



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

*Academic Year 2026 / 2027*

**INTEGRATED COURSE (I.C.): Pharmacology**

**NUMBER OF CFU (ECTS credits): 6**

**SSD (Academic Discipline Code): BIOS-11/A (formerly BIO/14), MEDS-22/A (formerly MED/36)**

**COORDINATOR OF THE I.C.:** Prof. Marzia Del Re

**E-MAIL:** marzia.delre@unicamillus.org

MODULE 1: Radiopharmaceuticals

NUMBER OF CFU (ECTS credits): 3

SSD (Academic Discipline Code): BIOS-11/A (formerly BIO/14)

LECTURER: Prof. Marzia Del Re

e-mail: marzia.delre@unicamillus.org

MODULE 2: Safe handling of radiopharmaceuticals

NUMBER OF CFU (ECTS credits): 3

SSD (Academic Discipline Code): MEDS-22/A (formerly MED/36)

LECTURER: Prof. Salvatore Annunziata

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### **PREREQUISITE COURSES**

None required.

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Students must have a knowledge of biochemistry, microbiology, general pathology and basic physiology enabling them to understand the contents of the syllabus relating to pharmacokinetics and pharmacodynamics, as well as the adverse events of the drugs covered. Basic knowledge of medical physics and chemistry is also required.

### **LEARNING OBJECTIVES**

The course covers the general principles of pharmacology that apply to all drugs, and subsequently the classes of drugs directly and indirectly related to radiological practice. In the general part, students will learn the principles of pharmacokinetics, pharmacodynamics and pharmacogenetics that apply to all classes of

drugs, including radiopharmaceuticals and contrast media. In the special part, particular emphasis will be placed on radiopharmaceuticals (used for both diagnostic and therapeutic purposes), on contrast media and on some specific classes of drugs. On completion of the course, students should know and understand the mechanism of action, pharmacokinetics, side effects, toxicological aspects and contraindications of the main radionuclides used in SPECT and PET nuclear medicine, and must be able to safeguard the physical safety of the patient when performing an instrumental examination using a radiopharmaceutical.

### **EXPECTED LEARNING OUTCOMES**

#### **DD 1: Knowledge and understanding**

By the end of the course students will know the pharmacokinetics and pharmacodynamics of drugs, both directly and indirectly connected with radiological preclinical practice, and will know the principles and consequences of drug interactions. They will also know the main radiopharmaceuticals used for both diagnostic and therapeutic purposes and the contrast media. Students will also be able to know the physical and chemical principles of radiopharmaceuticals; to describe the chemical and physical principles of radiopharmaceuticals; to know the principles for the correct management of radiopharmaceuticals in nuclear medicine; and to explain the correct use of a radiopharmaceutical control system.

#### **DD 2: Applying knowledge and understanding**

By the end of the course students will be able to use the knowledge acquired for the independent study of the aspects relating to the specific field to which they will devote themselves in their professional activity, and to use and handle radiopharmaceuticals knowledgeably.

#### **DD3: Making judgements**

By the end of the course students must be able to make general assessments on the topics covered.

#### **DD4: Communication skills**

By the end of the course students must be able to use the specific scientific terminology appropriately.

#### **DD5: Learning skills**

Students will have developed learning skills and methods suitable for deepening and improving their competencies in the field of Pharmacology, also through the consultation of the scientific literature.

### **SYLLABUS**

#### **Syllabus Radiopharmaceuticals**

- Principles of general pharmacology
- New drug development and study phases
- Preclinical and clinical trials of drugs

- Pharmacodynamics: mechanism of action of agonist and antagonist drugs, receptors and signalling pathways
- Pharmacokinetics: influencing factors, elimination and biotransformation of drugs
- Pharmacogenetics
- Antineoplastic chemotherapy, general principles of Target Therapy
- Radiopharmaceuticals in nuclear medicine
- Overview of radiopharmaceuticals in Nuclear Medicine
- Structure of the atom and the nucleus
- Overview of the types of radiation used in medicine and decay modes
- Overview of the principles of radiation protection
- Criteria for choosing a radiopharmaceutical
- Production and quality control of radiopharmaceuticals
- Overview of PET, overview of SPECT
- PET and SPECT radiopharmaceuticals
- Scintigraphic examinations (renal scintigraphy, myocardial scintigraphy, etc.)
- Radiolabelled nanoparticles: new pharmacological perspectives for imaging and therapy

#### **Syllabus Safe handling of radiopharmaceuticals**

- Overview of radiopharmaceuticals in Nuclear Medicine
- Structure of the atom and the nucleus
- Overview of the types of radiation used in medicine and decay modes
- Overview of the principles of radiation protection
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- Production and quality control of radiopharmaceuticals
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#### **COURSE STRUCTURE**

**Lectures:** each new lesson will be preceded by a summary of the previous one with the help of the students, who will often be asked to contribute during the lesson, with the aim of achieving the fullest possible understanding and learning of the topic covered, directly in the classroom.

#### **COURSE GRADE DETERMINATION**

**Written test:** written test with 33 questions. 1 point will be awarded for each correct answer and no penalty will be applied to wrong or blank answers. Time allowed: 35 minutes.

**Oral test:** the oral exam is optional and may be taken by students who wish to obtain honours (cum laude) or improve their mark.

The exam will be graded overall according to the following criteria:

|               |                                                                                                                                                                                |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Fail</b>   | Significant gaps and/or inaccuracies in the knowledge and understanding of the topics; limited analytical and synthesis skills, frequent generalizations.                      |
| <b>18-20</b>  | Barely sufficient knowledge and understanding of the topics, with possible imperfections; sufficient analytical, synthesis and judgement skills.                               |
| <b>21-23</b>  | Routine knowledge and understanding of the topics; correct analytical and synthesis skills with coherent logical argumentation.                                                |
| <b>24-26</b>  | Fair knowledge and understanding of the topics; good analytical and synthesis skills with rigorously expressed argumentation.                                                  |
| <b>27-29</b>  | Complete knowledge and understanding of the topics; considerable analytical and synthesis skills. Good independent judgement.                                                  |
| <b>30-30L</b> | Excellent level of knowledge and understanding of the topics. Considerable analytical, synthesis and independent judgement skills. Argumentation expressed in an original way. |

Students with disabilities and with specific learning disorders (SLD): in accordance with current legislation and with the guidance of the University's inclusion services, students with certified disabilities or specific learning disorders are entitled to the compensatory tools and measures provided for (e.g. additional time, concept maps, equivalent tests). Adaptations of the examination are agreed between the lecturer, the student and the competent office, without prejudice to the equivalence of the learning outcomes assessed.

### **OPTIONAL ACTIVITIES**

Students will have the opportunity to carry out theoretical/practical exercises and to take part in seminars. Lecturers will provide constant support during and after the lessons.

### **READING MATERIALS**

#### **Texts Radiopharmaceuticals**

- Laurence Brunton; Bjorn Knollmann. Goodman and Gilman. The Pharmacological Basis of Therapeutics, 14th Edition, McGraw Hill, 2023.
- Bertram G. Katzung, Todd W. Vanderah. "Basic and Clinical Pharmacology". 16th Edition, McGraw Hill Education, 2024.
- Nuclear Medicine Textbook, Methodology and Clinical Applications - Duccio Volterrani, Paola Anna Erba, Ignasi Carrió, H. William Strauss, Giuliano Mariani; ISBN 978-3-319-95563-6 ISBN 978-3-319-95564-3 (eBook) <https://doi.org/10.1007/978-3-319-95564-3>; © Springer Nature Switzerland AG 2019
- EANM Guidelines; © European Association of Nuclear Medicine

#### **Texts Safe handling of radiopharmaceuticals**

- **Lecturer's slides:** all the slides shown during the lessons will be provided to students by e-mail.

- **Nuclear Medicine Textbook, Methodology and Clinical Applications** - Duccio Volterrani, Paola Anna Erba, Ignasi Carrió, H. William Strauss, Giuliano Mariani; ISBN 978-3-319-95563-6 ISBN 978-3-319-95564-3 (eBook) <https://doi.org/10.1007/978-3-319-95564-3>; © Springer Nature Switzerland AG 2019
- **EANM Guidelines**; © European Association of Nuclear Medicine