

## **Degree in Radiology, Diagnostic Imaging, and Radiotherapy Techniques**

**Integrated Course:** Diagnostic Imaging and Techniques III

CFU: 12

SSD: MED/50, MED/36

COORDINATOR OF THE COURSE: GUARNERA ALESSIA

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### **MODULE *Diagnostic Imaging and radiotherapy***

CFU: 6

SSD: MED/36

PROFESSOR:

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### **MODULE *Medical Sciences and techniques***

CFU: 6

SSD: MED/50

PROFESSOR:

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## **PREREQUISITES**

### **Diagnostic Imaging and radiotherapy**

Knowledge of the physical principles and of the radiological anatomy.

Basic school education and knowledge of basic science subjects are required: physics, biology and mathematics. It is also essential that the student has good exposure skills and language properties.

### **Medical Sciences and techniques**

Knowledge of basic physics, interaction of radiation with matter, radiation protection, foundations of physics and techniques for the basic use of magnetic resonance and computed tomography equipment.

In order to understand and be able to apply the topics covered in integrated teaching under the professional aspect, adequate knowledge of the biological and biochemical bases of life, anatomy, histology and human physiology, electronics and information technology, radiation protection, radiopharmaceuticals and safety in the preparation of radiopharmaceuticals.

## LEARNING OBJECTIVES

### **Diagnostic Imaging and radiotherapy**

The course aims to provide the student with knowledge of physiological, physiopathological, clinical, and diagnostic applications of Imaging techniques in order to optimize scientific and technical skills to employ radiological equipment adequately.

Knowledge of this application is crucial for the development of specific professional skills.

### **Medical Sciences and techniques**

The training objectives are knowledge of the techniques and methods of radiotherapy treatment, development of the treatment plan and the equipment used for therapy.

To provide students with the knowledge of advanced techniques on MRI and Computed Tomography equipment.

The teaching, integrated with the medical disciplines, aims to provide the student with the specific technical professional skills for the provision of typical services in the clinical field of nuclear medicine / molecular imaging, through the study and deepening of the principles and of the equipment / instrumentation used (such as gamma cameras or PETs, fractionators and radiopharmacy instrumentation), the preparation of radiopharmaceuticals and its clinical applications and methodologies, used for diagnosis and therapy.

## LEARNING OUTCOMES

### **knowledge and understanding**

#### **Diagnostic Imaging and radiotherapy**

At the end of the course the student should know:

- the physiological, physiopathological, clinical, and diagnostic application of the Imaging technique
- to collaborate in optimizing Imaging acquisition
- how to perform a computed tomography scan by using acquired skills in various anatomic and pathological fields

At the end of the course the student should demonstrate knowledge of the operating principles of all the machines dedicated to oncological radiotherapy; know the main clinical indications for the application of radiotherapy techniques; knowing how to solve and prevent the most common technical problems in the field of oncological radiotherapy; adopt an appropriate study method to achieve knowledge of the topics of the integrated course.

#### **Medical Sciences and techniques**

At the end of this course the student will have to know:

- know the principles and functioning of radiotherapy equipment
- describe the radiotherapy treatment techniques;
- describe and recognize the treatment methods.

Students will be expected to know the advanced study of the Heart in Magnetic Resonance and Computed Tomography with Dual Source and Dual Energy techniques.

Advanced Neurology studies using Diffusion, Tractography and Functional Magnetic Resonance and TOF, PC and CEMRA angiographic studies. At the end of the course, the student must know / be able to:

- Know the diagnostic equipment (and its components) and dedicated instrumentation;
- Know the equipment (and its components) used for the production, preparation and dispensing of radiopharmaceuticals;
- Know the principles and methods of proper functioning of the same
- Know how to provide services according to the most common diagnostic / therapeutic protocols
- Illustrate the knowledge acquired and know how to apply them under the operational aspect.

### **Applying knowledge and understanding)**

#### **Diagnostic Imaging and radiotherapy**

At the end of the course the student will be able to:

- Correctly work on Computed Tomography scans

At the end of the course the student should be able to apply the knowledge in order to operate with professionalism and competence in the field of radiotherapy.

#### **Medical Sciences and techniques**

At the end of the course, the student will be able to use the knowledge acquired in the context of his profession. He / she will acquire the notions to independently develop evaluations on therapy techniques and methods.

At the end of the course, the student must be able to use:

- • knowingly equipments and methodologies, in order to provide the services correctly, in compliance with the radioprotection and safety principles, as well as in compliance with clinical risk policies;
- • the knowledge acquired for the autonomous study of aspects relating to the specific field to which the student will devote himself as part of his professional activity.

### **communication skills**

#### **Diagnostic Imaging and radiotherapy**

At the end of the course the student should be able to:

- appropriately use scientific terminology
- apply his/her knowledge to guarantee adequate professional and communication skills in a professional setting

The student should demonstrate that he has acquired adequate scientific terminology and that he is able to explain his knowledge in a clear and comprehensive way to specialist and non-specialist interlocutors.

#### **Medical Sciences and techniques**

At the end of the course, the student must know how to use the terminology acquired with competence and appropriateness in relation to the treatment technique.

At the end of the course, the student must be able to:

- Know, in an adequate way, the terminology and the related scientific aspects specific to the nuclear medicine discipline;

- apply their knowledge and skills to the professional context, in order to communicate effectively with:
- patient and carers, in order to obtain the best collaboration, provide all indications and information as well as the precautions and radiation protection aspects;
- the team he works with, coordinating and collaborating properly and proposing a timely, critical, proactive and resolving analysis of inconveniences and problems.

### **making judgements**

#### **Diagnostic Imaging and radiotherapy**

At the end of the course the student should know:

- how to make general assessments of the discussed topics

At the end of the course the student should demonstrate that he has adequately acquired the knowledge provided in such a way as to be able to operate, at the end of the studies, professional acts under his own responsibility and independently.

#### **Medical Sciences and techniques**

At the end of the course, the student must be able to:

- carry out general assessments on discussed topics

### **Learning Skills**

At the end of the course, the student will have acquired skills and learning methods suitable for the deepening and improvement of his/her skills in the field of Radiology, also through the consultation of scientific literature.

At the end of the course the student should demonstrate to be able to update and broaden their knowledge by independently drawing on texts, scientific articles, online platforms and databases.

## **COURSE SYLLABUS**

### **Diagnostic Imaging and radiotherapy**

- Computed Tomography Settings and Protocols
- Neuro CT
- Head and Neck CT
- Chest CT
- Cardio-CT
- Abdominal CT
- Pelvic CT
- Angio-CT
- Seminar: The role of computed tomography in trauma: international protocols and clinical applications. Date 13.11.2023 (16:00-19:00)

**Radiotherapy equipment: introduction to the use of Linac**

The teaching program will address the following topics: Definitions; Electromagnetic and corpuscular radiation and consequent radiobiological effect on neoplastic tissues and normal tissues; Beams of photons and electrons of different energy and characteristics of the action on the surface and in depth; Definition of volumes in radiotherapy; Dose fractionation and treatment techniques; Toxicity; Examples of treatment in various organ pathologies.

**Radiotherapy equipment: introduction to the use of dedicated machines**

The teaching program will address the following topics: explanation of the problems inherent in the different phases of the path of the cancer patient candidate for radiation treatment, deepening those concerning treatment planning and delivery both for 3D techniques and for ultra-conformed and volumetric ones.

**General principles of oncological radiotherapy**

The teaching program will address the following topics: radiotherapy, therapeutic purposes and integrations.

**Therapeutic process in the treatment planning phase**

The teaching program will address the following topics: Isotac and isocenter; Contouring and co-registration; Volumes according to ICRU 50 (treatment volume and irradiated volume); Principles of 3D planning and inverse planning (IMRT-VMAT); Acute tissues and late responders (toxicity); Organs in series and organs in parallel; DVH and Dose Constraints; Clinical evaluations of treatment plans.

**Therapeutic process in the therapy phase**

The teaching program will address the following topics: Evolution of the IGRT concept; Interfraction and intra-fraction control systems; Tracking systems; Concepts of adaptive and application methods.

**Special techniques**

The teaching program will address the following topics: Interventional Radiotherapy, techniques and clinical indications; Definition of IMRT (Step & shoot / Sliding windows); Cranial and extracranial stereotaxia (SRT / SBRT); Respiratory Gating; MRI hybrid radiotherapy equipment.

**Medical Sciences and techniques**

Linear accelerator, linear accelerator with cone-beam ct system, iort, brachitherapia, simulator, mobile laser, immobilization systems, cerebral stereotaxic treatment, cerebral treatment, tumor treatment of the respiratory system, breast treatment, breast treatment, breast treatment treatment of the digestive apparatus, treatment of the prostate and urinary system, treatment of cutaneous injuries, metastase ratement, treatment planning system (tps), digital reformat reconstruction (drr) and with beam-ct, detection of target target and contour (gtv) ctv-ptv), fusion of images, 2d, conformational (3d) and imrt treatment, isodose curve, disomogenization and dosage surface (bolus)

- Redefinition of Spatial Resolution and Contrast Resolution and methods of use in the various imaging methods
- CT scan Dual Source and Dual Energy, technology and imaging techniques in different anatomical districts

- Neuro imaging with MRI, Diffusion, Tractography and fMRI
  - Magnetic resonance at 3 Tesla
  - Perfusion in CT and MRI
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- Introduction to nuclear medicine / molecular imaging methodologies
  - organization and management of a Nuclear Medicine department (environments, equipment, roles and functions);
  - Nuclear Medicine Equipment (gamma camera, PET and SPECT)
  - Main applications in diagnostics and therapy (according to international protocols and guidelines)
  - Radiopharmaceuticals, quality controls, good preparation practices, waste disposal
  - Seminar: organization and management of a department of Nuclear Medicine (environments, equipment, roles and functions), preparation of radiopharmaceuticals.

## COURSE STRUCTURE

### **Diagnostic Imaging and radiotherapy**

The course consists of frontal lessons. Lectures will include theoretical lessons and seminars. The Professors will use didactic tools such as presentations organized in power-point files with explanatory diagrams, illustrations, and images. Attendance is mandatory. Interactive theoretical lectures will be held in which the basic knowledge of the teaching subjects will be addressed by the teacher. Interactive tests and quizzes during the lessons through which the learning and understanding skills, the ability of independent judgment, problem-solving and communication skills of the students will be verified.

### **Medical Sciences and techniques**

The course consists in frontal teaching structured in lessons based on the academic calendar.

The lectures will include theoretical lessons and seminars of case studies.

In addition to the lectures, workshops, exercises, group work and educational visits may be provided. In order to involve the student and improve learning, the teaching method contemplates, during the lectures, the resolution of some practical questions, the answer to some cognitive questionnaires, the preparation of thematic papers or bibliographic research.

## COURSE GRADE DETERMINATION

### **Diagnostic Imaging and radiotherapy**

### **Medical Sciences and techniques**

The exam will include a written test on topics discussed in the theoretical lectures and seminars, consisting of multiple choice questions with only one correct answer. The student will answer 33 questions related to all the teaching modules of the Course in Degree in Radiology, Diagnostic Imaging, and Radiotherapy Techniques. The student will pass the written test with 18/30. The written exam is mandatory to access the oral exam, which is optional and allows the student to demonstrate his/her preparation by discussing the topics related to the various teaching modules of the Degree Course in Radiology, Diagnostic Imaging, and Radiotherapy Techniques proving to have acquired the ability to make connections and express themselves

with an adequate scientific language. In case of accessing the oral test, the final evaluation will be a weighted average between the written and oral exams.

The exam will be evaluated according to the following criteria:

Not suitable: crucial deficiencies and/or inaccuracies in the knowledge and understanding of the topics; limited ability of analysis and synthesis, frequent generalizations.

18-20: sufficient knowledge and understanding of the topics, with possible imperfections; sufficient synthesis, analysis skills and judgment autonomy.

21-23: knowledge and understanding of routine topics; ability to correct analysis and synthesis with coherent logical topics.

24-26: good knowledge and understanding of the topics; good analytical skills and synthesis with arguments expressed in a rigorous way.

27-29: complete knowledge and comprehension of the arguments; remarkable analytical skills, synthesis.

Good autonomy of judgment.

30-30L: excellent knowledge and understanding of the topics; remarkable ability of analysis and synthesis, and autonomy of judgment; topics expressed in an original way.

## OPTIONAL ACTIVITIES

### Diagnostic Imaging and radiotherapy

Students will have the opportunity to carry out theoretical/practical exercises and attend seminars. Professors will provide constant support during and after the lessons

### Medical Sciences and techniques

In addition to the theoretical teaching activity, some themes and case studies will be discussed with monographic insights.

## READING MATERIALS

### Diagnostic Imaging and radiotherapy

- Nikolaou, Konstantin, Fabian Bamberg, Andrea Laghi, and Geoffrey D. Rubin. 2019. *Multislice CT*. Springer.
- Romano Luigia, Massimo Silva, Sonia Fulciniti, and Antonio Pinto. 2016. *MDCT Anatomy - Body*. Springer Milan.
- Radiation Therapy Study Guide: A Radiation Therapist's Review by Amy Heath. Springer, 2016.
- Mosby's Radiation Therapy Study Guide and Exam Review by Leia Levy. Elsevier 2020.
- Elementi di Radioterapia Oncologica. Manuale per tecnici sanitari di radiologia medica. Balducci M, Cellini F, Cornacchione P, D'Angelillo R, Mattiucci GC, Pasini D. Società Editrice Universo, 2013.

Didactic documents provided by the Professors.

### Medical Sciences and techniques

- External beam therapy, Peter Hoskin, Oxford
- Calabria F., Schillaci O. (Ed.) Radiopharmaceuticals: A Guide to PET/CT and PET/MRI, Milano, Springer, 2019
- Volterrani, D., Erba, P.A., Carrio, I., Strauss, H.W., Mariani, G., Nuclear Medicine Textbook, Milano, Spinger, 2019

- Assadi, Majid, Ahmadzadehfar, Hojjat, Biersack, Hans-Jürgen, Principles of Nuclear Medicine, Milano, Springer, 2018
- Consultation of documents and free resources produced by the European scientific societies of radiology, nuclear medicine, radiotherapy Guidelines & Recommendations or free content to download. For example: European Society of Radiology (<https://www.myesr.org/publications/guidelines-and-recommendations>); European Association of Nuclear Medicine (EANM) (<https://www.eanm.org/publications/technologists-guide/>)

Material provided by the Professors.