

# Postgraduate Certificate Advanced Thermodynamics



## Postgraduate Certificate Advanced Thermodynamics

- » Modality: online
- » Duration: 6 weeks
- » Certificate: TECH Global University
- » Credits: 6 ECTS
- » Schedule: at your own pace
- » Exams: online

Website: [www.techtute.com/us/engineering/postgraduate-certificate/advanced-thermodynamics](http://www.techtute.com/us/engineering/postgraduate-certificate/advanced-thermodynamics)

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# 01

# Introduction

More and more research groups are using the laws and functions of thermodynamics in the search for energy efficiency, whether in the industrial, aerospace or construction of new materials. For this reason, a thorough knowledge in this field, not only leads to the improvement of existing designs, but also opens possibilities in multiple productive sectors. Given this scenario of progress, TECH has designed this 100% online program, which will allow students, in just 6 weeks, to delve into magnetic systems, understand the phase transition or delve into the application of ideal gases. All this, through an innovative teaching material developed by a teaching team specialized in this field.



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*Thanks to TECH you can gain the most exhaustive knowledge about Advanced Thermodynamics. Enroll now”*

Thermodynamics is present in people's daily lives, although most people are not aware of it. Nevertheless, researchers and specialists in different engineering fields are constantly working with its laws and functions to obtain as a result the design of machinery or devices that are increasingly more efficient in the use of energy.

The advances that have been made in this field are notorious, however, in order to progress satisfactorily in the professional field of engineering it is of utmost importance to have a solid knowledge of Advanced Thermodynamics. For this reason, this academic institution has created this Program, which in only 6 weeks provides the concepts and keys that every specialist needs.

From the beginning of this program, the students will delve into the formalisms of thermodynamics, and subsequently, into the microscopy of macroscopic systems, canonical collectivity, magnetic systems or the Ising mode. For this purpose, innovative teaching material (video summaries, detailed videos or diagrams), complementary readings or case studies will be provided.

In this way TECH offers the professionals an excellent opportunity to consolidate essential concepts, which will lead them to progress in his career. In addition, they will be able to achieve it through a 100% online and flexible university program, to which students can access comfortably, whenever and wherever they wish. Students will only need a computer, tablet or cell phone with Internet connection to access, at any time, the syllabus of this Postgraduate Certificate.

This **Postgraduate Certificate in Advanced 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 they are created, provide scientific and practical information on the disciplines that are essential for professional practice
- ◆ Practical exercises where the self-assessment process can be carried out to improve learning
- ◆ Its special emphasis on innovative methodologies
- ◆ Theoretical lessons, questions to the expert, debate forums on controversial topics, and individual reflection assignments
- ◆ Content that is accessible from any fixed or portable device with an Internet connection



*You have a 100% online academic option, compatible with your professional and/or work responsibilities"*

“

*This is a program that will introduce you, through attractive and entertaining multimedia content, to the microscopy of macroscopic systems”*

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.

The 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 immersive education programmed to learn in real situations.

This program is designed around Problem-Based Learning, whereby the professional must try to solve the different professional practice situations that arise throughout the program. For this purpose, the student will be assisted by an innovative interactive video system created by renowned and experienced experts.

*Access the Ising model at any time and better understand the behavior of ferromagnetic materials.*

*You are just one step away from enrolling in a program that will give you everything you need to know about magnetic systems.*



# 02

# Objectives

Upon completion of this program, the students will have gained a thorough knowledge of Advanced Thermodynamics. This will be possible thanks to the multimedia material designed by a specialized teaching team, who will also solve any doubt that the students may have about the syllabus during the course. Thus, the student will have successfully understood the concepts of collectivity, microstates and macrostates or phase transition.



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*Case studies provided by specialists will lead you to integrate the different concepts, calculations and theories of thermodynamics into your daily professional performance"*



## General Objectives

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- ◆ Advance in the principles of thermodynamics
- ◆ Understand the concepts of collectivity and be able to differentiate between the different types
- ◆ Apply the concepts of Advanced Thermodynamics in different disciplines





## Specific Objectives

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- ◆ Know the basics of the Ising model
- ◆ Gain knowledge of the difference between boson and baryon statistics
- ◆ Understand the Theorem of Energy Equipartition

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*Click and enroll now in a Program that will easily delve you into boson and baryon statistics"*

# 03

# Structure and Content

TECH uses in all its program the Relearning method, based on the reiteration of content, thanks to which the students can delve into the formalism of Thermodynamics, the canonical collective, the Ising model or the photon gas, in a more agile and natural way. In addition, the video summaries, the complementary readings or the case studies to which you will have access 24 hours a day, from any device with internet connection, will facilitate the acquisition of knowledge in Advanced Thermodynamics.



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*A syllabus with a theoretical-practical vision that will lead you to master the formalisms of thermodynamics in only 6 weeks"*

## Module 1. Advanced Thermodynamics

- 1.1. Formalism of Thermodynamics
  - 1.1.1. Laws of Thermodynamics
  - 1.1.2. The Fundamental Equation
  - 1.1.3. Internal Energy: Euler's Form
  - 1.1.4. Gibbs-Duhem Equation
  - 1.1.5. Legendre Transformations
  - 1.1.6. Thermodynamic Potentials
  - 1.1.7. Maxwell's Relations for a Fluid
  - 1.1.8. Stability Conditions
- 1.2. Microscopic Description of Macroscopic Systems I
  - 1.2.1. Microstates and Macrostates: Introduction
  - 1.2.2. Phase Space
  - 1.2.3. Collectivities
  - 1.2.4. Microcanonical Collectivity
  - 1.2.5. Thermal Equilibrium
- 1.3. Microscopic Description of Macroscopic Systems II
  - 1.3.1. Discrete Systems
  - 1.3.2. Statistical Entropy
  - 1.3.3. Maxwell-Boltzmann Distribution
  - 1.3.4. Pressure
  - 1.3.5. Effusion
- 1.4. Canonical Collectivity
  - 1.4.1. Partition Function
  - 1.4.2. Ideal Systems
  - 1.4.3. Energy Degeneration
  - 1.4.4. Behavior of the Monoatomic Ideal Gas at a Potential
  - 1.4.5. Energy Equipartition Theorem
  - 1.4.6. Discrete Systems
- 1.5. Magnetic Systems
  - 1.5.1. Thermodynamics of Magnetic Systems
  - 1.5.2. Classical Paramagnetism
  - 1.5.3.  $\frac{1}{2}$ " Spin Paramagnetism
  - 1.5.4. Adiabatic Demagnetization
- 1.6. Phase Transitions
  - 1.6.1. Classification of Phase Transitions
  - 1.6.2. Phase Diagrams
  - 1.6.3. Clapeyron Equation
  - 1.6.4. Vapor-Condensed Phase Equilibrium
  - 1.6.5. The Critical Point
  - 1.6.6. Ehrenfest's Classification of Phase Transitions
  - 1.6.7. Landau's Theory
- 1.7. Ising's Model
  - 1.7.1. Introduction
  - 1.7.2. One-Dimensional Chain
  - 1.7.3. Open One-Dimensional Chain
  - 1.7.4. Mean Field Approximation
- 1.8. Real Gases
  - 1.8.1. Comprehensibility Factor: Virial Development
  - 1.8.2. Interaction Potential and Configurational Partition Function
  - 1.8.3. Second Virial Coefficient
  - 1.8.4. Van der Waals Equation
  - 1.8.5. Lattice Gas
  - 1.8.6. Corresponding States Law
  - 1.8.7. Joule and Joule-Kelvin Expansions



- 1.9. Photon Gas
  - 1.9.1. Boson Statistics Vs. Fermion Statistics
  - 1.9.2. Energy Density and Degeneracy of States
  - 1.9.3. Planck Distribution
  - 1.9.4. Equations of State of a Photon Gas
- 1.10. Macrocanonical Collectivity
  - 1.10.1. Partition Function
  - 1.10.2. Discrete Systems
  - 1.10.3. Fluctuations
  - 1.10.4. Ideal Systems
  - 1.10.5. The Monoatomic Gas
  - 1.10.6. Vapor-Solid Equilibrium

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*With this 100% online program, you will be able to understand the most advanced concepts of thermodynamics and apply them 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.





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

## Case Study to contextualize all content

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

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



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



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

### A learning method that is different and innovative

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

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

The case method 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.

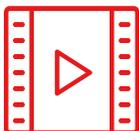
*Relearning will allow you to learn with less effort and better performance, involving you more in your training, developing a critical mindset, defending arguments, and contrasting opinions: a direct equation for success.*

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.



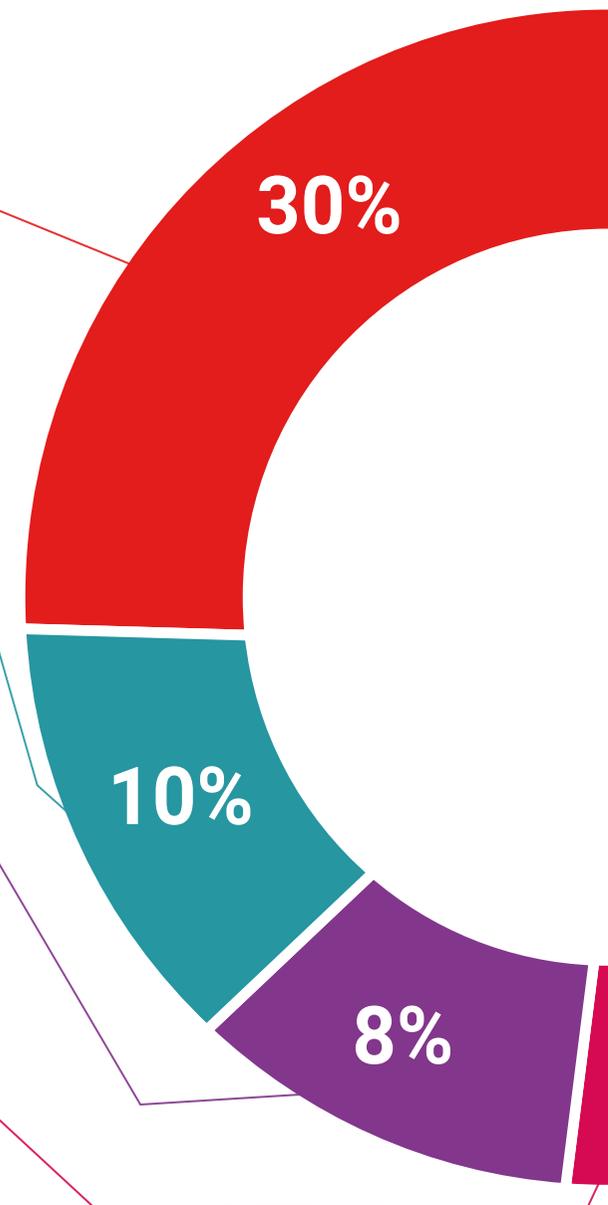
### Practising Skills and Abilities

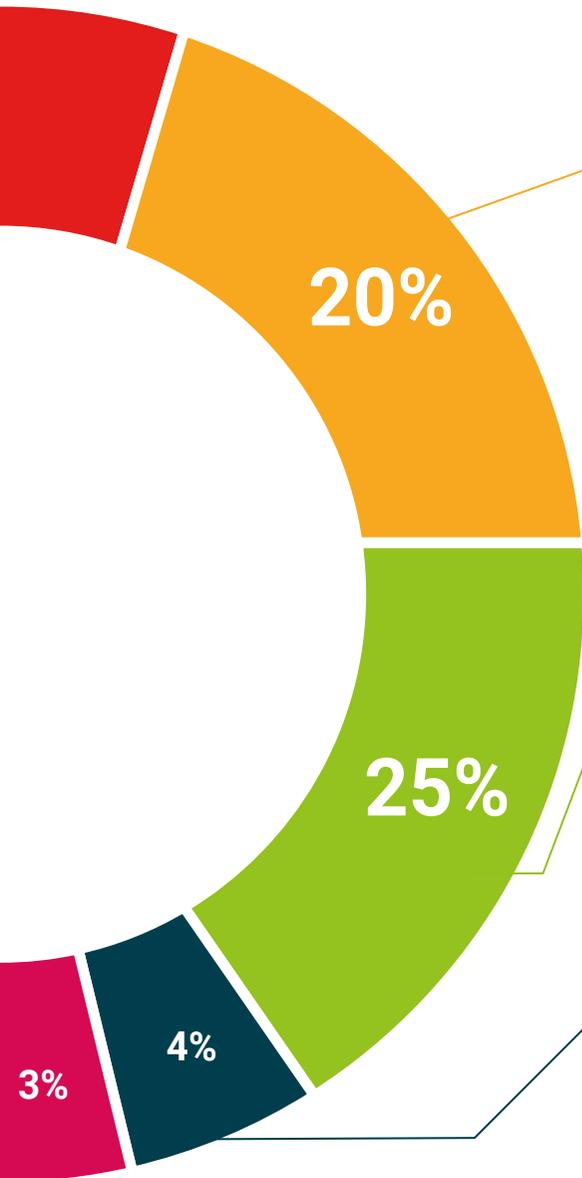
They will carry out activities to develop specific skills and abilities in each subject area. Exercises and activities to acquire and develop the skills and abilities that a specialist needs to develop in the context of the globalization that we are experiencing.



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



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

This program will allow you to obtain your **Postgraduate Certificate in Advanced Thermodynamics** 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** title 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: **Postgraduate Certificate in Advanced Thermodynamics**

Modality: **online**

Duration: **6 weeks**

Accreditation: **6 ECTS**



\*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.

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

**tech** global  
university

Postgraduate Certificate  
Advanced  
Thermodynamics

- » Modality: online
- » Duration: 6 weeks
- » Certificate: TECH Global University
- » Credits: 6 ECTS
- » Schedule: at your own pace
- » Exams: online

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