments and achieve success in your career"*

The case method is the most widely used learning system in the best faculties in the world. The case method was developed in 1912 so that law students would not only learn the law based on theoretical content. It consisted of presenting students with real-life, complex situations for them to make informed decisions and value judgments on how to resolve them. In 1924, Harvard adopted it as a standard teaching method.

What should a professional do in a given situation? This is the question that you are presented with in the case method, an action-oriented learning method. Throughout the program, the studies will be presented with multiple real cases. They will have to combine all their knowledge and research, and argue and defend their ideas and decisions.

Relearning Methodology

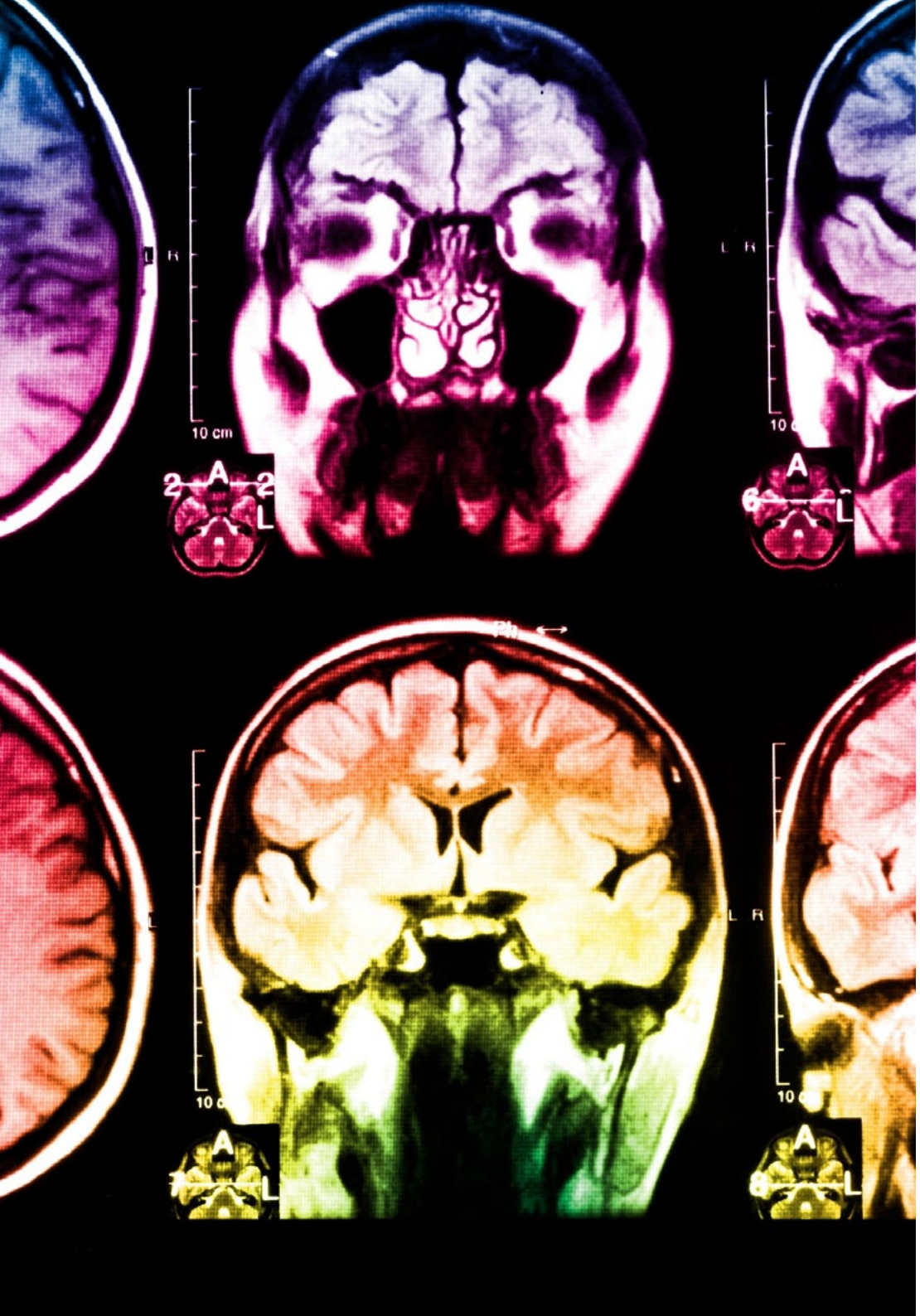
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines 8 different teaching elements in each lesson.

We enhance the Case Study with the best 100% online teaching method: Relearning.

In 2019, we obtained the best learning results of all online universities in the world.

At TECH, you will learn using a cutting-edge methodology designed to train the executives of the future. This method, at the forefront of international teaching, is called Relearning.

Our university is the only one in the world authorized to employ this successful method. In 2019, we managed to improve our students' overall satisfaction levels (teaching quality, quality of materials, course structure, objectives...) based on the best online university indicators.



In our program, learning is not a linear process, but rather a spiral (learn, unlearn, forget, and re-learn). Therefore, we combine each of these elements concentrically. This methodology has trained more than 650,000 university graduates with unprecedented success in fields as diverse as biochemistry, genetics, surgery, international law, management skills, sports science, philosophy, law, engineering, journalism, history, and financial markets and instruments. All this in a highly demanding environment, where the students have a strong socio-economic profile and an average age of 43.5 years.

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

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

In this way, and in what is called neurocognitive context-dependent e-learning, the different elements in our program are connected to the context where the individual carries out their professional activity.

This program offers the best educational material, prepared with professionals in mind:

Study Material

All teaching material is produced by the specialists who teach the course, specifically for the course, so that the teaching content is highly specific and precise.

These contents are then applied to the audiovisual format, to create the TECH online working method. All this, with the latest techniques that offer high quality pieces in each and every one of the materials that are made available to the student.

Classes

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

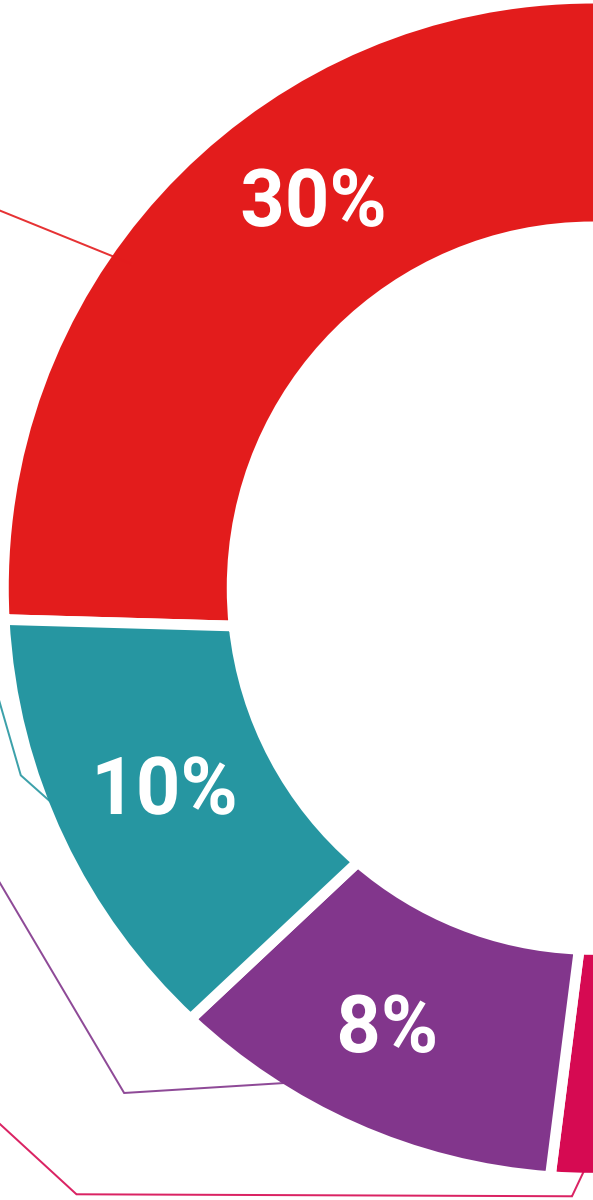
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

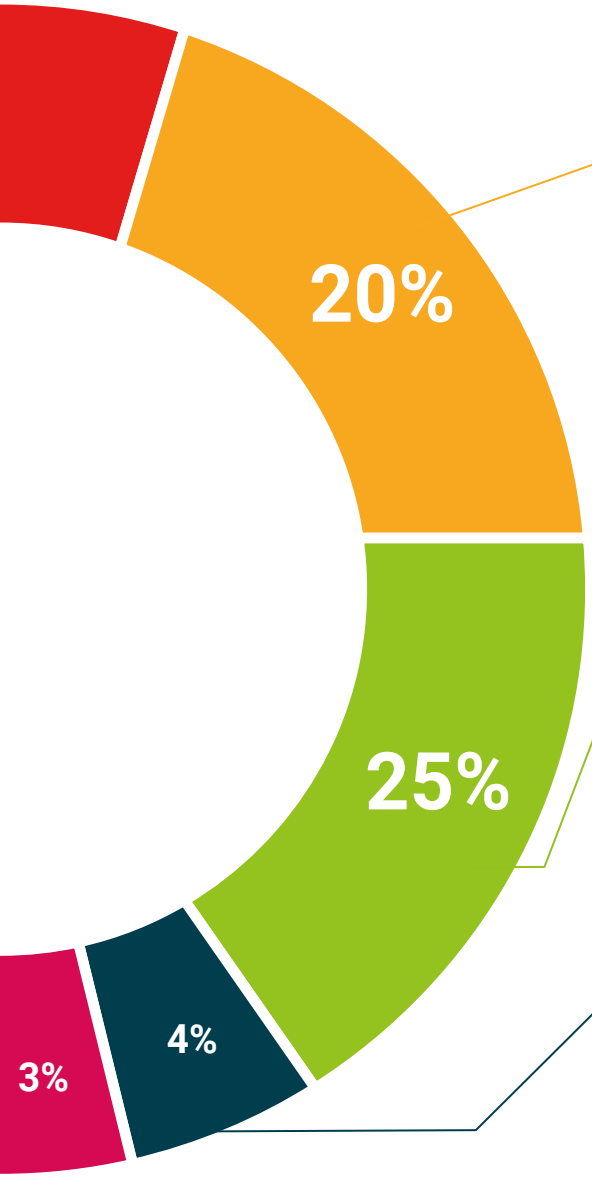
Practising Skills and Abilities

They will carry out activities to develop specific skills and abilities in each subject area. Exercises and activities to acquire and develop the skills and abilities that a specialist needs to develop in the context of the globalization that we are experiencing.

Additional Reading

Recent articles, consensus documents and international guidelines, among others. In TECH's virtual library, students will have access to everything they need to complete their course.





Case Studies

Students will complete a selection of the best case studies chosen specifically for this program. Cases that are presented, analyzed, and supervised by the best specialists in the world.

Interactive Summaries

The TECH team presents the contents attractively and dynamically in multimedia lessons that include audio, videos, images, diagrams, and concept maps in order to reinforce knowledge.

This exclusive educational system for presenting multimedia content was awarded by Microsoft as a "European Success Story".

Testing & Retesting

We periodically evaluate and re-evaluate students' knowledge throughout the program, through assessment and self-assessment activities and exercises, so that they can see how they are achieving their goals.

05

Certificate

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

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

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

Title: **Postgraduate Certificate in Thermodynamics**

Official Nº of Hours: **300 h.**


tech technological university

Awards the following

DIPLOMA

to

Mr./Ms. _____, with identification number _____.

For having passed and accredited the following program

POSTGRADUATE CERTIFICATE

in

Thermodynamics

This is a qualification awarded by this University, equivalent to 300 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

This qualification must always be accompanied by the university degree issued by the competent authority to practice professionally in each country. 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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