UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

CONSIGLIO INTERCLASSE IN MATEMATICA

COURSE OF STUDY TWO-YEAR MASTER OF SCIENCE PROGRAMME IN MATHEMATICS

ACADEMIC YEAR 2024-2025

ACADEMIC SUBJECT PRACTICAL PHYSICS

General information	
Programme year	First
Term	Second semester (February 2, 2025 – May 30, 2025)
European Credit Transfer and Accumulation System credits (ECTS)	7
SSD	FIS/01
Language	Italian
Mode of attendance	Theory – optional attendance, laboratory – compulsory attendance

Lecturer	
Name and surname	Gianlorenzo Massaro
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Telephone	
Department and office	Department of Physics, 1st floor, room 183
Virtual meeting room	Course team on Microsoft Teams
Web page	
Office hours	To be defined

Work schedule				
	Total	Lectures	Hands-on learning (recitations/laboratories)	Self-study
Hours	175	24	32	119
ECTS credits	7	3	4	

Learning objectives	
	• Understanding of the complexity of measurement process • Acquisition of the scientific method in the collection and analysis of data • Ability of making tests for validating statistical hypothesis

Course prerequisites	
	General Physics, Analytical Geometry, Differential Calculation

Syllabus	
Course contents	The scientific method. Physical quantities and their measurement. Uncertainties in measurements of physical quantities. Catalog of uncertainties. Measuring instruments and their properties. Best measurement estimate. Uncertainty estimation. Significant measures, uncertainties and significant figures. Comparison between measurement and expected value and between measurements. Organization and presentation of data. Definition of probability. Main properties of probability. Discrete and continuous random variables. Probability Distributions. Expected value and variance. The Gauss distribution and the standardized variable. Principle of

	maximum likelihood. Estimation of Gauss Distribution Parameters. Probability of standard deviation. Probability of obtaining a result in a measurement operation. The central limit theorem. Presentation of the result of a measure and intervals of confidence. Verification of hypotheses and significance. Weighted average. Adaptation of a functional relationship to experimental data. Graph method. Minimal square method. Weighing least squares method. Estimate uncertainty about the parameters of the straight line. Estimate of uncertainty on an interpolated value. Linear correlation coefficient. Covariance and correlation.
Reference books	- G. Cannelli, Metodologie sperimentali in Fisica, EdiSES - G. Ciullo, Introduzione al laboratorio di fisica, Springer
Additional course materials	Slides and lab sheets.

Expected learning outcomes	
Knowledge and understanding	Acquisition of the knowledge and skills necessary to independently conduct a experiment for verifying the laws of physics. The knowledge will be acquired through theoretical lessons
Applying knowledge and understanding	Acquisition of the basics knowledge to collect data, analyse them and interpret them critically. These skills will be acquired through classroom and laboratory exercises.
Soft skills	• Making informed judgments and choices Development of critical interpretation and evaluation capabilities of experimental data also in order to identify appropriate solutions and improvement strategies. These skills can be developed in the discussion with the teacher of the examples proposed during the lessons and exercises. • Communicating knowledge and understanding Skills development in ○ relationship in group work; ○ communications of their results correctly to non-specialist interview The result can be achieved by writing reports. • Capacities to continue learning Accomplishment of the ability to grow autonomously with own knowledge and skills for following a continuous upgrade path over time. To this end, students will be asked to review the knowledge acquired in previous courses, necessary to understand and develop the theoretical topics and to carry out laboratory activities.

Teaching methods	
	• Lectures supported by Power Point presentations. • Numerical classroom exercises with class involvement. • Laboratory exercises with instrumental measurements, data processing and interpretation with computer tools. Students will be encouraged to discuss with both the teacher and each other any critical points, experimental procedures, modes of analysis, conclusions.

Assessment	
Assessment methods	The final evaluation will take place through an oral test in which the student will have to demonstrate.

	• have acquired the fundamental theoretical knowledge to perform measurements, analyze and interpret them; • to know how to express them in a clear form and with properties of language. The vote will also take into account the interlocutory capacity demonstrated during lectures and exercises as well as the group relationships produced during the year at the end of each laboratory exercise.
Evaluation criteria	• Knowledge and understanding The student must demonstrate knowledge of the characteristics of the scientific method, the measurement procedures and the main characteristics of the measuring instruments, the methodologies for estimating errors and for analyzing data. The student must also demonstrate that he adequately masters the concepts of physics related to laboratory exercise. Understanding and possessing the fundamental concepts is a necessary condition for passing the exam. • Applying knowledge and understanding The student must be able to use the basic knowledge acquired to identify the correct procedures for the acquisition, processing and interpretation of data. The mastery of these procedures, at least in the basic setting, is a necessary requirement for passing the exam • Autonomy of judgment The student must be able to identify the most suitable methodological choices for solving the problem proposed. The demonstration of adequate proactive ability in the methodologies to be used is a condition for a significant increase in the final grade compared to the minimum necessary for passing the exam • Communication skills The student must be able to communicate his level of understanding with properties of language, without giving rise to ambiguity or misunderstanding. Deficiencies in possessing these skills will result in a penalty in the final judgment. • Capacities to continue learning Starting from the content of the course, the student must prove to be capable of enriching his understanding of the topics and methodologies independently.
Grading policy	The final mark is awarded out of thirty. The exam is passed when the mark is greater than or equal to 18

Further information	