Professional Master's Degree
Radiophysics

tech global university

Professional Master's Degree
Radiophysics

- Modality: **online**
- Duration: **12 months**
- Certificate: **TECH Global University**
- Credits: **60 ECTS**
- Schedule: **at your own pace**
- Exams: **online**

Website: **www.techtitute.com/us/engineering/professional-master-degree/master-radiophysics**

Index

01

Introduction

Radiophysics applied to Engineering is a multidisciplinary field, using the principles of Physics to understand, develop and apply technologies related to electromagnetic waves in this field. This branch of Engineering is immersed in the understanding of phenomena such as propagation, modulation and reception of radioelectric signals, ranging from electromagnetic theory to practical implementation in various areas, especially in medicine. For this reason, TECH presents this university program, which will train engineers in the development of the most advanced and innovative technology for the use of radiation. This program has a 100% online format, giving graduates the opportunity to expand their skills in an agile and adaptable way to their schedules.

Thanks to this Professional Master's Degree you will design more efficient and robust systems, contributing significantly to the technological and scientific advancement of society"

Radiophysics in Engineering seeks to optimize and improve the efficiency of various systems, such as medical imaging equipment, taking advantage of physical fundamentals to innovate in the creation and improvement of technologies that have a direct impact on the daily life of the community. This branch of Physics specializes in the analysis of the properties of electromagnetic waves and their interaction with matter, with the purpose of designing efficient devices and systems in areas such as medicine.

TECH presents this Professional Master's Degree in Radiophysics, a comprehensive program that will analyze in depth the uses and fundamental principles of radiation in the field of Engineering. This program will immerse graduates in the detailed examination of the most advanced techniques for measuring radiation, including the thorough study of detectors, measurement units and calibration methods.

In addition to focusing on Radiobiology and its impact on biological tissues, this academic program will cover physical principles and clinical dosimetry, as well as the application of more advanced methods, such as Proton Therapy. Likewise, techniques such as Intraoperative Radiotherapy and Brachytherapy will be mastered, exploring their physical basis and relevance in various environments.

Likewise, the engineers will delve into the case of Radiophysical technology applied to diagnostic imaging, offering an exhaustive understanding of the physics behind medical images, a variety of imaging techniques and even dosimetry in radiodiagnosis. Likewise, fields such as magnetic resonance and ultrasound, which dispense with ionizing radiation, will be included. Finally, special emphasis will be placed on the development of safety measures, regulations and safe practices.

TECH has created a comprehensive program based on the revolutionary *Relearning*methodology, focused on reinforcing key concepts to ensure a deep understanding of the content. In addition, graduates will only require an electronic device with an Internet connection to access all available resources.

This **Professional Master's Degree in Radiophysics** 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
- The graphic, schematic and practical contents of the book provide scientific and practical information on those 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

As a radiophysics specialist, you will optimize sensor performance and the quality of medical images. Enroll now!"

You will make use of the propagation, modulation and reception of electromagnetic waves for the quality of medical images, promoting higher quality diagnoses and treatments"

With this 100% online program, you will effectively apply electromagnetic phenomena to the development of advanced systems and technologies.

You will combine your in-depth knowledge of physics with technical skills to design and optimize systems that revolutionize fields such as medicine.

The program's teaching staff includes professionals from the sector who contribute their work experience to this training 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

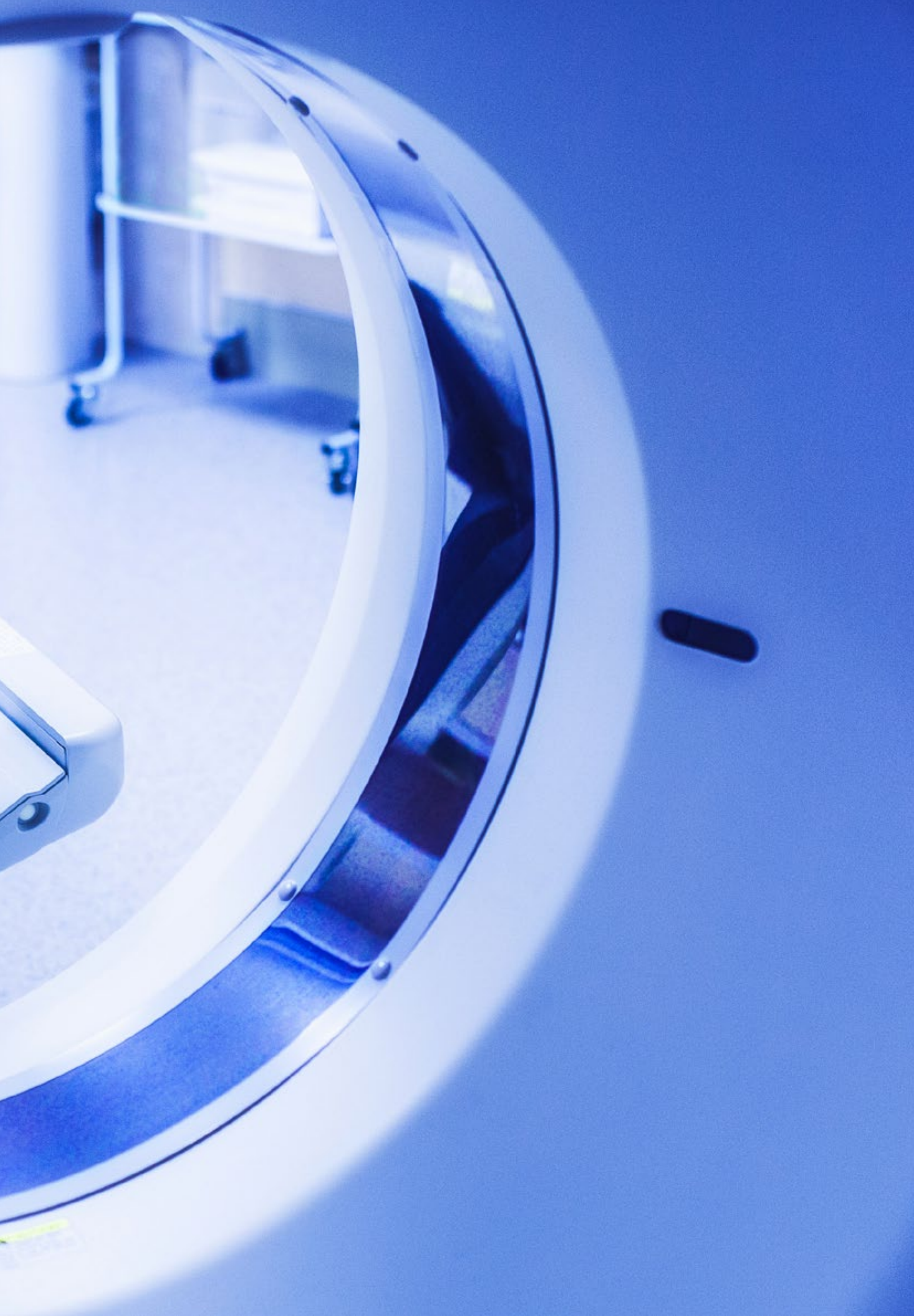
Objectives

This Professional Master's Degree aims to nurture engineers with the physical principles of electromagnetic waves, as well as their application in modern engineering. Through an amalgam of theory and practice, this program aims to forge professionals capable of designing revolutionary systems, from cutting-edge communication devices to medical advances. By embarking on this academic program, graduates will not only become experts at the interface between Physics and Engineering, but also agents of change, capable of leading technological breakthroughs that will set the tone for the next era of innovation.

The goal of TECH is to become a leader in the creation of technological solutions that open the doors to an innovative and promising future"

General Objectives

- Analyze the basic interactions of ionizing radiation with tissues
- Establish the effects and risks of ionizing radiation at the cellular level
- Analyze elements of the measurement of photon and electron beams in external radiation therapy
- Examine the quality control program
- Identify the different planning techniques for external radiotherapy treatments
- Analyze the interactions of protons with matter
- Examine radiation protection and radiobiology in Proton Therapy
- Analyze the technology and equipment used in intraoperative radiation therapy
- Examine the clinical outcomes of brachytherapy in different oncologic settings
- Analyze the importance of radiation protection
- Assimilate the existing risks derived from the use of ionizing radiation
- Develop the international regulations applicable to radiation protection



Specific Objectives

Module 1. Interaction of Ionizing Radiation with Matter

- Internalize the Bragg-Gray theory and the dose measured in air
- Develop the limits of the different dosimetric quantities
- Analyze the calibration of a dosimeter

Module 2. 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

Module 3. External Radiotherapy. Physical dosimetry

- Examine the quality control program of external radiotherapy equipment

Module 4. External Radiotherapy. Clinical dosimetry

- Specify the different characteristics of the different types of external radiotherapy treatments
- Analyze the different verification systems for external radiotherapy plans, as well as the metrics used

Module 5. Advanced Radiotherapy Method. Proton therapy

- Analyze proton beams and their clinical use
- Evaluate the necessary requirements for the characterization of this radiotherapy technique
- Establish the differences of this modality with conventional radiotherapy

Module 6. Advanced Radiotherapy Method. Intraoperative radiotherapy

- Identify the main clinical indications for the application of intraoperative radiotherapy
- Analyze in detail the methods of dose calculation in intraoperative radiotherapy
- Examine the factors influencing patient and medical staff safety during intraoperative radiotherapy procedures

Module 7. Brachytherapy in the Field of Radiotherapy

- Examine the application of the Monte Carlo method in brachytherapy
- Evaluating planning systems using the TG 43 formalism
- Dose planning in Brachytherapy
- Identify and analyze the key differences between High Dose Rate (HDR) and Low Dose Rate (LDR) Brachytherapy

Module 8. Advanced Diagnostic Imaging

- Develop specialized knowledge about the operation of an X-ray tube and a digital image detector
- Identify the different types of radiological images (static and dynamic), as well as the advantages and disadvantages offered by the various technologies currently available
- Analyze international quality control protocols for radiology equipment
- Delve into the fundamental aspects in the dosimetry of patients undergoing radiological tests

Module 9. Nuclear Medicine

- Distinguish between modes of image acquisition from a patient with a radiopharmaceutical
- Develop expertise on MIRD methodology in dosimetry

Module 10. Radiation Protection in Hospital Radioactive Facilities

- Determine the radiological risks present in hospital radioactive facilities, as well as the specific magnitudes and units applied in these cases
- Establish the concepts applicable to the design of a radioactive facility, knowing the main specific parameters

You will achieve your objectives thanks to TECH and this Professional Master's Degree, which has an extensive library, full of the most innovative multimedia resources"

03

Competencies

This university program will equip engineers with an arsenal of competencies that will make them leaders in the technological field. From advanced mastery of electromagnetic theory, to the ability to innovate in the design of communication systems and medical devices, this program will enable graduates to merge physics with engineering to solve complex challenges. The ability to model and simulate electromagnetic phenomena, combined with skills in system optimization and the application of cutting-edge technologies, will define these professionals as visionaries capable of driving revolutionary advances in the field of Engineering.

Enroll now in this 100% online Professional Master's Degree! You will expand your knowledge in Radiophysics to transform the technological future"

General Skills

- Develop the existing mathematical models and their differences
- Specify the equipment used in external radiotherapy treatments
- Develop the most relevant and advanced physical aspects of the proton therapy beam
- Fundamentals of radiation protection and safety practices
- Create strategies to optimize radiation distribution in the target tissue and minimize irradiation of surrounding healthy tissues
- Propose quality management protocols for Brachytherapy procedures
- Compile the instrumentation of a Nuclear Medicine Service
- Develop in depth knowledge of gamma cameras and PET
- Specify the main safety actions in the use of ionizing radiation
- Design and manage structural shielding against radiation in hospitals

Specific Skills

- Perform quality control of an ionization chamber
- Set up simulation, localization and image-guided radiotherapy equipment
- Control photon beam and electron beam calibration procedures
- Master the tools to evaluate external radiotherapy planning
- Propose specific measures to minimize radiation exposure
- Develop source calibration techniques using well and air chambers
- Specify procedures and planning for prostate brachytherapy
- Fundamentals of the physical basis of gamma camera and PET performance
- Determine the quality controls between gamma cameras and PET
- Perform actions at the level of radiological protection in hospital services

Develop the ability to analyze, design and implement innovative solutions in the field of electromagnetic waves"

04

Course Management

The professors who teach this academic program applied to Engineering represent the forefront of knowledge and experience in this multidisciplinary field. These professionals are internationally recognized experts in areas such as electromagnetic wave propagation, as well as ionizing and non-ionizing radiation. Combining theory with practical application, their commitment to lifelong learning, dedication to cutting-edge research, and ability to guide and motivate graduates make these faculty members exceptional mentors and role models for those seeking to excel in the exciting world of Radiophysics.

"The faculty of this Professional Master's Degree is committed to passing on their knowledge to the next generation of engineers"

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. Rodríguez, Carlos Andrés

- Specialist in Hospital Radiophysics
- Physician in Hospital Radiophysics at the University Clinical Hospital of Valladolid, responsible for the Nuclear Medicine section
- Principal Tutor of residents of the Department of Radiophysics and Radiological Protection of the University Clinical Hospital of Valladolid
- Degree in Hospital Radiophysics
- Degree in Physics at the University of Salamanca

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

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)

Ms. Milanés Gaillet, Ana Isabel

- Radiophysicist at the University Hospital 12 de Octubre
- Medical Physicist at the Beata María Ana Hospital of Hermanas Hospitalarias
- Expert in Radiological Anatomy and Physiology from the Spanish Society of Medical Physics
- Expert in Medical Physics from the International University of Andalusia
- Degree in Physics from the Autonomous University of Madrid

Take the opportunity to learn about the latest advances in this field in order to apply it to your daily practice"

05

Structure and Content

The structure of this Professional Master's Degree will encompass a perfect combination of solid theoretical foundations and innovative practical applications. From specialized modules in electromagnetic wave propagation, each component of the program is designed to cultivate elite technical skills and foster critical thinking in solving complex problems. In addition, the content will incorporate emerging topics, such as medical radiation and technological applications in diverse areas, ensuring that graduates are equipped to lead at the very frontier of innovation.

TECH offers you this Professional Master's Degree as a unique educational experience, which will prepare you to transform the technological landscape with vision and mastery"

Module 1. Interaction of Ionizing Radiation with Matter

1.1. Ionizing Radiation-Matter Interaction
   1.1.1. Ionizing Radiation
   1.1.2. Collisions
   1.1.3. Braking Power and Range
1.2. Charged Particle-Matter Interaction
   1.2.1. Fluorescent Radiation
      1.2.1.1. Characteristic Radiation or X-rays
      1.2.1.2. Auger Electrons
   1.2.2. Braking Radiation
   1.2.3. Spectrum Upon Collision of Electrons with a High Z Material
   1.2.4. Electron-Positron Annihilation
1.3. Photon-Matter Interaction
   1.3.1. Attenuation
   1.3.2. Hemireductive Layer
   1.3.3. Photoelectric Effect
   1.3.4. Compton Effect
   1.3.5. Pair Creation
   1.3.6. Predominant Effect According to Energy
   1.3.7. Imaging in Radiology
1.4. Radiation Dosimetry
   1.4.1. Equilibrium of Charged Particles
   1.4.2. Bragg-Gray Cavity Theory
   1.4.3. Spencer-Attix Theory
   1.4.4. Absorbed Dose in Air
1.5. Radiation Dosimetry Quantities
   1.5.1. Dosimetric Quantities
   1.5.2. Radiation Protection Quantities
   1.5.3. Radiation Weighting Factors
   1.5.4. Weighting Factors of the Organs According to Radiosensitivity
1.6. Detectors for the Measurement of Ionizing Radiation
   1.6.1. Ionization of Gases
   1.6.2. Excitation of Luminescence in Solids
   1.6.3. Dissociation of Matter
   1.6.4. Detectors in the Hospital Environment
1.7. Ionizing Radiation Dosimetry
   1.7.1. Environmental Dosimetry
   1.7.2. Area Dosimetry
   1.7.3. Personal Dosimetry
1.8. Thermoluminescence Dosimeters
   1.8.1. Thermoluminescence Dosimeters
   1.8.2. Dosimeter Calibration
   1.8.3. Calibration at the National Dosimetry Center
1.9. Physics of Radiation Measurement
   1.9.1. Value of a Quantity
   1.9.2. Accuracy
   1.9.3. Precision
   1.9.4. Repeatability
   1.9.5. Reproducibility
   1.9.6. Traceability
   1.9.7. Quality in Measurement
   1.9.8. Quality Control of an Ionization Chamber
1.10. Uncertainty in Radiation Measurement
   1.10.1. Measurement Uncertainty
   1.10.2. Tolerance and Action Level
   1.10.3. Type A Uncertainty
   1.10.4. Type B Uncertainty

Module 2. Radiobiology

2.1. Interaction of Radiation with Organic Tissues
- 2.1.1. Interaction of Radiation with Tissues
- 2.1.2. Interaction of Radiation with the Cell
- 2.1.3. Physicochemical Response

2.2. Effects of Ionizing Radiation on DNA
- 2.2.1. Structure of DNA
- 2.2.2. Radiation-Induced Damage
- 2.2.3. Damage Repair

2.3. Radiation Effects on Organic Tissues
- 2.3.1. Effects on the Cell Cycle
- 2.3.2. Irradiation Syndromes
- 2.3.3. Aberrations and Mutations

2.4. Mathematical Models of Cell Survival
- 2.4.1. Mathematical Models of Cell Survival
- 2.4.2. Alpha-Beta Model
- 2.4.3. Effect of Fractionation

2.5. Efficacy of Ionizing Radiation on Organic Tissues
- 2.5.1. Relative Biological Efficacy
- 2.5.2. Factors Altering Radiosensitivity
- 2.5.3. LET and Oxygen Effect

2.6. Biological Aspects According to the Dose of Ionizing Radiations
- 2.6.1. Radiobiology at Low Doses
- 2.6.2. Radiobiology at High Doses
- 2.6.3. Systemic Response to Radiation

2.7. Estimation of the Risk of Ionizing Radiation Exposure
- 2.7.1. Stochastic and Random Effects
- 2.7.2. Risk Estimation
- 2.7.3. ICRP Dose Limits

2.8. Radiobiology in Medical Exposures in Radiotherapy
- 2.8.1. Isoeffect
- 2.8.2. Proliferation Effect
- 2.8.3. Dose-Response

2.9. Radiobiology in Medical Exposures in Other Medical Exposures
- 2.9.1. Brachytherapy
- 2.9.2. Radiodiagnostics
- 2.9.3. Nuclear Medicine

2.10. Statistical Models in Cell Survival
- 2.10.1. Statistical Models
- 2.10.2. Survival Analysis
- 2.10.3. Epidemiological Studies

Module 3. External Radiotherapy. Physical dosimetry

3.1. Linear Electron Accelerator. Equipment in External Radiotherapy
- 3.1.1. Linear Electron Accelerator (LEA)
- 3.1.2. External Radiotherapy Treatment Planner (TPS)
- 3.1.3. Registration and Verification Systems
- 3.1.4. Special Techniques
- 3.1.5. Hadrontherapy

3.2. Simulation and Localization Equipment in External Radiotherapy
- 3.2.1. Conventional Simulator
- 3.2.2. Computed Tomography (CT) Simulation
- 3.2.3. Other Image Modalities

3.3. Equipment in Image-Guided External Radiation Therapy
- 3.3.1. Simulation Equipment
- 3.3.2. Image-Guided Radiotherapy Equipment. CBCT
- 3.3.3. Image-Guided Radiotherapy Equipment. Planar Image
- 3.3.4. Auxiliary Localization Systems

3.4. Photon Beams in Physical Dosimetry
- 3.4.1. Measurement Equipment
- 3.4.2. Calibration Protocols
- 3.4.3. Calibration of Photon Beams
- 3.4.4. Relative Dosimetry of Photon Beams

3.5. Electron Beams in Physical Dosimetry
- 3.5.1. Measurement Equipment
- 3.5.2. Calibration Protocols
- 3.5.3. Electron Beam Calibration
- 3.5.4. Relative Electron Beam Dosimetry

3.6. Commissioning of External Radiation Therapy Equipment
- 3.6.1. Installation of External Radiotherapy Equipment
- 3.6.2. Acceptance of External Radiotherapy Equipment
- 3.6.3. Initial Reference State (ERI)
- 3.6.4. Clinical Use of External Radiation Therapy Equipment
- 3.6.5. Treatment Planning System

3.7. Quality Control of External Radiation Therapy Equipment
- 3.7.1. Quality Control in Linear Accelerators
- 3.7.2. Quality Controls on IGRT Equipment
- 3.7.3. Quality Controls on Simulation Systems
- 3.7.4. Special Techniques

3.8. Quality Control of Radiation Measuring Equipment
- 3.8.1. Dosimetry
- 3.8.2. Measurement Instrumentation
- 3.8.3. Dummies Used

3.9. Application of Risk Analysis Systems in External Radiation Therapy
- 3.9.1. Risk Analysis Systems
- 3.9.2. Error Reporting Systems
- 3.9.3. Process Maps

3.10. Quality Assurance Program in Physical Dosimetry
- 3.10.1. Responsibilities
- 3.10.2. Requirements in External Radiation Therapy
- 3.10.3. Quality Assurance Program. Clinical and Physical Aspects
- 3.10.4. Maintenance of the Quality Assurance Program

Module 4. External Radiotherapy. Clinical Dosimetry

4.1. Clinical Dosimetry in External Radiotherapy
- 4.1.1. Clinical Dosimetry in External Radiotherapy
- 4.1.2. Treatments in External Radiatherapy
- 4.1.3. Beam Modifying Elements

4.2. Stages of Clinical Dosimetry of External Radiotherapy
- 4.2.1. Simulation Stage
- 4.2.2. Treatment Planning
- 4.2.3. Treatment Verification
- 4.2.4. Linear Electron Accelerator Treatment

4.3. Treatment Planning Systems in External Radiotherapy
- 4.3.1. Modeling in Planning Systems
- 4.3.2. Calculation Algorithms
- 4.3.3. Utilities of Planning Systems
- 4.3.4. Image Tools of the Planning Systems

4.4. Quality Control of Planning Systems in External Radiotherapy
- 4.4.1. Quality Control of Planning Systems in External Radiotherapy
- 4.4.2. Initial Reference State
- 4.4.3. Periodic Controls

4.5. Manual Calculation of Monitor Units (MUs)
- 4.5.1. Manual Control of MUs
- 4.5.2. Factors Intervening in the Dose Distribution
- 4.5.3. Practical Example of Calculation of UMs

4.6. Conformal 3D Radiotherapy Treatments
- 4.6.1. 3D Radiotherapy (RT3D)
- 4.6.2. RT3D Treatments with Photon Beams
- 4.6.3. RT3D Treatments with Electron Beams

4.7. Advanced Intensity Modulated Treatments
- 4.7.1. Intensity Modulated Treatments
- 4.7.2. Optimization
- 4.7.3. Specific Quality Control

4.8. Evaluation of an External Radiotherapy Planning
- 4.8.1. Dose-Volume Histogram
- 4.8.2. Conformation Index and Homogeneity Index
- 4.8.3. Clinical Impact of the Schedules
- 4.8.4. Planning Errors

4.9 Advanced Special Techniques in External Radiotherapy
- 4.9.1. Radiosurgery and Extracranial Stereotactic Radiotherapy
- 4.9.2. Total Body Irradiation
- 4.9.3. Total Body Surface Irradiation
- 4.9.4. Other Technologies in External Radiation Therapy

4.10. Verification of Treatment Plans in External Radiotherapy
- 4.10.1. Verification of Treatment Plans in External Radiotherapy
- 4.10.2. Treatment Verification Systems
- 4.10.3. Treatment Verification Metrics

Module 5. Advanced Radiotherapy Method. Proton Therapy

5.1. Proton Therapy Proton Radiotherapy
- 5.1.1. Interaction of Protons with Matter
- 5.1.2. Clinical Aspects of Proton Therapy
- 5.1.3. Physical and Radiobiological Basis of Proton Therapy

5.2. Equipment in Protontherapy
- 5.2.1. Facilities
- 5.2.2. Components of a Protontherapy System
- 5.2.3. Physical and Radiobiological Basis of Proton Therapy

5.3. Proton Beam
- 5.3.1. Parameters
- 5.3.2. Clinical Implications
- 5.3.3. Application in Oncological Treatments

5.4. Physical Dosimetry in Proton Therapy
- 5.4.1. Absolute Dosimetry Measurements
- 5.4.2. Beam Parameters
- 5.4.3. Materials in Physical Dosimetry

5.5. Clinical Dosimetry in Proton Therapy
- 5.5.1. Application of Clinical Dosimetry in Proton Therapy
- 5.5.2. Planning and Calculation Algorithms
- 5.5.3. Imaging Systems

5.6. Radiological Protection in Proton Therapy
- 5.6.1. Design of an Installation
- 5.6.2. Neutron Production and Activation
- 5.6.3. Activation

5.7. Proton Therapy Treatments
- 5.7.1. Image-Guided Treatment
- 5.7.2. In Vivo Treatment Verification
- 5.7.3. BOLUS Usage

5.8. Biological Effects of Proton Therapy
- 5.8.1. Physical Aspects
- 5.8.2. Radiobiology
- 5.8.3. Dosimetric Implications

5.9. Measuring Equipment in Proton Therapy
- 5.9.1. Dosimetric Equipment
- 5.9.2. Radiation Protection Equipment
- 5.9.3. Personal Dosimetry

5.10. Uncertainties in Proton Therapy
- 5.10.1. Uncertainties Associated with Physical Concepts
- 5.10.2. Uncertainties Associated with the Therapeutic Process
- 5.10.3. Advances in Protontherapy

Module 6. Advanced Radiotherapy Method. Intraoperative Radiotherapy

6.1. Intraoperative Radiotherapy
- 6.1.1. Intraoperative Radiotherapy
- 6.1.2. Current Approach to Intraoperative Radiotherapy
- 6.1.3. Intraoperative Radiotherapy versus Conventional Radiotherapy

6.2. Technology in Intraoperative Radiotherapy
- 6.2.1. Mobile Linear Accelerators in Intraoperative Radiotherapy
- 6.2.2. Intraoperative Imaging Systems
- 6.2.3. Quality Control and Maintenance of Equipment

6.3. Treatment Planning in Intraoperative Radiation Therapy
- 6.3.1. Dose Calculation Methods
- 6.3.2. Volumetry and Delineation of Organs at Risk
- 6.3.3. Dose Optimization and Fractionation

6.4. Clinical Indications and Patient Selection for Intraoperative Radiation Therapy
- 6.4.1. Types of Cancers Treated with Intraoperative Radiotherapy
- 6.4.2. Assessment of Patient Suitability
- 6.4.3. Clinical Studies and Discussion

6.5. Surgical Procedures in Intraoperative Radiotherapy
- 6.5.1. Surgical Preparation and Logistics
- 6.5.2. Radiation Administration Techniques During Surgery
- 6.5.3. Postoperative Follow-Up and Patient Care

6.6. Calculation and Administration of Radiation Dose for Intraoperative Radiotherapy
- 6.6.1. Dose Calculation Formulas and Algorithms
- 6.6.2. Correction Factors and Dose Adjustment
- 6.6.3. Real-Time Monitoring during Surgery

6.7. Radiation Protection and Safety in Intraoperative Radiotherapy
- 6.7.1. International Radiation Protection Standards and Regulations
- 6.7.2. Safety Measures for the Medical Staff and the Patient
- 6.7.3. Risk mitigation strategies

6.8. Interdisciplinary Collaboration in Intraoperative Radiation Therapy
- 6.8.1. Role of the Multidisciplinary Team in Intraoperative Radiotherapy
- 6.8.2. Communication between Radiotherapists, Surgeons and Oncologists
- 6.8.3. Practical Examples of Interdisciplinary Collaboration

6.9. Flash Technique. Latest Trend in Intraoperative Radiation Therapy
- 6.9.1. Research and Development in Intraoperative Radiation Therapy
- 6.9.2. New Technologies and Emerging Therapies in Intraoperative Radiotherapy
- 6.9.3. Implications for Future Clinical Practice

6.10. Ethics and Social Aspects in Intraoperative Radiation Therapy
- 6.10.1. Ethical Considerations in Clinical Decision-Making
- 6.10.2. Access to Intraoperative Radiation Therapy and Equity of Care
- 6.10.3. Communication with Patients and Families in Complex Situations

Module 7. Brachytherapy in the Field of Radiotherapy

7.1. Brachytherapy
    7.1.1. Physical Principles of Brachytherapy
    7.1.2. Biological Principles and Radiobiology applied to Brachytherapy
    7.1.3. Brachytherapy and External Radiotherapy. Differences
7.2. Radiation Sources in Brachytherapy
    7.2.1. Radiation Sources used in Brachytherapy
    7.2.2. Radiation Emission of the Sources used in Brachytherapy
    7.2.3. Calibration of the Sources
    7.2.4. Safety in the Handling and Storage of Brachytherapy Sources
7.3. Dose Planning in Brachytherapy
    7.3.1. Dose Planning Techniques in Brachytherapy
    7.3.2. Optimization of the Dose Distribution in the Target Tissue
    7.3.3. Application of the Monte Carlo Method
    7.3.4. Specific Considerations for Minimizing Irradiation of Healthy Tissue
    7.3.5. TG 43 Formalism
7.4. Administration Techniques in Brachytherapy
    7.4.1. High Dose Rate Brachytherapy (HDR) versus Low Dose Rate Brachytherapy (LDR)
    7.4.2. Clinical Procedures and Treatment Logistics
    7.4.3. Management of Devices and Catheters used in the Administration of Brachytherapy
7.5. Clinical Indications for Brachytherapy
    7.5.1. Brachytherapy Applications in the Treatment of Prostate Cancer
    7.5.2. Brachytherapy in Cervical Cancer: Techniques and Results
    7.5.3. Brachytherapy in Breast Cancer: Clinical Considerations and Results
7.6. Quality Management in Brachytherapy
    7.6.1. Specific Quality Management Protocols for Brachytherapy
    7.6.2. Quality Control of Equipment and Treatment Systems
    7.6.3. Audit and Compliance with Regulatory Standards
7.7. Clinical Results in Brachytherapy
    7.7.1. Review of Clinical Studies and Results in the Treatment of Specific Cancers
    7.7.2. Evaluation of the Efficacy and Toxicity of Brachytherapy
    7.7.3. Clinical Cases and Discussion of Results
7.8. Ethics and International Regulatory Aspects in Brachytherapy
    7.8.1. Ethical Issues in Shared Decision-Making with Patients
    7.8.2. Compliance with International Radiation Safety Standards and Regulations
    7.8.3. International Liability and Legal Aspects in Brachytherapy Practice of Brachytherapy
7.9. Technological Development in Brachytherapy
    7.9.1. Technological Innovations in the Field of Brachytherapy
    7.9.2. Research and Development of New Techniques and Devices in Brachytherapy
    7.9.3. Interdisciplinary Collaboration in Brachytherapy Research Projects
7.10. Practical Application and Simulations in Brachytherapy
    7.10.1. Clinical Simulation of Brachytherapy
    7.10.2. Resolution of Practical Situations and Technical Challenges
    7.10.3. Evaluation of Treatment Plans and Discussion of Results

Module 8. Advanced Diagnostic Imaging

8.1. Advanced Physics in X-Ray Generation
    8.1.1. X-Ray Tube
    8.1.2. Radiation Spectra Used in Radiodiagnosis
    8.1.3. Radiological Technique
8.2. Radiological Imaging
    8.2.1. Digital Image Recording Systems
    8.2.2. Dynamic Imaging
    8.2.3. Radiodiagnostic Equipment
8.3. Quality Control in Diagnostic Radiology
    8.3.1. Quality Assurance Program in Diagnostic Radiology
    8.3.2. Quality Protocols in Radiodiagnostics
    8.3.3. General Quality Control Checks
8.4. Patient Dose Estimation in X-Ray Installations
    8.4.1. Patient Dose Estimation in X-Ray Facilities
    8.4.2. Patient Dosimetry
    8.4.3. Diagnostic Dose Reference Levels

8.5. General Radiology Equipment
- 8.5.1. General Radiology Equipment
- 8.5.2. Specific Quality Control Tests
- 8.5.3. Doses to Patients in General Radiology

8.6. Mammography Equipment
- 8.6.1. Mammography Equipment
- 8.6.2. Specific Quality Control Tests
- 8.6.3. Mammography Patient Dose

8.7. Fluoroscopy Equipment. Vascular and Interventional Radiology
- 8.7.1. Fluoroscopy Equipment
- 8.7.2. Specific Quality Control Tests
- 8.7.3. Doses to Interventional Patients

8.8. Computed Tomography Equipment
- 8.8.1. Computed Tomography Equipment
- 8.8.2. Specific Quality Control Tests
- 8.8.3. Dose to CT Patients

8.9. Other Radiodiagnostic Equipment
- 8.9.1. Other Radiodiagnostic Equipment
- 8.9.2. Specific Quality Control Tests
- 8.9.3. Non-Ionizing Radiation Equipment

8.10. Radiological Image Visualization Systems
- 8.10.1. Digital Image Processing
- 8.10.2. Calibration of Display Systems
- 8.10.3. Quality Control of Display Systems

Module 9. Nuclear Medicine

9.1. Radionuclides used in Nuclear Medicine
- 9.1.1. Radionuclides
- 9.1.2. Typical Diagnostic Radionuclides
- 9.1.3. Typical Radionuclides in Therapy

9.2. Obtaining Artificial Radionuclides
- 9.2.1. Nuclear Reactor
- 9.2.2. Cyclotron
- 9.2.3. Generators

9.3. Instrumentation in Nuclear Medicine
- 9.3.1. Activimeters. Calibration of Activimeters
- 9.3.2. Intraoperative Probes
- 9.3.3. Gammacameras and SPECT
- 9.3.4. PET

9.4. Quality Assurance Program in Nuclear Medicine
- 9.4.1. Quality Assurance in Nuclear Medicine
- 9.4.2. Acceptance, Reference and Consistency Tests
- 9.4.3. Good Practice Routine

9.5. Nuclear Medicine equipment: Gamma Cameras
- 9.5.1. Image Formation
- 9.5.2. Image Acquisition Modes
- 9.5.3. Standard Protocol for a Patient

9.6. Nuclear Medicine equipment: SPECT
- 9.6.1. Tomographic Reconstruction
- 9.6.2. Synogram
- 9.6.3. Reconstruction Corrections

9.7. Nuclear Medicine equipment: PET
- 9.7.1. Physical Basis
- 9.7.2. Detector Material
- 9.7.3. 2D and 3D Acquisition. Sensitivity
- 9.7.4. Time of Flight

9.8. Image Reconstruction Corrections in Nuclear Medicine
- 9.8.1. Attenuation Correction
- 9.8.2. Dead Time Correction
- 9.8.3. Random Event Correction
- 9.8.4. Scattered Photon Correction
- 9.8.5. Standardization
- 9.8.6. Image Reconstruction

9.9. Quality Control of Nuclear Medicine Equipment
- 9.9.1. International Guidelines and Protocols
- 9.9.2. Planar Gamma Cameras
- 9.9.3. Tomographic Gamma Cameras
- 9.9.4. PET

9.10. Dosimetry in Nuclear Medicine Patients
- 9.10.1. MIRD Formalism
- 9.10.2. Estimation of Uncertainties
- 9.10.3. Erroneous Administration of Radiopharmaceuticals

Module 10. Radiation Protection in Hospital Radioactive Facilities

10.1. Hospital Radiation Protection
- 10.1.1. Hospital Radiation Protection
- 10.1.2. Radiation Protection Magnitudes and Specialized Radiation Protection Units
- 10.1.3. Risks Specific to the Hospital Area

10.2. International Regulations on Radiation Protection
- 10.2.1. International Legal Framework and Authorizations
- 10.2.2. International Regulations on Health Protection against Ionizing Radiations
- 10.2.3. International Regulations on Radiological Protection of the Patient
- 10.2.4. International Regulations on the Specialty of Hospital Radiophysics
- 10.2.5. Other International Regulations

10.3. Radiation Protection in Hospital Radioactive Facilities
- 10.3.1. Nuclear Medicine
- 10.3.2. Radiodiagnostics
- 10.3.3. Radiotherapy Oncology

10.4. Dosimetric Control of Exposed Professionals
- 10.4.1. Dosimetric Control
- 10.4.2. Dose Limits
- 10.4.3. Personal Dosimetry Management

10.5. Calibration and Verification of Radiation Protection Instrumentation
- 10.5.1. Calibration and Verification of Radiation Protection Instrumentation
- 10.5.2. Verification of Environmental Radiation Detectors
- 10.5.3. Verification of Surface Contamination Detectors

10.6. Control of the Airtightness of Encapsulated Radioactive Sources
- 10.6.1. Control of the Airtightness of Encapsulated Radioactive Sources
- 10.6.2. Methodology
- 10.6.3. International Limits and Certificates

10.7. Design of Structural Shielding in Medical Radioactive Facilities
- 10.7.1. Design of Structural Shielding in Medical Radioactive Facilities
- 10.7.2. Important Parameters
- 10.7.3. Thickness Calculation

10.8. Structural Shielding Design in Nuclear Medicine
- 10.8.1. Structural Shielding Design in Nuclear Medicine
- 10.8.2. Nuclear Medicine Installations
- 10.8.3. Workload Calculation

10.9. Design of Structural Shielding in Radiotherapy
- 10.9.1. Design of Structural Shielding in Radiotherapy
- 10.9.2. Radiotherapy Facilities
- 10.9.3. Workload Calculation

10.10. Structural Shielding Design in Radiodiagnostics
- 10.10.1. Structural Shielding Design in Radiodiagnostics
- 10.10.2. Radiodiagnostic Installations
- 10.10.3. Workload Calculation

06

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

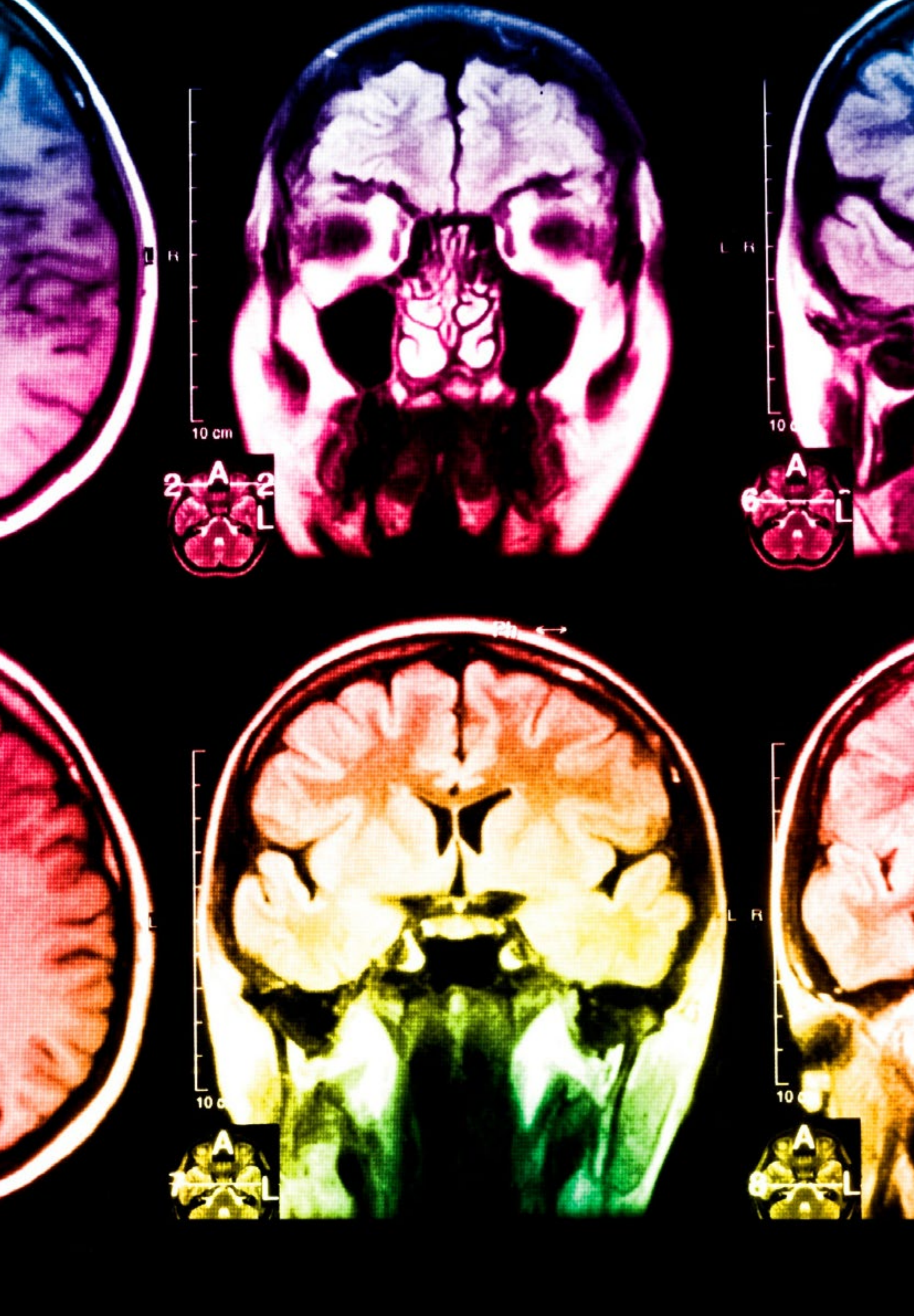
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines 8 different teaching elements in each lesson.

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.

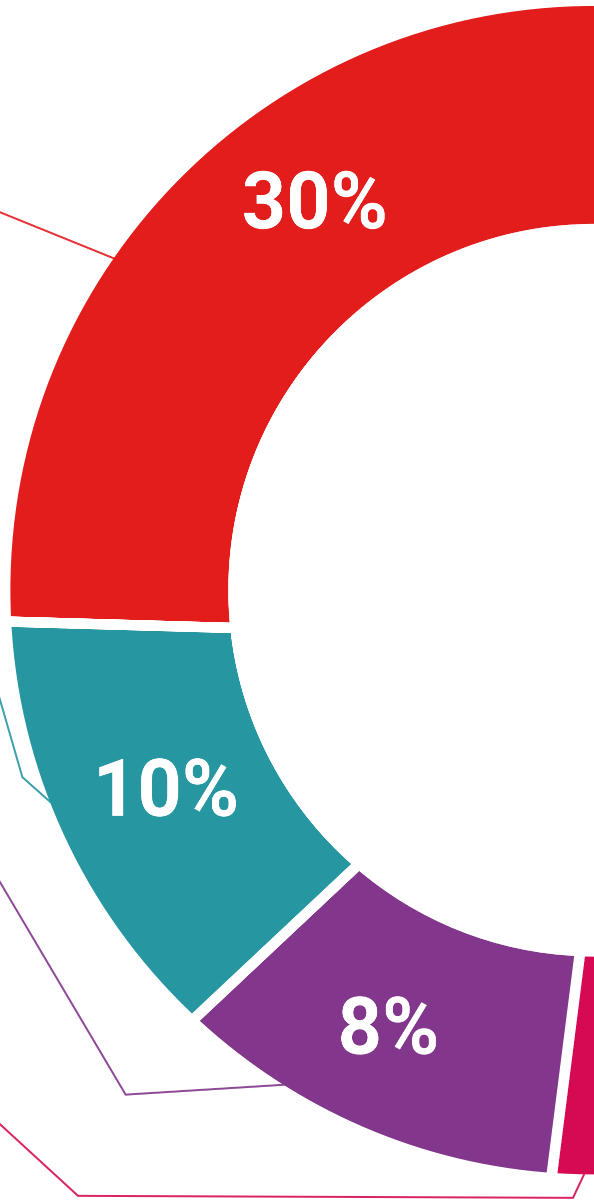
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

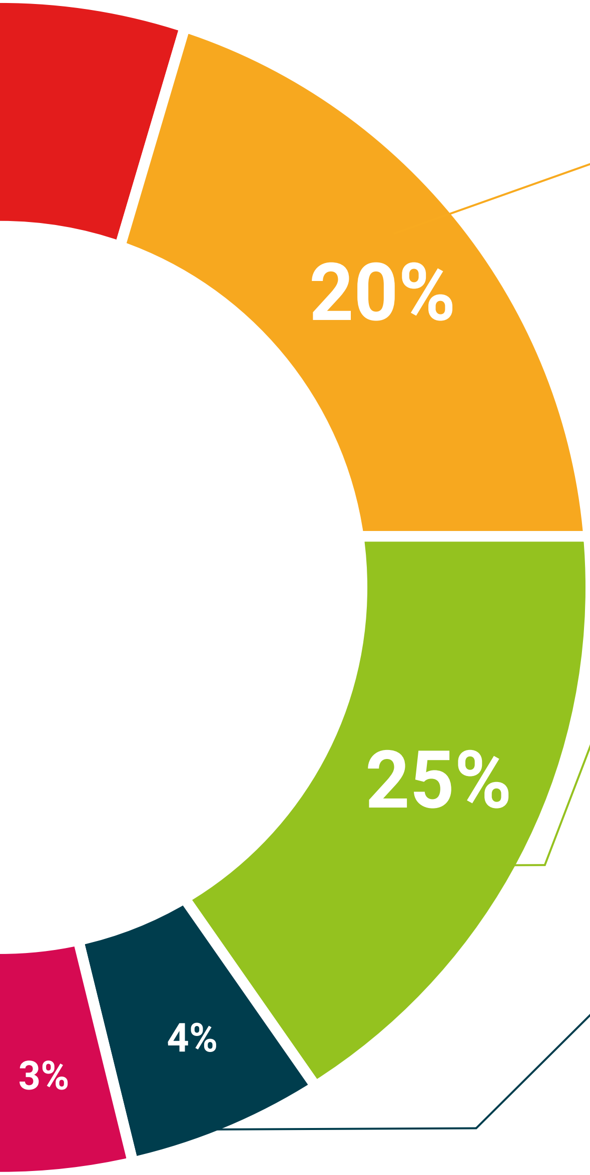
Practicing Skills and Abilities

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.

07
Certificate

The Professional Master's Degree in Radiophysics guarantees students, in addition to the most rigorous and up-to-date education, access to a Professional Master's Degree issued by TECH Global University.

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 **Professional Master's Degree diploma in Radiophysics** 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: **Professional Master's Degree in Radiophysics**

Modality: **online**

Duration: **12 months**

Accreditation: **60 ECTS**

tech global university

Mr./Ms. _________________, with identification document ___________
has successfully passed and obtained the title of:

Professional Master's Degree in Radiophysics

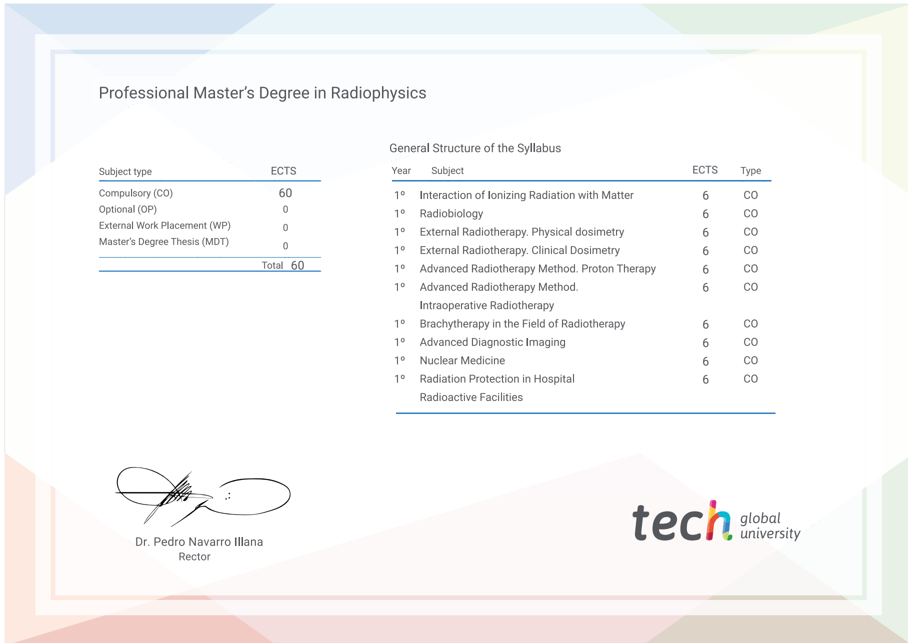
This is a program of 1,500 hours of duration equivalent to 60 ECTS, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

TECH Global University is a university officially recognized by the Government of Andorra on the 31st of January of 2024, which belongs to the European Higher Education Area (EHEA).

In Andorra la Vella, on the 28th of February of 2024

Dr. Pedro Navarro Illana
Rector

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



Professional Master's Degree in Radiophysics

Subject type	ECTS
Compulsory (CO)	60
Optional (OP)	0
External Work Placement (WP)	0
Master's Degree Thesis (MDT)	0
Total	60

General Structure of the Syllabus

Year	Subject	ECTS	Type
1º	Interaction of Ionizing Radiation with Matter	6	CO
1º	Radiobiology	6	CO
1º	External Radiotherapy. Physical dosimetry	6	CO
1º	External Radiotherapy. Clinical Dosimetry	6	CO
1º	Advanced Radiotherapy Method. Proton Therapy	6	CO
1º	Advanced Radiotherapy Method. Intraoperative Radiotherapy	6	CO
1º	Brachytherapy in the Field of Radiotherapy	6	CO
1º	Advanced Diagnostic Imaging	6	CO
1º	Nuclear Medicine	6	CO
1º	Radiation Protection in Hospital Radioactive Facilities	6	CO

Dr. Pedro Navarro Illana
Rector

tech global university

*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.

tech global university

Professional Master's Degree
Radiophysics

» Modality: **online**
» Duration: **12 months**
» Certificate: **TECH Global University**
» Credits: **60 ECTS**
» Schedule: **at your own pace**
» Exams: **online**

Professional Master's Degree
Radiophysics

tech global university