Postgraduate Diploma
Thermodynamics

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Postgraduate Diploma
Thermodynamics

- » Modality: **online**
- » Duration: **6 months**
- » Certificate: **TECH Technological University**
- » Dedication: **16h/week**
- » Schedule: **at your own pace**
- » Exams: **online**

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

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01

Introduction

Energy is neither created nor destroyed, it is only transformed. This is one of the laws of thermodynamics, thanks to which, progress has been made today in vehicle engines, in the creation of solar panels or in the manufacture of machinery in the food industry. In order to continue progressing and innovating in this field, however, it is necessary to have a broad knowledge of the main fundamentals of this branch of physics. For this reason, this 100% online degree was created, which will allow the student to acquire advanced learning about calorimetry, ideal gas laws or icrocanonical collectivity. This will be possible thanks to the multimedia resources developed ad hoc by a specialized teaching team.

With this Postgraduate Diploma. you will obtain the necessary knowledge about Thermodynamics, to apply it to the industrial sector”

Behind many of today's advances in the industrial and automotive sectors, and even in the household appliances that we use in our daily lives, are the principles of thermodynamics. These concepts are the basis for all engineering professionals who wish to prosper with their creations, projects or new ideas.

The applications of Thermodynamics are very diverse, but undoubtedly require clear concepts about this branch of physics and also that the professional has the technical knowledge that will lead to finding the best solutions. For this reason, TECH has decided to create this Postgraduate Diploma in Thermodynamics, which in only 6 months will acquire the most and relevant information in this field.

A program, which is also characterized by providing students with the most innovative pedagogical tools of academic teaching. This will allow them to delve in a much more dynamic and agile way into entropy, statistical mechanics, Ising's model or the fundamentals of atmospheric thermodynamics. In addition, the Relearning system will allow reducing the long hours of study.

This academic institution thus offers an excellent opportunity for the specialist who wishes to pursue a quality program conveniently, when and where he/she wishes. The only thing they need is an electronic device with an Internet connection to be able to view, at any time, the Syllabus hosted on the Virtual Campus. In addition, students will have the freedom to distribute the course load according to their needs, obtaining greater flexibility and allowing them to combine their work and/or personal responsibilities with a 100% online program.

This **Postgraduate Diploma in Thermodynamics** contains the most complete and up-to-date educational program on the market. Its most notable features are:

- 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

“Enroll now in a Postgraduate Diploma which is compatible with your professional responsibilities”

The case studies elaborated by the specialists who participate in this program will show you the applications of thermodynamic diagrams"

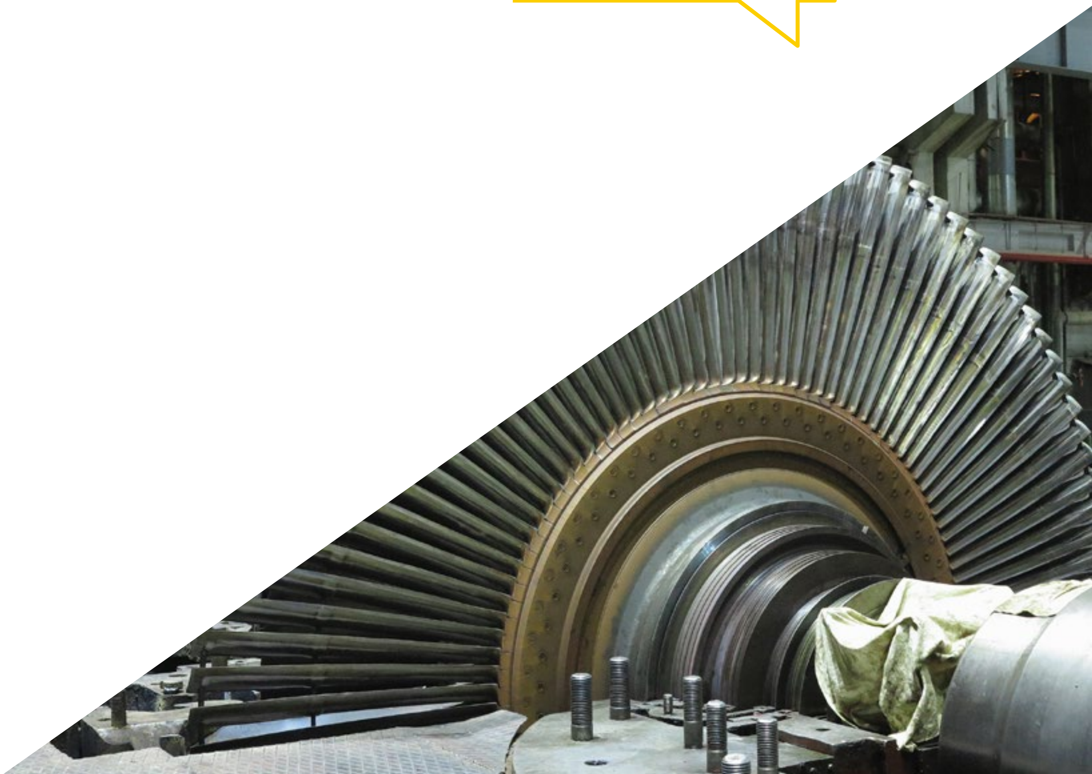
The program's teaching staff includes professionals from sector who contribute their work experience to this educational program, as well as renowned specialists from leading societies and prestigious universities.

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 during the academic year For this purpose, the student will be assisted by an innovative interactive video system created by renowned and experienced experts.

Teaching resources are available 24 hours a day, allowing you to delve into the keys to the thermodynamics of the atmosphere in a more enjoyable way.

Thanks to the innovative content of this program, you will delve into the four principles of thermodynamics.



02

Objectives

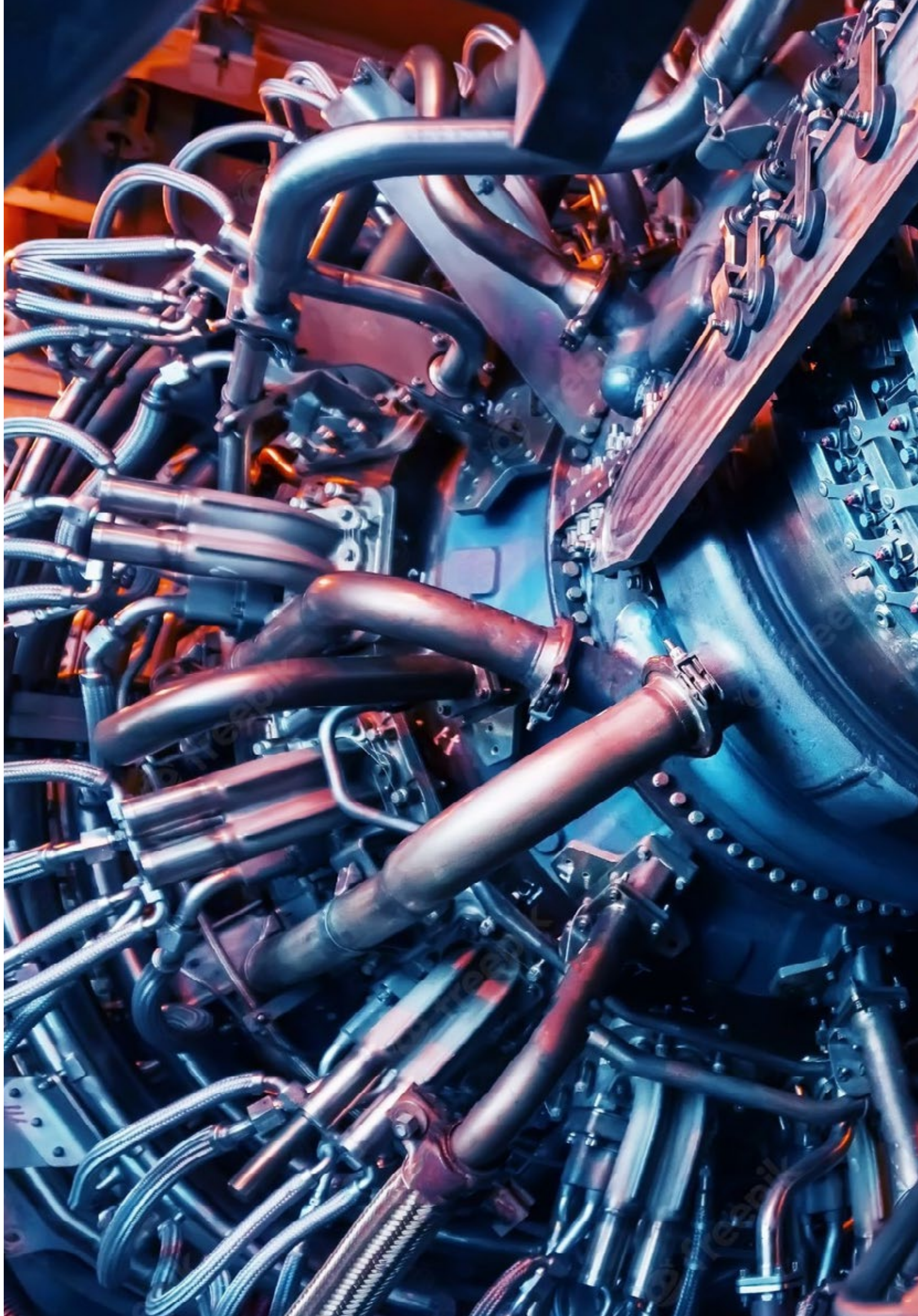
Thanks to the theoretical-practical approach of this Postgraduate Diploma, the student will obtain the most complete knowledge which can be applied directly to their daily practice. Upon completion of this program, you will have mastered the principles of thermodynamics and will be able to transfer the concepts to your projects to obtain optimal results. The case studies and detailed videos developed for this program will be very useful in the foundation of ideas.

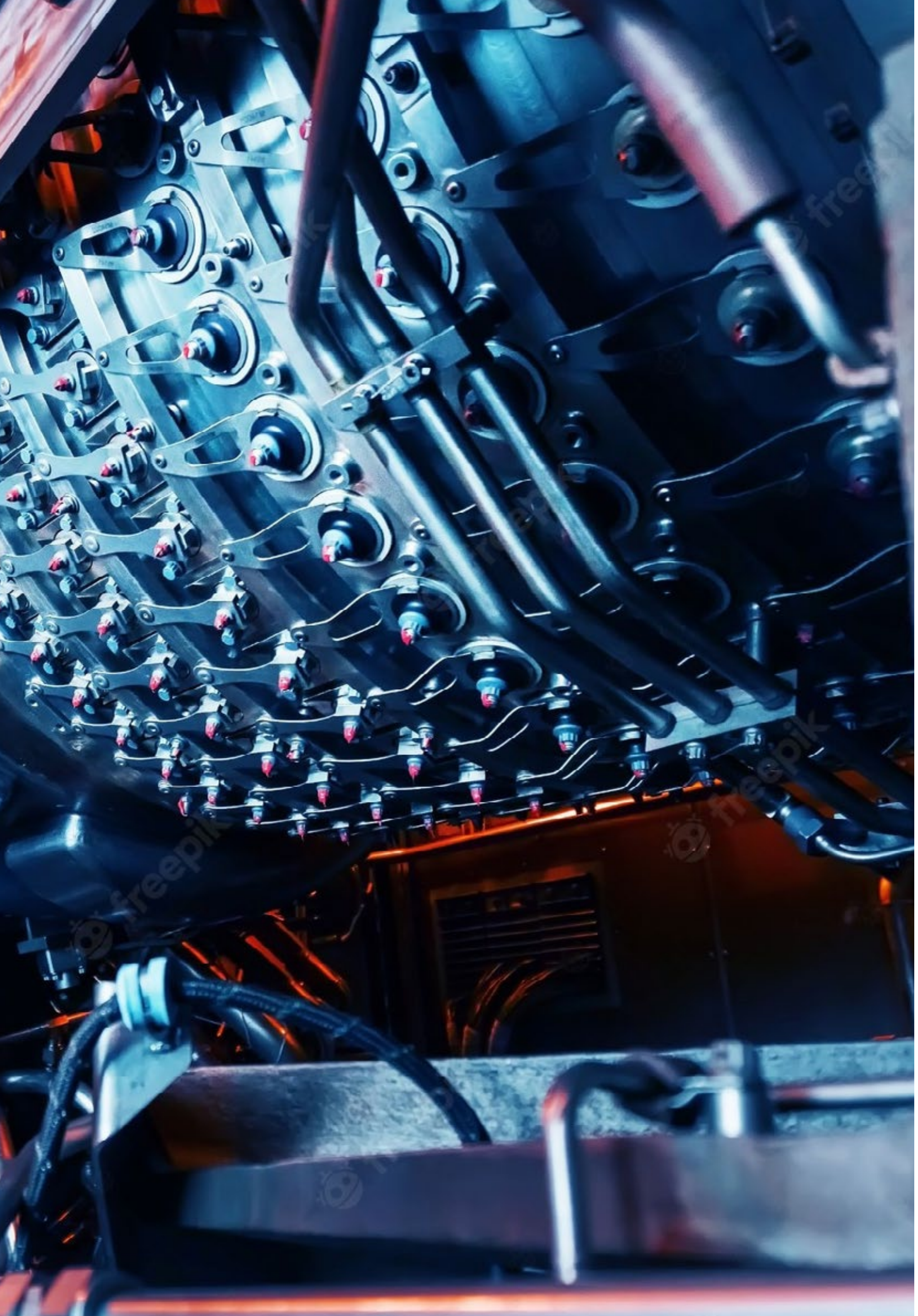
TECH offers you the most advanced content, so that in only 6 months you can master and effectively apply the thermodynamic systems"

General Objectives

- Understand the four principles of thermodynamics and apply them to the study of thermodynamic systems
- Know how to distinguish which collectivity will be more useful to the study of a given system depending on the type of thermodynamic system
- Acquire the basic notions of magnetic systems
- Understand the Use of Thermodynamic Diagrams in Meteorology

With the knowledge acquired in this Postgraduate Diploma, you will be able to solve quickly and effectively any problem about Thermodynamics"





Specific Objectives

Module 1. Thermodynamics

- Solve problems effectively in the field of thermodynamics
- Acquire basic notions of statistical mechanics
- Be able to analyze different contexts and environments in the field of physics based on a solid mathematical foundation
- Understand and use mathematical and numerical methods commonly used in thermodynamics

Module 2. Advanced Thermodynamics

- Advance in the principles of thermodynamics
- Understand the concepts of collectivity and be able to differentiate between 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
- Know the basics of the Ising model
- Gain knowledge of the difference between boson and baryon statistics

Module 3. Thermodynamics of the Atmosphere

- Recognize thermodynamic phenomena
- Identify the determinant role of water vapor in the atmosphere
- Be able to characterize atmospheric stability
- Obtain basic knowledge about current global warming

03

Structure and Content

This Postgraduate Diploma provides the engineering professional with all the necessary knowledge on the laws of thermodynamics for its direct application in those projects and ideas that he/she has in mind. In order to acquire, in only 6 months, this intensive learning, you will have video summaries of each topic, videos in detail, essential readings and case studies prepared by the expert teaching team that is part of this program. All of this will allow you to successfully advance in your career.

After completing 450 teaching hours, you will be able to create any project you have in mind that requires advanced knowledge in thermodynamics"

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
   1.4.4. 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

Module 3. Thermodynamics of the Atmosphere

3.1. Introduction
  3.1.1. Thermodynamics of the Ideal Gas
  3.1.2. Laws of Conservation of Energy
  3.1.3. Laws of Thermodynamics
  3.1.4. Pressure, Temperature and Altitude
  3.1.5. Maxwell-Boltzmann Distribution of Velocities

- 3.2. The Atmosphere
    - 3.2.1. The Physics of the Atmosphere
    - 3.2.2. Air Composition
    - 3.2.3. Origin of the Earth's Atmosphere
    - 3.2.4. Atmospheric Mass Distribution and Temperature
- 3.3. Fundamentals of Atmospheric Thermodynamics
    - 3.3.1. Equation of State of Air
    - 3.3.2. Humidity Indices
    - 3.3.3. Hydrostatic Equation: Meteorological Applications
    - 3.3.4. Adiabatic and Diabatic Processes
    - 3.3.5. Entropy in Meteorology
- 3.4. Thermodynamic Diagrams
    - 3.4.1. Relevant Thermodynamic Diagrams
    - 3.4.2. Properties of Thermodynamic Diagrams
    - 3.4.3. Emagrams
    - 3.4.4. Oblique Diagram: Applications
- 3.5. Study of Water and its Transformations
    - 3.5.1. Thermodynamic Properties of Water
    - 3.5.2. Phase Transformation in Equilibrium
    - 3.5.3. Clausius-Clapeyron Equation
    - 3.5.4. Approximations and Consequences of the Clausius-Clapeyron Equation
- 3.6. Condensation of Water Vapor in the Atmosphere
    - 3.6.1. Phase Transitions of Water
    - 3.6.2. Thermodynamic Equations of Saturated Air
    - 3.6.3. Equilibrium of Water Vapor with Water Droplets: Kelvin and Köhler Curves
    - 3.6.4. Atmospheric Processes that Give Rise to Water Vapor Condensation
- 3.7. Atmospheric Condensation by Isobaric Processes
    - 3.7.1. Dew and Frost Formation
    - 3.7.2. Formation of Radiative and Advection Fogs
    - 3.7.3. Isoenthalpic Processes
    - 3.7.4. Equivalent Temperature and Wet Thermometer Temperature
    - 3.7.5. Isoenthalpic Mixtures of Air Masses
    - 3.7.6. Mixing Mists
- 3.8. Atmospheric Condensation by Adiabatic Ascent
    - 3.8.1. Saturation of Air by Adiabatic Rise
    - 3.8.2. Reversible Adiabatic Saturation Processes
    - 3.8.3. Pseudo-Adiabatic Processes
    - 3.8.4. Equivalent Pseudo-Potential and Wet-Thermometer Temperature
    - 3.8.5. Föhn Effect
- 3.9. Atmospheric Stability
    - 3.9.1. Stability Criteria in Unsaturated Air
    - 3.9.2. Stability Criteria in Saturated Air
    - 3.9.3. Conditional Instability
    - 3.9.4. Convective Instability
    - 3.9.5. Analysis of Stabilities by Means of the Oblique Diagram
- 3.10. Thermodynamic Diagrams
    - 3.10.1. Conditions for Equivalent Area Transformations
    - 3.10.2. Examples of Thermodynamic Diagrams
    - 3.10.3. Graphical Representation of Thermodynamic Variables in a T-ln(p) Diagram
    - 3.10.4. Use of Thermodynamic Diagrams in Meteorology

A program that will you allow to delve into the Clausius-Clapeyron equation and its use in determining the enthalpy of vaporization of substances"

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

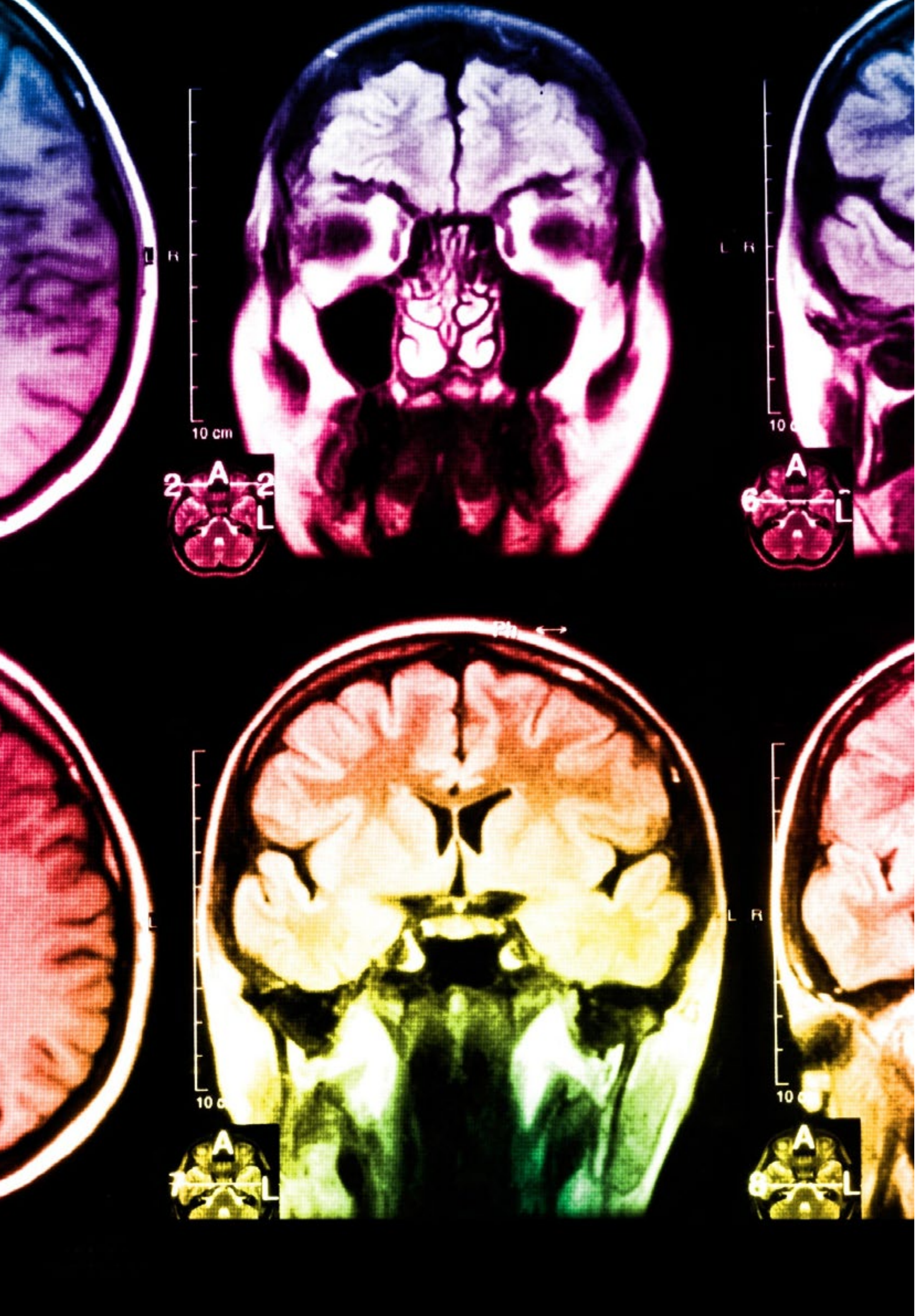
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines 8 different teaching elements in each lesson.

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.

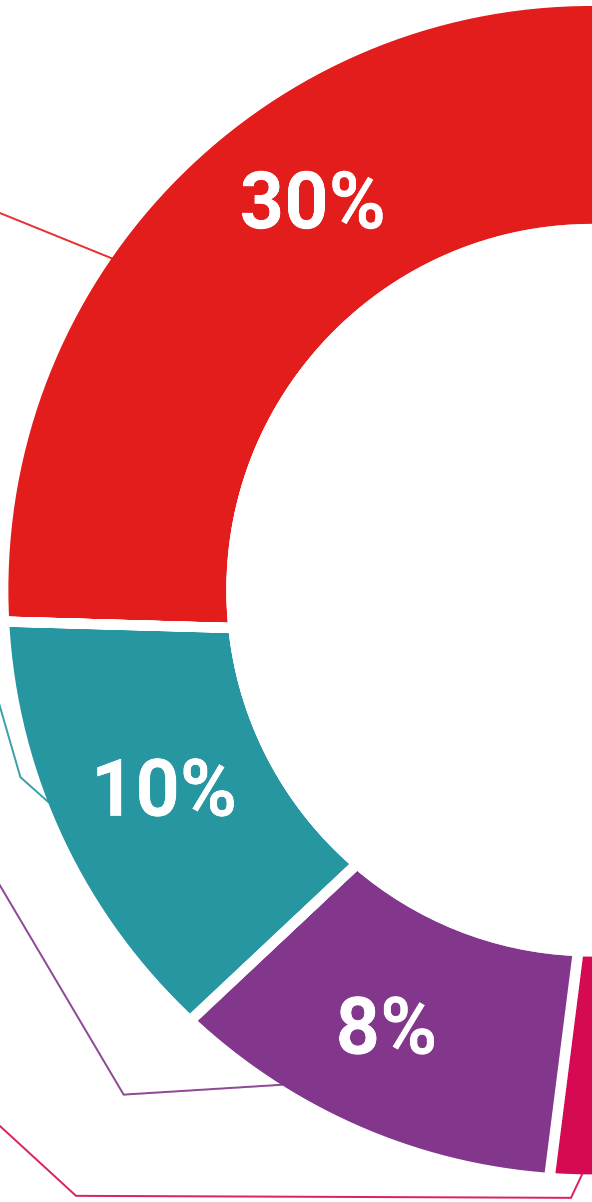
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

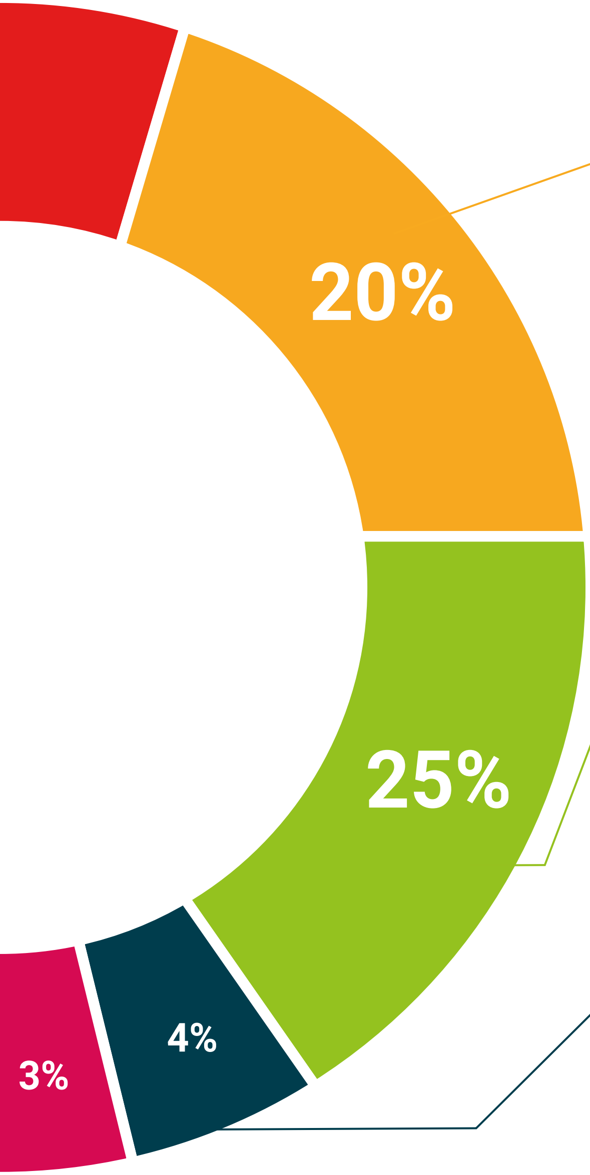
Practising Skills and Abilities

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 Diploma in Thermodynamics 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 Thermodynamics** contains the most complete and up-to-date program on the market.

After the student has passed the assessments, they will receive their corresponding **Postgraduate 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 meets the requirements commonly demanded by labor exchanges, competitive examinations, and professional career evaluation committees.

Title: **Postgraduate Certificate in Thermodynamics**

Official Nº of hours: **450 h.**


tech technological university

Awards the following

DIPLOMA

to

Mr./Ms. ________________, with identification number ____________.

For having passed and accredited the following program

POSTGRADUATE DIPLOMA

in

Thermodynamics

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

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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