

# Professional Master's Degree Radiophysics for Nursing





## Professional Master's Degree Radiophysics for Nursing

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

Website [www.techtitute.com/us/nursing/professional-master-degree/master-radiophysics-nursing](http://www.techtitute.com/us/nursing/professional-master-degree/master-radiophysics-nursing)

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# 01

# Introduction

Thanks to the technological evolution that the healthcare field has undergone, Radiotherapy has been nurtured by revolutionary tools aimed at disease detection and treatment delivery. For example, fluoroscopy systems provide continuous X-ray images to track the movement of tumors. In this way, specialists promote early detection of pathologies such as lung cancer or soft tissue sarcomas. To contribute to this cause, TECH has developed a pioneering program dedicated to nurses who wish to enrich themselves with the latest trends in Dosimetry and thus improve the quality of life of their patients. In turn, it is delivered 100% online, adapting to the schedule of busy professionals.



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*You will apply the most advanced treatments in Brachytherapy and you will effectively fight breast cancer thanks to this 100% online TECH program"*

Radiobiology is a fundamental discipline in the field of Nursing. This branch offers a comprehensive view on the biological effects of ionizing radiation on living tissues. Therefore, health professionals gain a better understanding to establish safe and effective doses in radiotherapy treatments. In this sense, this science is also useful in assessing the risks of irradiation, allowing physicians to make informed decisions in specific clinical situations. On the other hand, Radiobiology is essential both for research and for the development of new therapies affecting cancer cells

Aware of this reality, TECH has implemented an innovative program that combines the concepts of biology and radiation physics. Designed by an experienced faculty, this curriculum will delve into the interaction of radiation with organic tissues. In this way, students will develop mechanisms to repair radiation-induced damage to DNA structure. Moreover, the teaching materials will delve into the calibration of photon beams to ensure the consistency of treatments. In addition, the training will provide guidelines for the application of Clinical Dosimetry in Proton Therapy, based on calculation algorithms

To strengthen the mastery of these contents, the program will apply the innovative Relearning system, pioneer in TECH, which promotes the assimilation of complex concepts through the natural and progressive reiteration of them. For the analysis of its contents, students will only need a device with Internet access (such as a cell phone, computer or tablet) since the evaluation schedules and timetables can be planned individually. Likewise, in the Virtual Campus, students will be able to draw on a library full of multimedia resources (including interactive summaries, complementary readings and infographics) to strengthen their learning in a totally dynamic way

This **Professional Master's Degree in Radiophysics for Nursing** contains the most complete and up-to-date scientific program on the market. Its most notable features are:

- ♦ The development of case studies presented by experts in Radiophysics
- ♦ 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



*Do you want to specialize in the verification of treatment plans in External Radiation Therapy? Achieve it in only 12 months with this innovative program"*



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*You will delve into the benefits of 3D radiotherapy to reduce common side effects such as fatigue, dizziness or nausea”*

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

*You will address the effects of ionizing radiation on DNA and take actions to repair the damage caused*

*With the Relearning system you will integrate the concepts in a natural and progressive way. Forget about memorizing*



# 02 Objectives

The purpose of this program in Radiophysics for Nursing is to provide students with theoretical knowledge and practical skills for both diagnosis and treatment of pathologies using ionizing radiation. In this way, nurses will understand the effects of emissions on biological tissues and their effects on health. In turn, this will allow graduates to apply the precise doses of radiation, while performing optimal monitoring to evaluate patients' responses to treatments







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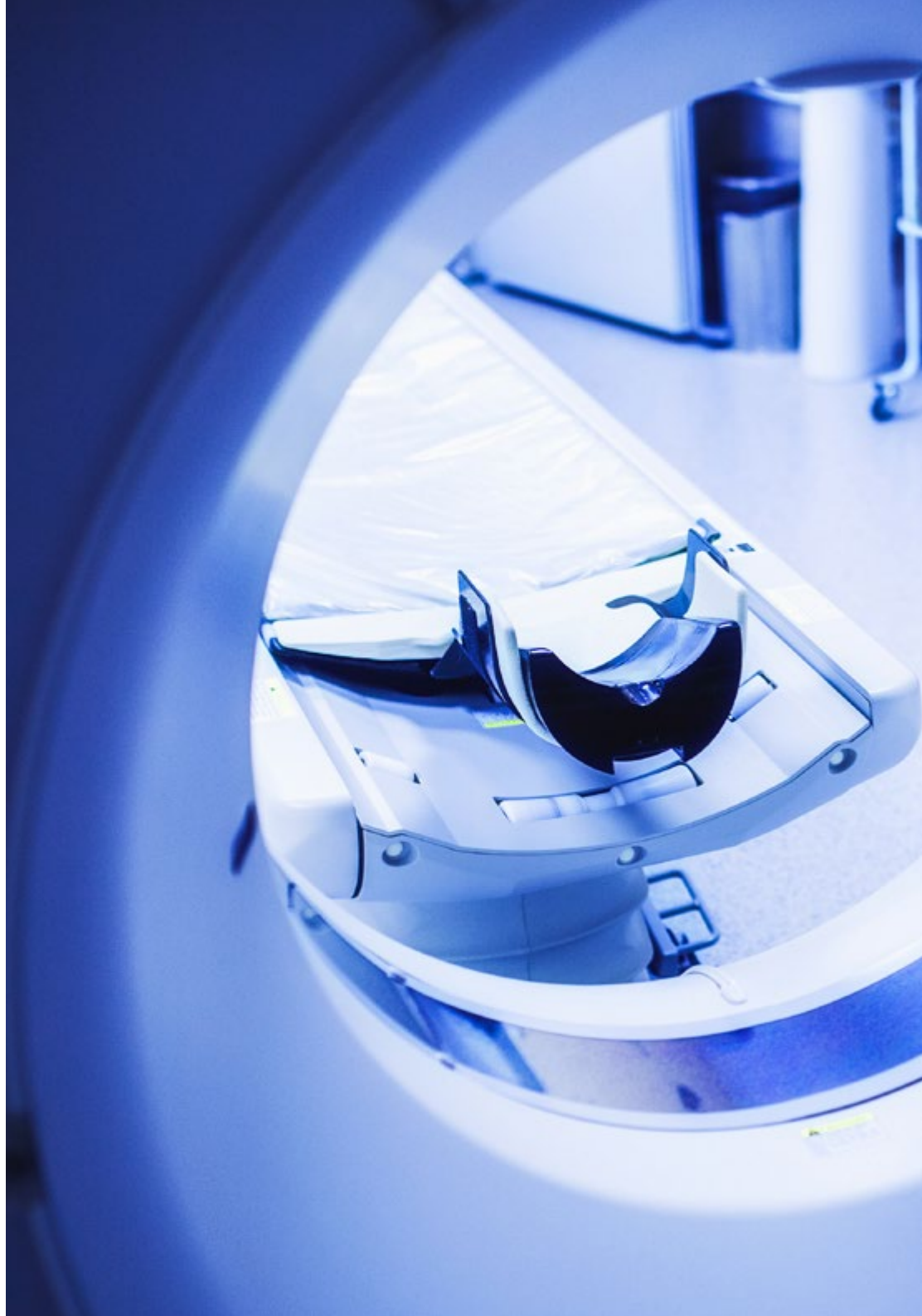
*With this program, you will be able to delve in a dynamic way into the techniques most commonly used techniques for Intraoperative Radiotherapy”*



## General Objectives

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- ♦ Analyze the basic interactions of ionizing radiation with tissues
- ♦ Establish the effects and risks of ionizing radiation at the cellular level
- ♦ Analyze elements of photon and electron beam measurement in external radiotherapy
- ♦ Examine the quality control program
- ♦ Identify the different treatment planning techniques for external radiotherapy treatment planning techniques
- ♦ 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 oncological contexts
- ♦ Analyze the importance of the Radiological Protection
- ♦ Assimilate the existing risks derived from the use of ionizing radiation
- ♦ Develop the international regulations applicable to radiation protection





## Specific Objectives

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### **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 the interaction of ionizing radiation with tissues and organs
- ◆ Examine the different existing mathematical models in radiobiology

### **Module 3. External Radiotherapy. Physical Dosimetry**

- ◆ Examine the quality control program of 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 of 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 between this modality with conventional radiotherapy both technologically and clinically



### 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
- ♦ Evaluate 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 Brachytherapy (LDR)

### 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 the international protocols for quality control of 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 radiopharmaceutical
- ♦ Develop expertise on MIRD methodology in patient 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

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*You will obtain a complete update on the administration of radiopharmaceuticals from the point of view of the nursing professional”*



# 03 Skills

The priority of this program is to enrich the clinical practice of nurses through the acquisition of skills that will enhance their professional horizons. The program will enhance skills aimed at the management of patient care after surgical interventions. In addition, the academic itinerary will address the interaction of Ionizing Radiation with Dosimetry and Radiobiology. Likewise, students will make the most of the current approach to Intraoperative Radiotherapy following specific guidelines for different types of cancer. In short, this Professional Master's Degree will allow experts an immersive learning programmed to train in real situations.



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*You will carry out successful specific quality control tests with which you will guarantee the safety of patients and healthcare personnel”*



## General Skills

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- ◆ 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
- ◆ Establish radiation protection and patient safety practices
- ◆ Create strategies to optimize radiation distribution in the target tissue and to minimize the 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 the structural shielding against existing radiation in hospitals





## Specific Skills

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- ◆ 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 the procedures and planning for prostate Brachytherapy
- ◆ Establish the physical basis of gamma camera and PET performance
- ◆ Determine the quality controls between gamma cameras and PET
- ◆ Carry out radiological protection actions in hospital departments



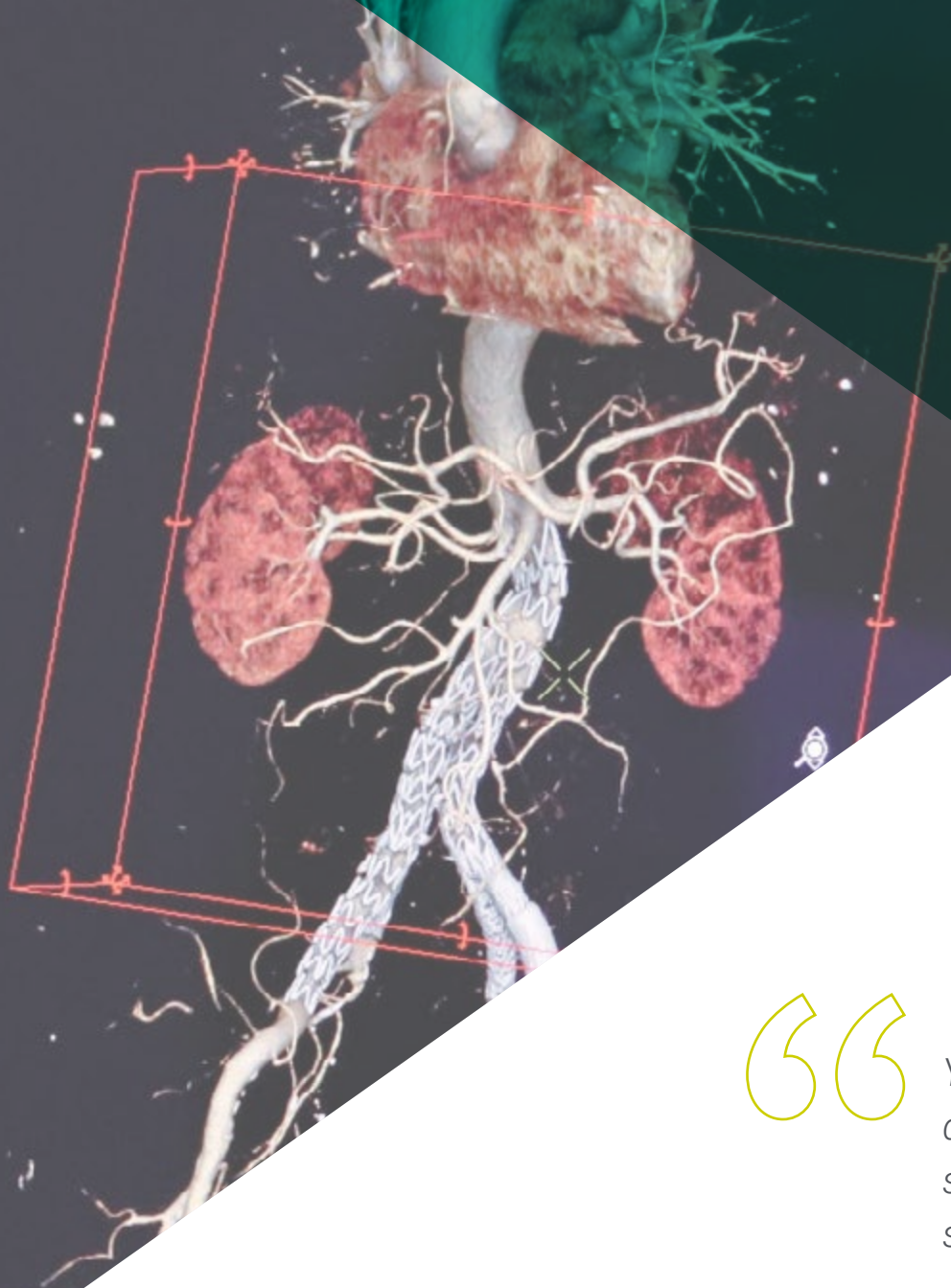
*TECH provides you with a multitude of practical cases so that you can develop your study as if you were facing real cases"*

04

# Course Management

In its maxim of offering educational excellence, TECH brings together a first class teaching team. The professionals who make up this program have extensive experience in research and application in the field of Radiophysics. Their excellent results have allowed them to work in the most prestigious hospitals. Accordingly, these specialists pour into this training all their knowledge in order to guarantee a successful learning process that allows students to acquire skills that they can immediately incorporate into their practice





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*You will have access to a curriculum designed by a recognized teaching staff, that will guarantee you a successful learning process”*

## Management



### Dr. De 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, Universidad Católica San Antonio de 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, head of the Nuclear Medicine section
- ◆ Principal Tutor of residents of the Department of Radiophysics and Radiological Protection of the Hospital Clínico Universitario de Valladolid.
- ◆ Degree in Hospital Radiophysics
- ◆ Degree in Physics at the University of Salamanca

### Dr. Morera Cano, Daniel

- ◆ Specialist in Hospital Radiophysics
- ◆ Hospital Radiophysics Faculty at the University Hospital Son Espases
- ◆ Master's Degree in Industrial Safety and Environment by the Polytechnic University of Valencia
- ◆ Master's Degree in Radiological Protection in Radioactive and Nuclear Facilities
- ◆ 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 in the University of Valencia
- ◆ Reviewer of the journal Applied Radiation and Isotopes
- ◆ International PhD in Medical Physics, University of Seville
- ◆ Master's Degree in Medical Physics from the University of Rennes I
- ◆ Degree in Physics from the Universidad de Zaragoza
- ◆ Member of: European Federation of Organisations in Medical Physics (EFOMP) and Spanish Society of Medical Physics (SEFM)

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*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

Consisting of 10 modules, this curriculum provides a comprehensive specialized vision in the field of Hospital Radiophysics. The training focuses on the state-of-the-art technology used in Radiotherapy, Nuclear Medicine and Radiodiagnosis. In this sense, the didactic materials will analyze the operation of electron linear accelerators, mammographs, computerized axial tomography, etc. At the same time, specialists will acquire new skills both in the administration of radiotherapeutic treatments and in diagnostic imaging. On the other hand, students will delve into quality controls in radiology equipment to ensure safety during therapies.





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*A degree that will allow you to apply state-of-the-art equipment such as computed tomography or gamma cameras to your clinical practice”*



## Module 1. Interaction of Ionizing Radiation with Matter

- 1.1. Radiation Ionizing-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. Charged Particle Equilibrium
  - 1.4.2. Bragg-Gray Cavity Theory
  - 1.4.3. Spencer-Attix Theory
  - 1.4.4. Absorbed Dose in Air
- 1.5. Magnitudes in Radiation Dosimetry
  - 1.5.1. Dosimetric Quantities
  - 1.5.2. Radiation Protection Quantities
  - 1.5.3. Radiation Weighting Factors
  - 1.5.4. Weighting Factors of Organs according to their 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 Setting
- 1.7. Dosimetry of Ionizing Radiation
  - 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. Calibration of Dosimeters
  - 1.8.3. Calibration at 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 the Measurement
  - 1.9.8. Quality Control of an Ionization Chamber
- 1.10. Uncertainty in Radiation Measurement
  - 1.10.1. Uncertainty in the Measurement
  - 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 Cells
  - 2.1.3. Physical-Chemical 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. Effects of Radiation 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 Radiations 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. Record Keeping and Verification System
  - 3.1.4. Special Techniques
  - 3.1.5. Hadrontherapy
- 3.2. Simulation and Localization Equipment in External Radiation Therapy
  - 3.2.1. Conventional Simulator
  - 3.2.2. Computed Tomography (CT) Simulation
  - 3.2.3. Other Image Modalities
- 3.3. Image-guided External Radiation Therapy Equipment
  - 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. Measuring 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. Measuring Equipment
  - 3.5.2. Calibration Protocols
  - 3.5.3. Calibration of Electron Beams
  - 3.5.4. Relative Dosimetry of Electron Beams
- 3.6. Implementation of External Radiotherapy Equipment
  - 3.6.1. Installation of External Radiotherapy Equipment
  - 3.6.2. Acceptance of External Radiotherapy Equipment
  - 3.6.3. Initial Reference Status (IRS)
  - 3.6.4. Clinical Use of External Radiotherapy Equipment
  - 3.6.5. Treatment Planning Systems
- 3.7. Quality Control of External Radiotherapy Equipment
  - 3.7.1. Quality Control of Linear Accelerators
  - 3.7.2. Quality Control in the IGRT Equipment
  - 3.7.3. Quality Control in Simulation Systems
  - 3.7.4. Special Techniques
- 3.8. Quality Control of Radiation Measuring Equipment
  - 3.8.1. Dosimetry
  - 3.8.2. Measuring Tools
  - 3.8.3. Mannequins Employed
- 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 Mapping
- 3.10. Quality Assurance Programming in Physical Dosimetry
  - 3.10.1. Responsibilities
  - 3.10.2. Requirements in External Radiotherapy
  - 3.10.3. Quality Assurance Programming Clinical and Physical Aspects
  - 3.10.4. Maintenance of Quality Control Program

## Module 4. External Radiotherapy. Clinical Dosimetry

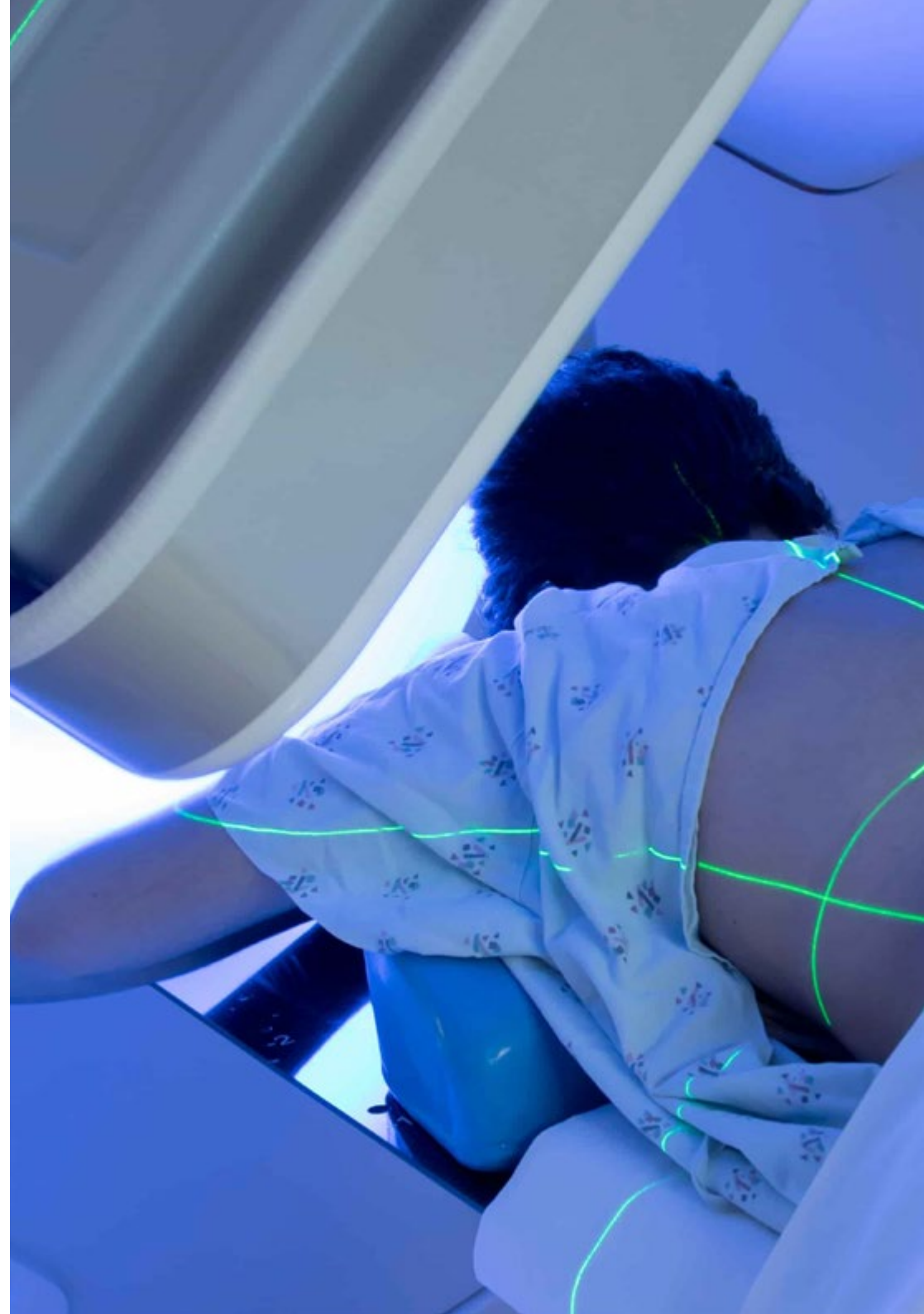
- 4.1. Clinical Dosimetry in External Radiotherapy
  - 4.1.1. Clinical Dosimetry in External Radiotherapy
  - 4.1.2. Treatment in External Radiotherapy
  - 4.1.3. Beam Modifying Elements
- 4.2. Stages of Clinical Dosimetry of External Radiotherapy
  - 4.2.1. Simulation Stage
  - 4.2.2. Treatment Planning
  - 4.2.3. Treatment Verification
  - 4.2.4. Linear Electron Accelerator Treatment
- 4.3. Treatment Planning Systems in External Radiotherapy
  - 4.3.1. Models in Planning Systems
  - 4.3.2. Calculating Algorithms
  - 4.3.3. Utilities of Planning Systems
  - 4.3.4. Imaging Tools for 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. Intervening Factors in Dose Distribution
  - 4.5.3. Practical Example of Calculation of MUs
- 4.6. Conformal 3D Radiotherapy Treatments
  - 4.6.1. 3D Radiotherapy (RT3D)
  - 4.6.2. Photon Beam RT3D Treatments
  - 4.6.3. Electron Beam RT3D Treatments
- 4.7. Advanced Intensity Modulated Treatments
  - 4.7.1. Modulated Intensity Treatments
  - 4.7.2. Optimization
  - 4.7.3. Specific Quality Control



- 4.8. Evaluation of External Radiation Therapy Planning
  - 4.8.1. Dose-volume Histogram
  - 4.8.2. Conformation Index and Homogeneity Index
  - 4.8.3. Clinical Impact of the Planning
  - 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 Radiotherapy
- 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 Radiotherapy with Protons
  - 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 Proton Therapy
  - 5.2.1. Facilities
  - 5.2.2. Components in Proton Therapy Systems
  - 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



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- 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 Procedures
    - 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 Proton Therapy

## **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 Systems in Intraoperative Radiotherapy
  - 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 Radiotherapy
  - 6.4.1. Types of Cancer 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. Formulas and Dosis Calculation Algorithms
  - 6.6.2. Dose Correction and Adjustment Factors
  - 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 Radiotherapy
  - 6.8.1. Role of the Multidisciplinary Team in Intraoperative Radiotherapy
  - 6.8.2. Communication between Radiation Therapists, Surgeons and Oncologists
  - 6.8.3. Practical Examples of Interdisciplinary Collaboration
- 6.9. Flash Technique. Latest Trend in Intraoperative Radiotherapy
  - 6.9.1. Research and Development in Intraoperative Radiotherapy
  - 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 Radiotherapy
  - 6.10.1. Ethical Considerations in Clinical Decision-Making
  - 6.10.2. Access to Intraoperative Radiotherapy and Equity of Care
  - 6.10.3. Communication with Patients and Family 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
  - 7.2.3. Calibration of Sources
  - 7.2.4. Safety in the Handling and Storage of Brachytherapy Sources
- 7.3. Dose Planning in Brachytherapy
  - 7.3.1. Techniques of Dose Planning 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 to Minimize Irradiation of Healthy Tissues
  - 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. Application of Brachytherapy in the Treatment of Prostate cancer
  - 7.5.2. Brachytherapy in Cervical Cancer: Technique and Results
  - 7.5.3. Brachytherapy in Breast Cancer: Clinical Considerations and Results
- 7.6. Brachytherapy Quality Management
  - 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 Outcomes in the Treatment of Specific Cancers
  - 7.7.2. Brachytherapy Efficacy and Toxicity Assessment
  - 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
- 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 for 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 Tubes
  - 8.1.2. Radiation Spectra Used in Radiodiagnosis
  - 8.1.3. Radiological Technique
- 8.2. Imaging in Radiology
  - 8.2.1. Digital Image Recording Systems
  - 8.2.2. Dynamic Imaging
  - 8.2.3. Radiodiagnostic Equipment
- 8.3. Quality Control in Radiodiagnostics
  - 8.3.1. Quality Assurance Program in Radiodiagnosis
  - 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 Installations
  - 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. Dose to Patients in Mammography
- 8.7. Fluoroscopy Equipment. Vascular and Interventional Radiology
  - 8.7.1. Fluoroscopy Equipment
  - 8.7.2. Specific Quality Control Tests
  - 8.7.3. Dose to Patients in Interventions
- 8.8. Computed Tomography Equipment
  - 8.8.1. Computed Tomography Equipment
  - 8.8.2. Specific Quality Control Tests
  - 8.8.3. Dose to Patients in CT
- 8.9. Other Radiodiagnostics Equipment
  - 8.9.1. Other Radiodiagnostics 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 Visualization 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 Therapy Radionuclides
- 9.2. Typical Radionuclides in Therapy
  - 9.2.1. Obtaining Artificial Radionuclides
  - 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. Gamma Camera 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 Constancy 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 Patient Protocol
- 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. MIRL Formalism
  - 9.10.2. Uncertainty Estimation
  - 9.10.3. Erroneous Administration of Radiopharmaceuticals

## Module 10. Radiation Protection in Hospital Radioactive Facilities

- 10.1. Radiation Protection in Hospitals
  - 10.1.1. Radiation Protection in Hospitals
  - 10.1.2. Radiological Protection Magnitudes and Specialized Radiation Protection Units
  - 10.1.3. Risks in the Hospital Area
- 10.2. International Radiation Protection Standards
  - 10.2.1. International Legal Framework and Authorizations
  - 10.2.2. International Regulations on Health Protection against Ionizing Radiation
  - 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. Tightness Control of Encapsulated Radioactive Sources
  - 10.6.1. Tightness Control 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 Facilities
  - 10.8.3. Calculation of the Workload
- 10.9. Structural Shielding Design in Radiotherapy
  - 10.9.1. Structural Shielding Design in Radiotherapy
  - 10.9.2. Radiotherapy Facilities
  - 10.9.3. Calculation of the Workload
- 10.10. Structural Shielding Design in Radiodiagnostics
  - 10.10.1. Structural Shielding Design in Radiodiagnostics
  - 10.10.2. Radiodiagnostics Facilities
  - 10.10.3. Calculation of the Workload

06

# Methodology

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

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



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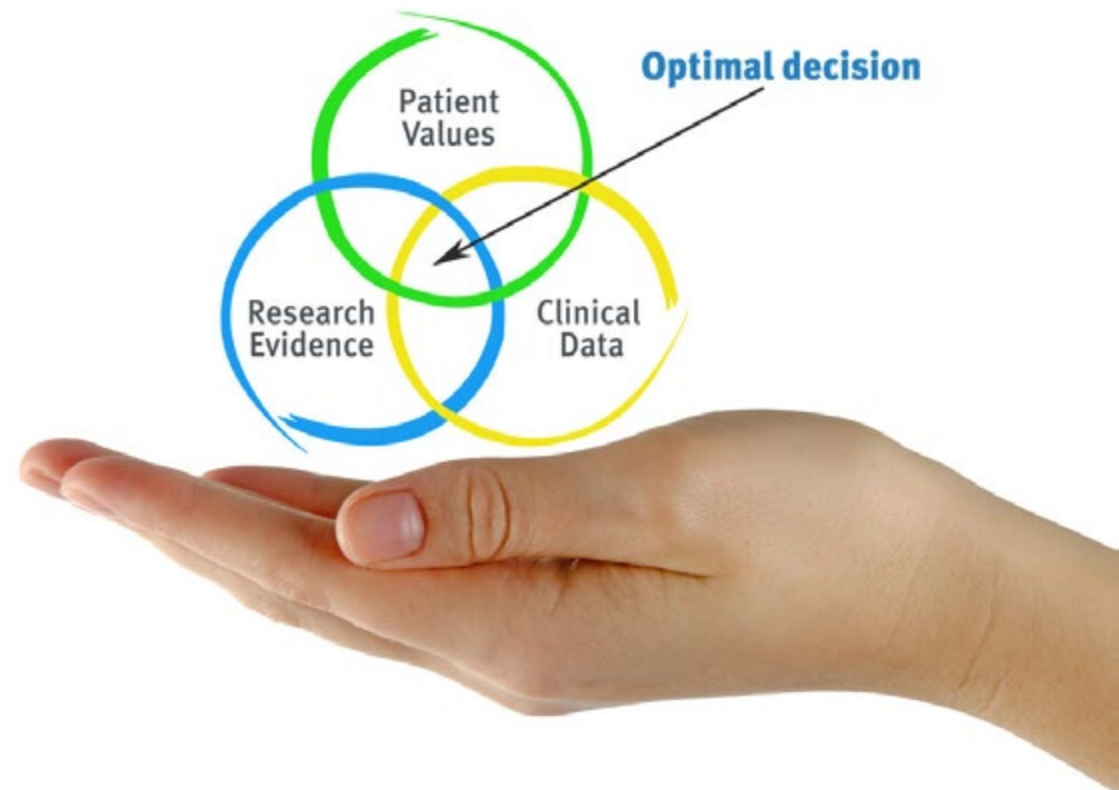
*Discover Relearning, a system that abandons conventional linear learning, to take you through cyclical teaching systems: a way of learning that has proven to be extremely effective, especially in subjects that require memorization"*



## At TECH Nursing School we use the Case Method

In a given situation, what should a professional do? Throughout the program, students will face multiple simulated clinical cases, based on real patients, in which they will have to do research, establish hypotheses, and ultimately resolve the situation. There is an abundance of scientific evidence on the effectiveness of the method. Nurses learn better, faster, and more sustainably over time.

*With TECH, nurses can experience a learning methodology that is shaking the foundations of traditional universities around the world.*



According to Dr. Gérvas, the clinical case is the annotated presentation of a patient, or group of patients, which becomes a "case", an example or model that illustrates some peculiar clinical component, either because of its teaching power or because of its uniqueness or rarity. It is essential that the case is based on current professional life, in an attempt to recreate the real conditions in professional nursing practice.

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*Did you know that this method was developed in 1912, at Harvard, for law students? The case method consisted of presenting students with real-life, complex situations for them to make decisions and justify their decisions on how to solve them. In 1924, Harvard adopted it as a standard teaching method”*

The effectiveness of the method is justified by four fundamental achievements:

1. Nurses who follow this method not only grasp concepts, but also develop their mental capacity, by evaluating real situations and applying their knowledge.
2. The learning process has a clear focus on practical skills that allow the nursing professional to better integrate knowledge acquisition into the hospital setting or primary care.
3. Ideas and concepts are understood more efficiently, given that the example situations are based on real-life.
4. Students like to feel that the effort they put into their studies is worthwhile. This then translates into a greater interest in learning and more time dedicated to working on the course.



## Relearning Methodology

At TECH we enhance the case method with the best 100% online teaching methodology available: Relearning.

This university is the first in the world to combine case studies with a 100% online learning system based on repetition combining a minimum of 8 different elements in each lesson, which is a real revolution compared to the simple study and analysis of cases.



*The nurse will learn through real cases and by solving complex situations in simulated learning environments. These simulations are developed using state-of-the-art software to facilitate immersive learning.*



At the forefront of world teaching, the Relearning method has managed to improve the overall satisfaction levels of professionals who complete their studies, with respect to the quality indicators of the best online university (Columbia University).

With this methodology we have trained more than 175,000 nurses with unprecedented success in all specialities regardless of practical workload. Our pedagogical methodology is developed in a highly competitive environment, with a university student body with a strong socioeconomic profile and an average age of 43.5 years old.

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

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.

The overall score obtained by TECH's learning system is 8.01, according to the highest international standards.





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 really 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.



### Nursing Techniques and Procedures on Video

We introduce you to the latest techniques, to the latest educational advances, to the forefront of current medical techniques. All of this in direct contact with students and explained in detail so as to aid their assimilation and understanding. And best of all, you can watch them as many times as you want.



### 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".



### 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.





#### Expert-Led Case Studies and Case Analysis

Effective learning ought to be contextual. Therefore, TECH presents real cases in which the expert will guide students, focusing on and solving the different situations: a clear and direct way to achieve the highest degree of understanding.



#### 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.



#### 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.



#### Quick Action Guides

TECH offers the most relevant contents of the course in the form of worksheets or quick action guides. A synthetic, practical, and effective way to help students progress in their learning.



07

# Certificate

This Professional Master's Degree in Radiophysics for Nursing guarantees students, in addition to the most rigorous and up-to-date program, access to a Professional Master's Degree issued by TECH Global University



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



This program will allow you to obtain your **Professional Master's Degree diploma in Radiophysics for Nursing** 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 for Nursing**

Modality: **online**

Duration: **12 months**

Accreditation: **60 ECTS**



\*Apostille Convention. In the event that the student wishes to have their paper diploma issued with an apostille, TECH Global University will make the necessary arrangements to obtain it, at an additional cost.

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



## Professional Master's Degree Radiophysics for Nursing

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

# Professional Master's Degree Radiophysics for Nursing