UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Fisica e Chimica - Emilio Segrè
ACADEMIC YEAR	2022/2023
MASTER'S DEGREE (MSC)	PHYSICS
SUBJECT	RADIATION DETECTORS WITH LAB
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	20901-Attività formative affini o integrative
CODE	22658
SCIENTIFIC SECTOR(S)	FIS/07
HEAD PROFESSOR(S)	ABBENE LEONARDO Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	86
COURSE ACTIVITY (Hrs)	64
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	

DOCENTE: Prof. LEONARDO ABBENE

PREREQUISITES	- Basic knowledge of the Laws of Classical Physics and quantum mechanics. - Standard methodologies for error analysis, counting statistics and data processing. - Basic knowledge of Nuclear and Subnuclear Physics.
LEARNING OUTCOMES	Knowledge and understanding The student will have the knowledge of the issues regarding the physics of ionizing radiation detection. In particular, the student will be able to understand the issues related to the characterization and development of ionizing radiation detectors. Applying knowledge and understanding The student will acquire the methods regarding the physics of ionizing radiation detection and the application to experimental issues. In particular the student will be able to solve problems related to the characterization and development of ionizing radiation detectors. Making judgments The student will be able to apply the scientific methodology to solve problems; The student will also acquire the ability to analyze the signals and the results from detection systems. Communication skills The student will acquire the ability to express physical concepts related to the radiation detection with appropriate and rigorous terminology. Learning ability The student will have the ability to plan new experiments on radiation detection, analyze the results and perform comparisons with the literature.
ASSESSMENT METHODS	Oral Exam. The oral test consists of an interview, checking the knowledge; the evaluation is expressed in thirtieths. The proposed questions will test: a) the knowledge acquired by the student; b) the processing capabilities, and c) explaining capability. In particular, costructive connections among theory, models and experiments will be required. The final evaluation: Excellent 30-30 cum laude, excellent knowledge of the topics, excellent properties of language and analytical ability. The student must be very able to solve proposed problems and experiments. Very good 26-29 very good knowledge of topics; Good 24-25 good understanding of the main topics; Satisfactory 21-23, satisfactory understanding of the main topics; Sufficient 18-20, Minimum basic understanding of the main topics; Insufficient, the student has not a sufficient knowledge of the main topics.
EDUCATIONAL OBJECTIVES	The course has the following educational objectives: • provide to the students a basic understanding of key physical principles in ionizing radiation detection; • provide to the students a deep knowledge of instrumentation and experimental procedures for the detection of ionizing radiation.
TEACHING METHODS	- Lectures. - Laboratory activities.
SUGGESTED BIBLIOGRAPHY	G. F. Knoll-Radiation Detection and Measurement- quarta edizione- Editore John Wiley & Sons Inc.- ISBN: 978-0-470-13148-0.

SYLLABUS

Hrs	Frontal teaching
4	Introduction. Radiation Sources. Units and Definitions. Fast Electron Sources . Heavy Charged Particle Sources. Sources of Electromagnetic Radiation. Neutron Sources.

SYLLABUS

Hrs	Frontal teaching
4	Radiation Interactions. Interaction of Heavy Charged Particles. Interaction of Fast Electrons. Interaction of X and Gamma Rays. Interaction of Neutrons. Radiation Exposure and Dose.
4	General Properties of Radiation Detectors. Simplified Detector Model. Modes of Detector Operation Pulse Height Spectra. Counting Curves and Plateaus. Energy Resolution. Detection Efficiency. Dead Time.
4	Ionization Chambers. Gas Detectors. The Ionization Process in Gases. Charge Migration and Collection. Signal Formation in Pulse Mode operation: Shockley-Ramo theorem. Radiation Dose Measurement with Ion Chambers. Proportional Counters. Multi Wire Proportional Chambers. Geiger-Mueller Counters.
4	Scintillation Detectors. Organic Scintillators. Photomultiplier Tubes and Photodiodes.
6	Semiconductor Detectors. Silicon Detectors. Germanium Detectors. Room Temperature Semiconductor Detectors (GaAs, CdTe, CdZnTe, HgI2, TlBr). Planar, Pixel, Strip and Co-planar Detectors.
2	Other Solid-state Detectors and Miscellaneous Detector Types.
2	Pulse Processing and Shaping: Techniques and Instrumentation.
2	Applications of Radiation Detectors in Nuclear and Applied Physics and in Astrophysics.

Hrs	Workshops
12	Introduction to the typical instrumentation of a radiation detector system. Setting of the key features for the pulse processing.
20	Experimental set-up mounting of a solid-state radiation system (semiconductor detectors, scintillators). Signal acquisition. Measurement of spectroscopic response, energy, counting, dead time and detection efficiency.