Postgraduate Diploma

Radiophysics Applied to Radiotherapy

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Postgraduate Diploma
Radiophysics Applied to Radiotherapy

- 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-radiophysics-applied-radiotherapy**

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01

Introduction

Radiophysics Applied to Radiotherapy fuses Physics and Engineering to optimize and improve Radiotherapy treatments used in Cancer and other diseases. In fact, by applying principles of ionizing radiation physics and engineering techniques, millimetric precision is achieved in the administration of radiation doses, maximizing the destruction of cancerous tissue and preserving the surrounding healthy tissue. The use of sophisticated equipment and advanced control systems allows the personalization of treatments, adapting them to the anatomy of each patient. TECH has focused on providing engineers with a program that will train them in the strategic use of radiation to improve the diagnosis and treatment of various pathologies.

Thanks to this Postgraduate Diploma in Radiophysics Applied to Radiotherapy, you will guarantee the maximum effectiveness of diagnoses and treatments in the medical field"

The application of Radiophysics in Radiotherapy focuses on using physical principles to design treatment plans that maximize the dose in diseased tissue and minimize exposure to healthy tissue. The application of Radiophysics in Radiotherapy focuses on using physical principles to design treatment plans that maximize the dose in diseased tissue and minimize exposure to healthy tissue.

This Postgraduate Diploma was born, which opens the doors for engineers to explore the interaction between ionizing radiation and biological tissues, understanding the resulting cellular and biological effects, and analyzing the repair mechanisms. In addition, the relative biological efficiency of various forms of ionizing radiation will be evaluated, which will be fundamental for clinical practice in external radiotherapy, highlighting the importance of radioprotection and risk management associated with these radiations.

The program will also delve into physical dosimetry, a cornerstone in external radiotherapy to characterize the radiation beams used in clinical treatments. Emphasis will also be placed on the necessary controls on equipment and the minimum requirements to ensure safe and consistent treatments.

Another crucial aspect will be clinical dosimetry, with a special focus on the use of computer tools to solve challenges. Finally, the stages of the radiotherapeutic process will be explored, from simulation to dose verification for specific therapies, such as intensity-modulated therapies, which involve modulating the intensity of the radiation beam to achieve inhomogeneous dose distributions.

In this way, a comprehensive and in-depth program has been developed based on the innovative *Relearning*methodology, a pioneer in TECH. This method focuses on the repetition of key concepts to ensure that graduates achieve a full understanding of the content. In addition, access to all learning resources will only require an electronic device with an Internet connection.

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

- The development of practical cases presented by experts in Radiophysics Applied to Radiotherapy
- 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

Developing and mastering advanced technologies, such as computed tomography, will enable you to contribute significantly to medical teams"

Through this fully online program, you will delve into the application of physical dosimetry to ensure accurate radiation dose delivery"

You will use physical dosimetry for external radiotherapy, taking advantage of the most advanced multimedia resources to optimize treatments.

Thanks to TECH and this complete training, you will be introduced to Radiobiology of healthy and cancerous tissues. Enroll now!

The program's teaching staff includes professionals from the field 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 students will be assisted by an innovative interactive video system created by renowned and experienced experts.

02

Objectives

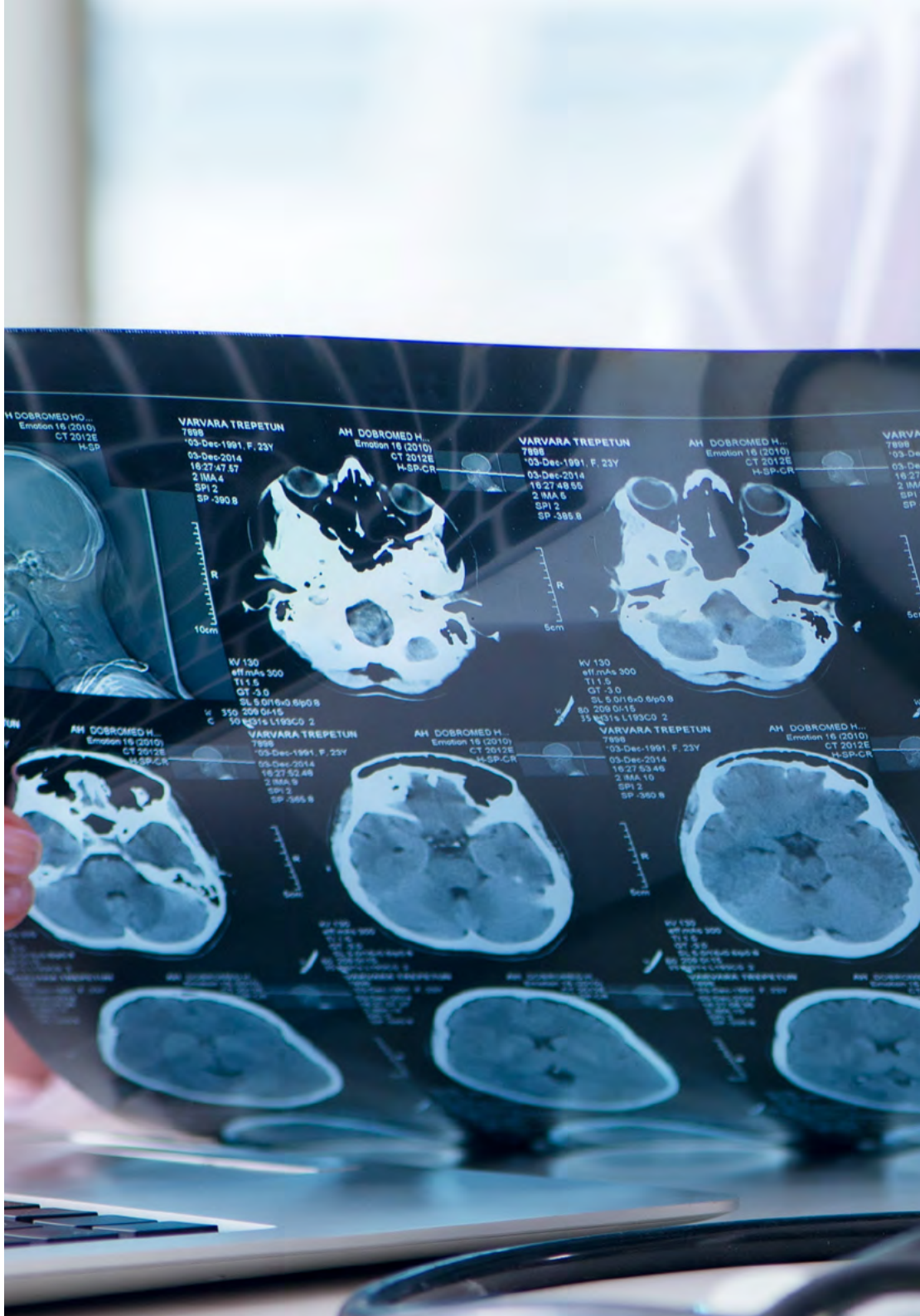
The main objective of the program is to train engineers in Radiobiology, Physical and Clinical Dosimetry, as well as in the advanced use of Radiotherapy technologies. At the end of this program, graduates will have not only a solid knowledge of how ionizing radiation interacts with biological tissues, but also the practical skills to design and develop Radiotherapy procedures with precision and safety. In addition, the importance of radioprotection, accuracy in dose administration and efficiency in the use of computer tools to solve challenges will be emphasized.

Give a twist to your career as an engineer, focusing on the medical field, and specialize in Radiophysics Applied to Radiotherapy in just 6 months"

General Objectives

- Investigate the basic interactions of ionizing radiation with tissues
- Establish the effects and risks of ionizing radiation at the cellular level
- Determine the cellular response to these effects in different medical exposures
- Specify the equipment used in external radiotherapy treatments
- Develop the steps to initiate treatments with external radiotherapy equipment
- Analyze the elements used in the measurement of photon and electron beams for external radiotherapy treatments
- Examine the quality control program
- Analyze the evolution of clinical dosimetry in external radiotherapy over the years
- Delve into the different stages of external radiotherapy treatment
- Delve into the characteristics of treatment planning systems
- Identify the different planning techniques for external radiotherapy treatments
- Apply specific quality controls for the verification of treatment plans

You will apply your knowledge in Radiobiology and Dosimetry to support physicians in administering more accurate and safer treatments. Bet on TECH!"



Specific Objectives

Module 1. Radiobiology

- Assess the risks associated with the main medical exposures
- Analyze the effects of ionizing radiation interaction with tissues and organs
- Examine the various mathematical models available in radiobiology
- Establish the various parameters that affect the biological response to ionizing radiation

Module 2. External Radiotherapy. Physical dosimetry

- Establish the different simulation, localization and image-guided radiotherapy equipment
- Develop photon beam and electron beam calibration procedures
- Examine the quality control program of external radiotherapy equipment

Module 3. External Radiotherapy. Clinical Dosimetry

- Specify the different characteristics of the different types of external radiotherapy treatments
- Develop quality control procedures for planning systems
- Examine the tools used to evaluate external radiotherapy planning
- Analyze the different verification systems for external radiotherapy plans, as well as the metrics used

03

Course Management

The faculty who have designed this Postgraduate Diploma in Radiophysics Applied to Radiotherapy are true experts in this field. They will bring a unique combination of practical experience and solid theoretical knowledge, providing exceptional training. These highly specialized professionals not only have an outstanding academic background, but also keep up to date with the latest radiotherapeutic technologies. Their fundamental commitment is to guide graduates toward excellence, imparting technical information and instilling values such as accuracy, ethics and the desire to continuously improve.

The best teaching staff will guide you on your journey through the Postgraduate Diploma in Radiophysics Applied to Radiotherapy, with the TECH quality guarantee"

Management

Dr. De Luis Pérez, Francisco Javier

- Specialist in Hospital Radiophysics
- Head of the Radiophysics and Radiological Protection Service at Quirónsalud Hospitals in Alicante, Torrevieja and Murcia
- Research Group in Personalized Multidisciplinary Oncology, Catholic University San Antonio of Murcia
- PhD in Applied Physics and Renewable Energies, University of Almeria
- Degree in Physical Sciences, specializing in Theoretical Physics, University of Granada
- Member of: Spanish Society of Medical Physics (SEFM), Royal Spanish Society of Physics (RSEF), Illustrious Official College of Physicists and Consulting and Contact Committee, Proton Therapy Center (Quirónsalud)

Professors

Dr. Irazola Rosales, Leticia

- Specialist in Hospital Radiophysics
- Physician in Hospital Radiophysics at the Biomedical Research Center of La Rioja
- Working group on Lu-177 treatments at the Spanish Society of Medical Physics (SEFM)
- Collaborator at the University of Valencia
- Reviewer of the journal Applied Radiation and Isotopes
- International PhD in Medical Physics, University of Seville, Spain
- Professional Master's Degree in Medical Physics from the University of Rennes I
- Degree in Physics from the University of Zaragoza
- Member of: European Federation of Organizations in Medical Physics (EFOMP) and Spanish Society of Medical Physics (SEFM)

Dr. Morera Cano, Daniel

- Specialist in Hospital Radiophysics
- Physician in Hospital Radiophysics at the University Hospital Son Espases
- Professional Master's Degree in Industrial Safety and Environment by the Polytechnic University of Valencia
- Professional Master's Degree in Radiological Protection in Radioactive and Nuclear Facilities by the Polytechnic University of Valencia
- Degree in Industrial Engineering from the Polytechnic University of Valencia

04

Structure and Content

The approach of this academic program is meticulous and complete, aimed at training highly qualified engineers in Radiophysics Applied to Radiotherapy. Its content will cover from the fundamental principles of Radiobiology to Clinical Dosimetry, offering a tour through modules that will analyze in depth the interaction between radiation and biological tissues and the advanced use of radiotherapeutic technologies. This program will integrate theoretical knowledge with practical applications, emphasizing professional ethics, constant innovation and commitment to excellence.

You will acquire specialized knowledge for practice in the different areas of the healthcare field where ionizing radiation is present"

Module 1. Radiobiology

1.1. Interaction of Radiation with Organic Tissues
- 1.1.1. Interaction of Radiation with Tissues
- 1.1.2. Interaction of Radiation with the Cell
- 1.1.3. Physicochemical Response

1.2. Effects of Ionizing Radiation on DNA
- 1.2.1. Structure of ADN
- 1.2.2. Radiation-Induced Damage
- 1.2.3. Damage Repair

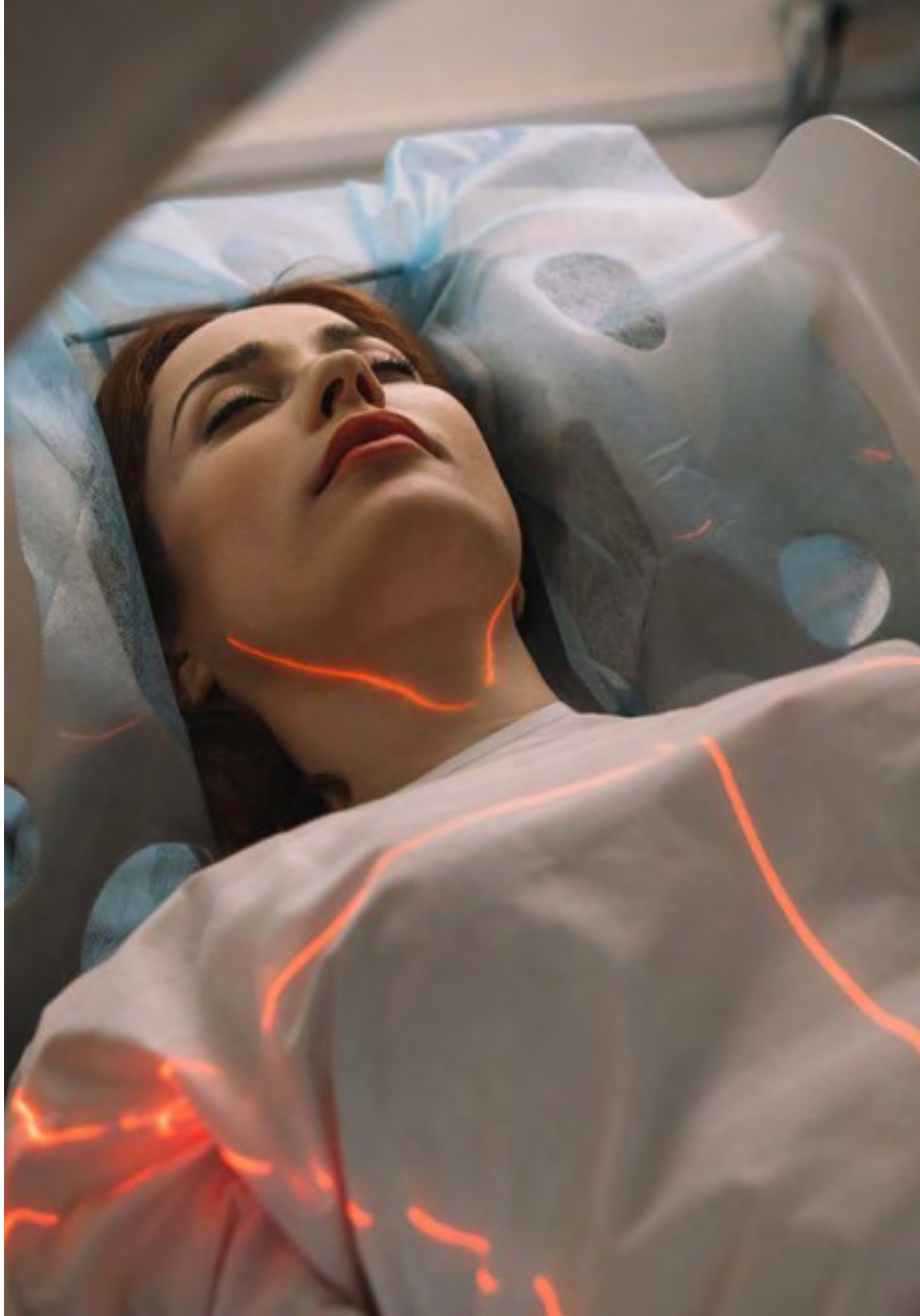
1.3. Radiation Effects on Organic Tissues
- 1.3.1. Effects on the Cell Cycle
- 1.3.2. Irradiation Syndromes
- 1.3.3. Aberrations and Mutations

1.4. Mathematical Models of Cell Survival
- 1.4.1. Mathematical Models of Cell Survival
- 1.4.2. Alpha-Beta Model
- 1.4.3. Effect of Fractionation

1.5. Efficacy of Ionizing Radiation on Organic Tissues
- 1.5.1. Relative Biological Efficacy
- 1.5.2. Factors Altering Radiosensitivity
- 1.5.3. LET and Oxygen Effect

1.6. Biological Aspects According to the Dose of Ionizing Radiations
- 1.6.1. Radiobiology at Low Doses
- 1.6.2. Radiobiology at High Doses
- 1.6.3. Systemic Response to Radiation

1.7. Estimation of the Risk of Ionizing Radiation Exposure
- 1.7.1. Stochastic and Random Effects
- 1.7.2. Risk Estimation
- 1.7.3. ICRP Dose Limits



1.8. Radiobiology in Medical Exposures in Radiotherapy
- 1.8.1. Isoeffect
- 1.8.2. Proliferation Effect
- 1.8.3. Dose-Response

1.9. Radiobiology in Medical Exposures in Other Medical Exposures
- 1.9.1. Brachytherapy
- 1.9.2. Radiodiagnostics
- 1.9.3. Nuclear Medicine

1.10. Statistical Models in Cell Survival
- 1.10.1. Statistical Models
- 1.10.2. Survival Analysis
- 1.10.3. Epidemiological Studies

Module 2. External Radiotherapy. Physical Dosimetry

2.1. Linear Electron Accelerator. Equipment in External Radiotherapy
- 2.1.1. Linear Electron Accelerator (LEA)
- 2.1.2. External Radiotherapy Treatment Planner (TPS)
- 2.1.3. Registration and Verification Systems
- 2.1.4. Special Techniques
- 2.1.5. Hadrontherapy

2.2. Simulation and Localization Equipment in External Radiotherapy
- 2.2.1. Conventional Simulator
- 2.2.2. Computed Tomography (CT) Simulation
- 2.2.3. Other Image Modalities

2.3. Equipment in Image-Guided External Radiation Therapy
- 2.3.1. Simulation Equipment
- 2.3.2. Image-Guided Radiotherapy Equipment. CBCT
- 2.3.3. Image-Guided Radiotherapy Equipment. Planar Image
- 2.3.4. Auxiliary Localization Systems

2.4. Photon Beams in Physical Dosimetry
- 2.4.1. Measurement Equipment
- 2.4.2. Calibration Protocols
- 2.4.3. Calibration of Photon Beams
- 2.4.4. Relative Dosimetry of Photon Beams

2.5. Electron Beams in Physical Dosimetry
- 2.5.1. Measurement Equipment
- 2.5.2. Calibration Protocols
- 2.5.3. Electron Beam Calibration
- 2.5.4. Relative Electron Beam Dosimetry

2.6. Commissioning of External Radiation Therapy Equipment
- 2.6.1. Installation of External Radiotherapy Equipment
- 2.6.2. Acceptance of External Radiotherapy Equipment
- 2.6.3. Initial Reference State (ERI)
- 2.6.4. Clinical Use of External Radiation Therapy Equipment
- 2.6.5. Treatment Planning System

2.7. Quality Control of External Radiation Therapy Equipment
- 2.7.1. Quality Control in Linear Accelerators
- 2.7.2. Quality Controls on IGRT Equipment
- 2.7.3. Quality Controls on Simulation Systems
- 2.7.4. Special Techniques

2.8. Quality Control of Radiation Measuring Equipment
- 2.8.1. Dosimetry
- 2.8.2. Measurement Instrumentation
- 2.8.3. Dummies Used

2.9. Application of Risk Analysis Systems in External Radiation Therapy
- 2.9.1. Risk Analysis Systems
- 2.9.2. Error Reporting Systems
- 2.9.3. Process Maps

2.10. Quality Assurance Program in Physical Dosimetry
- 2.10.1. Responsibilities
- 2.10.2. Requirements in External Radiation Therapy
- 2.10.3. Quality Assurance Program. Clinical and Physical Aspects
- 2.10.4. Maintenance of the Quality Assurance Program

Module 3. External Radiotherapy. Clinical Dosimetry

3.1. Clinical Dosimetry in External Radiotherapy
- 3.1.1. Clinical Dosimetry in External Radiotherapy
- 3.1.2. Treatments in External Radiatherapy
- 3.1.3. Beam Modifying Elements

3.2. Stages of Clinical Dosimetry of External Radiotherapy
- 3.2.1. Simulation Stage
- 3.2.2. Treatment Planning
- 3.2.3. Treatment Verification
- 3.2.4. Linear Electron Accelerator Treatment

3.3. Treatment Planning Systems in External Radiotherapy
- 3.3.1. Modeling in Planning Systems
- 3.3.2. Calculation Algorithms
- 3.3.3. Utilities of Planning Systems
- 3.3.4. Image Tools of the Planning Systems

3.4. Quality Control of Planning Systems in External Radiotherapy
- 3.4.1. Quality Control of Planning Systems in External Radiotherapy
- 3.4.2. Initial Reference State
- 3.4.3. Periodic Controls

3.5. Manual Calculation of Monitor Units (MUs)
- 3.5.1. Manual Control of MUs
- 3.5.2. Factors Intervening in the Dose Distribution
- 3.5.3. Practical Example of Calculation of UMs

3.6. Conformal 3D Radiotherapy Treatments
- 3.6.1. 3D Radiotherapy (RT3D)
- 3.6.2. RT3D Treatments with Photon Beams
- 3.6.3. RT3D Treatments with Electron Beams

3.7. Advanced Intensity Modulated Treatments
- 3.7.1. Intensity Modulated Treatments
- 3.7.2. Optimization
- 3.7.3. Specific Quality Control

3.8. Evaluation of an External Radiotherapy Planning
- 3.8.1. Dose-Volume Histogram
- 3.8.2. Conformation Index and Homogeneity Index
- 3.8.3. Clinical Impact of the Schedules
- 3.8.4. Planning Errors

3.9. Advanced Special Techniques in External Radiotherapy
- 3.9.1. Radiosurgery and Extracranial Stereotactic Radiotherapy
- 3.9.2. Total Body Irradiation
- 3.9.3. Total Body Surface Irradiation
- 3.9.4. Other Technologies in External Radiation Therapy

3.10. Verification of Treatment Plans in External Radiotherapy
- 3.10.1. Verification of Treatment Plans in External Radiotherapy
- 3.10.2. Treatment Verification Systems
- 3.10.3. Treatment Verification Metrics

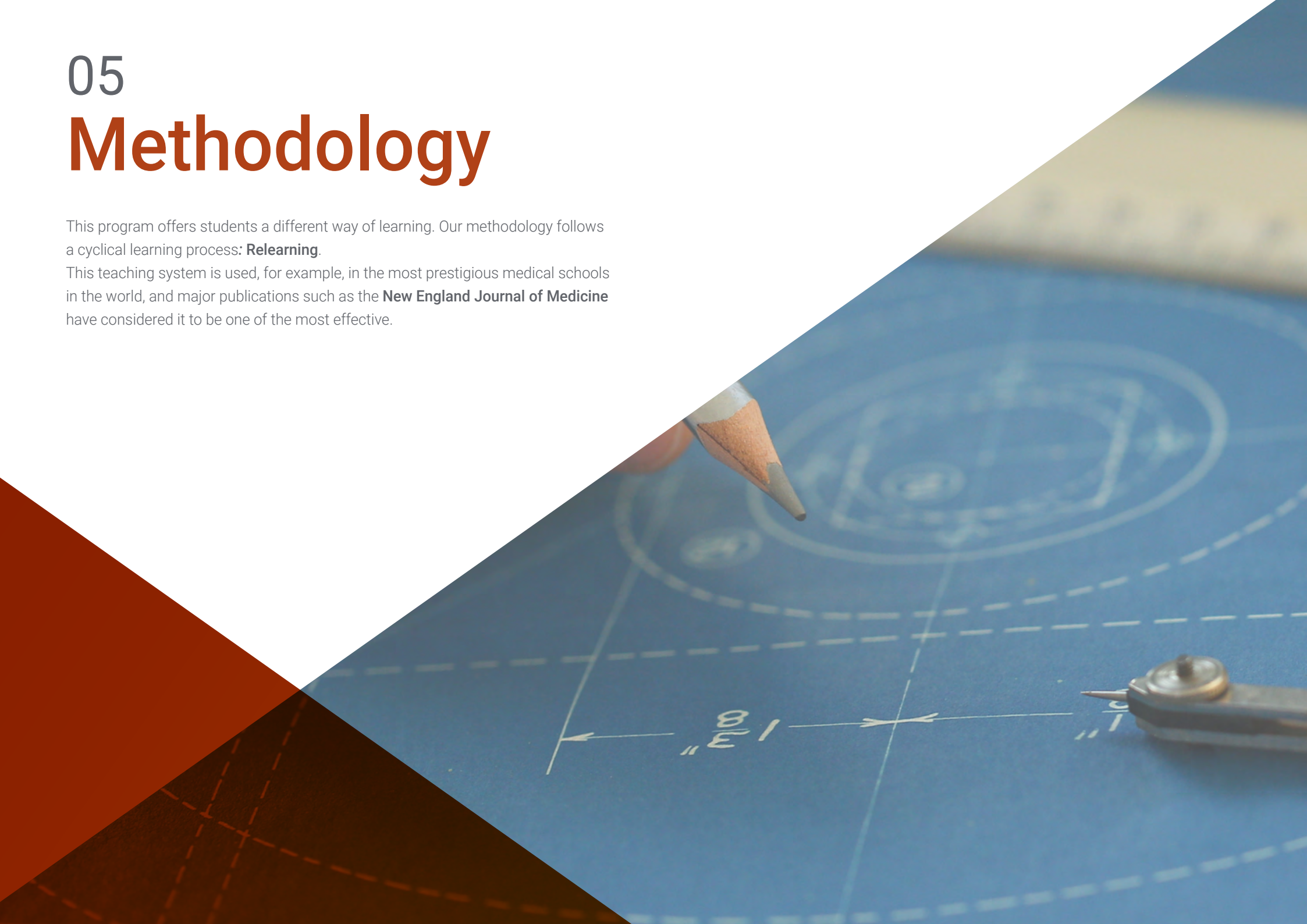
Thanks to the revolutionary Relearning methodology, you will integrate all the knowledge in an optimal way to successfully achieve the results you are looking for"

05

Methodology

This program offers students a different way of learning. Our methodology follows a cyclical learning process*:* **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 method of skills and knowledge development. Our goal is to strengthen skills in a changing, competitive, and highly demanding environment.

At TECH, you will experience a way of learning 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

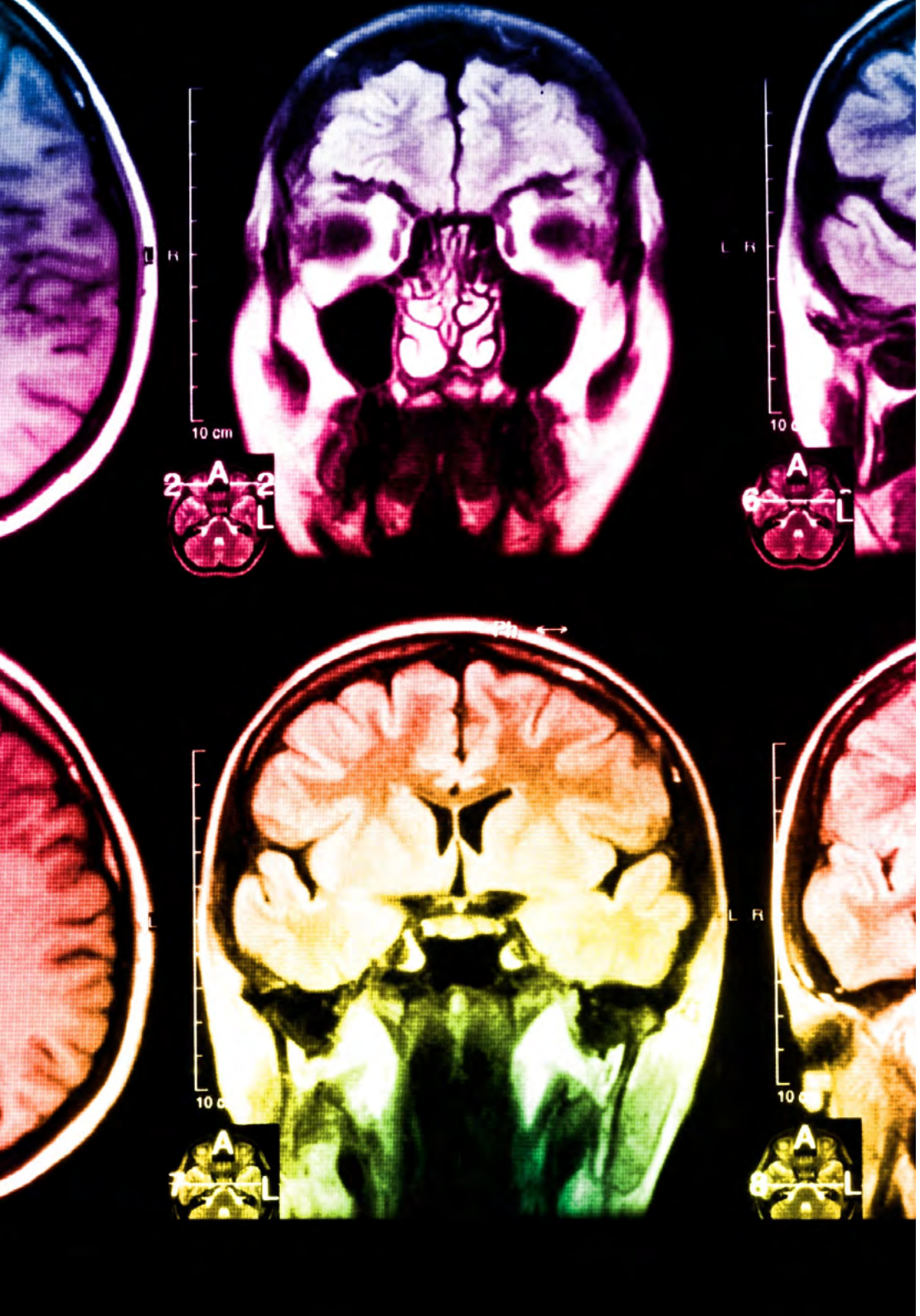
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines 8 different teaching elements in each lesson.

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 prepare 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 prepared 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 education, 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 adapted in 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.

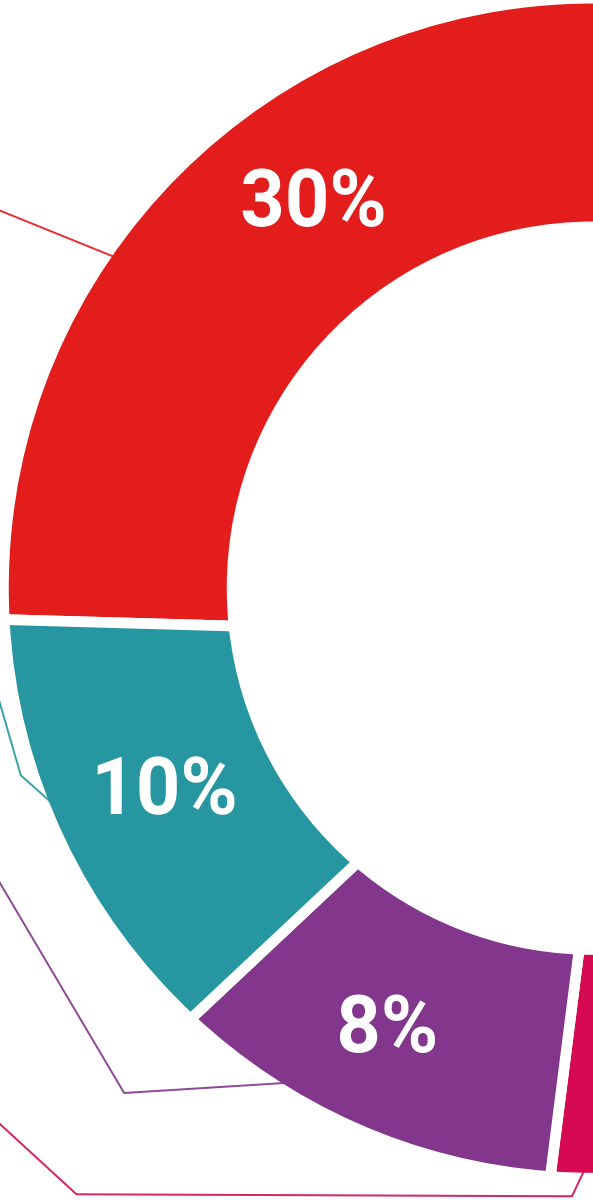
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

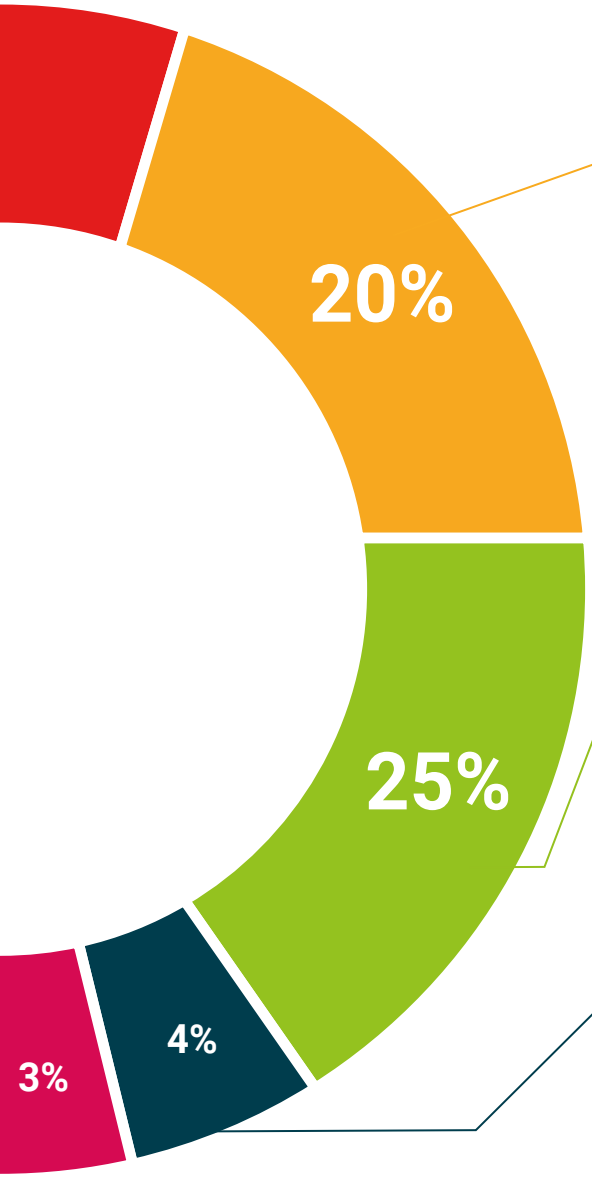
Practicing Skills and Abilities

They will carry out activities to develop specific competencies and skills in each thematic field. Exercises and activities to acquire and develop the skills and abilities that a specialist needs to develop 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 assess and re-assess 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 Radiophysics Applied to Radiotherapy guarantees, in addition to the most rigorous and training, 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 Radiophysics Applied to Radiotherapy** 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 Diploma in Radiophysics Applied to Radiotherapy**

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

Radiophysics Applied to Radiotherapy

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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