COURSE OF STUDY *Physics (LM-17)*

ACADEMIC YEAR *2023-2024*

ACADEMIC SUBJECT *Health Physics*

General information	
Year of the course	2nd
Academic calendar (starting and ending date)	1st semester: September - December 2023
Credits (CFU/ECTS):	6
SSD	FIS/07
Language	English
Mode of attendance	Compulsory

Professor/ Lecturer	
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Department and address	Department of Physics, first floor, office 104
Virtual room	Microsoft TEAMS, code b095zmk
Office Hours (and modalities: e.g., by appointment, on line, etc.)	By appointment to be agreed by email; in-person or remotely.

Work schedule			
Hours			
Total	Lectures	Hands-on (laboratory, workshops, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
150	32	30	88
CFU/ECTS			
8	4	2	

Learning Objectives **Course prerequisites**	Fundamentals of health physics and safe use of ionizing radiation Electromagnetism, atomic and nuclear structure, basic knowledge of particle physics, basic knowledge of particle detectors and counting statistic

Teaching strategies	The course is taught in front of the students, where all the topics are explained and knowledge is consolidated, also promoting the active participation of the students. Conducting exercises and practice tests in which students' ability to solve health physics problems with a rational and scientific approach is developed and consolidated. Support material will be made available through the Microsoft TEAMS platform.
Expected learning outcomes in terms of	
Knowledge and understanding on:	• Understanding the scientific method, the nature, and the methods of research in Physics • Knowledge of advanced instrumentation in experimental physics • Dose evaluation • Radiation protection • Real system modeling ionizing radiation risks

Applying knowledge and understanding on:	● Ability to use analogy to apply known solutions to new problems (problem solving) ● Ability to design and implement experimental or theoretical procedures to solve problems in academic and industrial research or to improve existing results ● Ability to use analytical and numerical mathematical computation tools ● Ability to estimate the dose and the risk associated with the use of ionizing radiation with regard to their industrial, research and medical applications
Soft skills	● **Making informed judgments and choices** o Ability to work with increasing levels of autonomy, including taking responsibility in project planning and managing facilities o Apply the notions learned in multi-disciplinary contexts o Apply health physics concepts to real systems ● **Communicating knowledge and understanding** o Competence in communication in Italian and English in advanced fields of Physics o Use of rigorous and precise language, o Use of logical arguments ● **Capacities to continue learning** o Acquisition of basic knowledge tools for continuous learning and knowledge updates o Problem-solving strategies o Modelling real systems
Syllabus	
Content knowledge	**Radioactivity**: alpha beta and gamma decay. Radioactive series. Secular Equilibrium. **Ionizing radiation**: Interactions of high-energy photons with matter: photoelectric effect, Rayleigh scattering, Compton scattering, pair production, photonuclear interactions. Interactions of charged particles with matter. Bethe-Bloch formula. Bragg peak and particle range. Interactions of neutrons with matter. LET (Linear Energy Transfer). **Dosimetry of ionizing radiation:** main dosimetric quantities: exposure, absorbed dose, equivalent dose and effective dose. Basics of biological effects of ionizing radiation: deterministic and stochastic effects. Weight factors for different types of ionizing radiation and for the different tissues of the human body. **Radiation detection**: Ionization chambers, counters, free-air chamber, air-wall chamber. Bragg-Gray principle. Dose measurement. TLD dosimeters. Counting statistic. Minimum Detectable Activity. Alpha and gamma spectra analysis **Operational radiation protection**: external and internal exposure. Principle of radiation protection. Shielding design. Basic concepts of Italian radiation regulatory system. **Introduction to X-ray imaging techniques**: X-ray tubes. Basics of Computed Tomography and its applications in the medical, industrial and Cultural Heritage fields. **Nuclear Magnetic Resonance**: Bloch equations and principles of image reconstruction.
Texts and readings	H. Cember “Health Physics”, Mc Graw Hill

	E.B. Podgorsak "Radiation Physics for medical Physicist", Springer J.E. Turner 'Atoms, Radiation and radiation Protection', Wiley
Notes, additional materials	Lecture Notes provided by the teacher
Repository	Microsoft TEAMS, code **b095zmk**

Assessment	
Assessment methods	The examination consists of an oral test involving a colloquium on the main theoretical subjects of the programme.
Assessment criteria	● **Knowledge and understanding** The level of knowledge and understanding of physical laws and phenomena taught is assessed. ● **Applying knowledge and understanding** The ability to apply the physical laws learned to interpret phenomena and solve problems within the course program is assessed. ● **Autonomy of judgment** The autonomy in analyzing the phenomena and physical laws presented in the course is evaluated. ● **Communicating knowledge and understanding** The mastery of the use of the language of physics and the overall quality of the exposure are evaluated. ● **Communication skills** the methods used in conveying, receiving and processing information through verbal means is evaluated ● **Capacities to continue learning** The ability to organize knowledge, critical reasoning and possible self-deepening is evaluated.
Final exam and grading criteria	The oral test consists of an examination in which comprehension, knowledge and ability to discuss the topics of the course programme are assessed. Particularly significant are the mastery of subjects and the ability to reason autonomously. The final grade is given out of thirty and the exam is passed if the final grade is at least 18/30. In the case of an oral examination particularly brilliant for clarity and completeness, praise may be attributed.
Further information	The attendance of lessons is strongly recommended