UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Fisica e Chimica - Emilio Segrè
ACADEMIC YEAR	2017/2018
BACHELOR'S DEGREE (BSC)	PHYSICS
INTEGRATED COURSE	PHYSICS I - LABORATORY
CODE	16672
MODULES	Yes
NUMBER OF MODULES	2
SCIENTIFIC SECTOR(S)	FIS/01, FIS/05
HEAD PROFESSOR(S)	AGLIOLO GALLITTO AURELIO — Professore Associato — Univ. di PALERMO
OTHER PROFESSOR(S)	DI SALVO TIZIANA — Professore Ordinario — Univ. di PALERMO AGLIOLO GALLITTO AURELIO — Professore Associato — Univ. di PALERMO
CREDITS	12
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	Annual
ATTENDANCE	Mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**AGLIOLO GALLITTO AURELIO** Tuesday 14:00 16:00 Via Archirafi 36, studio del docente (per gli studenti di Scienze Fisiche). Viale delle Scienze, Ed.18 (per gli studenti di Ottica e Optometria e gli studenti di Scienze Biologiche). Modalita a distanza. Su appuntamento. Thursday 14:00 16:00 Via Archirafi 36, studio del docente (per gli studenti di Scienze Fisiche). Viale delle Scienze, Ed.18 (per gli studenti di Ottica e Optometria e gli studenti di Scienze Biologiche). Modalita a distanza. Su appuntamento. **DI SALVO TIZIANA** Tuesday 15:00 17:00 Sede di via Archirafi 36Ufficio presso il secondo piano Thursday 15:00 17:00 Sede di via Archirafi 36Ufficio presso il secondo piano

DOCENTE: Prof. AURELIO AGLIOLO GALLITTO

PREREQUISITES	Knowledge of mathematics required for the enrollment in the bachelor degree course in Physical Sciences.
LEARNING OUTCOMES	Knowledge and understanding Acquisition of methods for the determination of the best estimate of a physical quantity, statistical data analysis and understanding of the various methods that allow the determination of the uncertainty associated with the measured value. Applying knowledge and understanding The laboratory work aims to bring students achieving a level of autonomy sufficient to realization of activity regarding experimental problems of classical physics (mechanics and thermodynamics). Students will acquire ability in organizing a laboratory experiment to achieve the aim. Making judgements Autonomy in dealing with a scientific reasoning on experimental measurements of general classical physics quantities. Ability to evaluate the results achieved in order to evaluate the correctness of the result or its possible rejection. Communication skills Capacity in dealing with a laboratory experiment on physical phenomena and to explain the experimental results in a clear and correct way, also in collaboration with the other elements of working group. Capacity to produce a group report on the activities carried out, the analysis of the acquired data and the final results of an experiment. Learning skills On the basis of the skills acquired during the teaching, students will be able to organize, run and evaluate a simple physics experiment devoted to the study of physical laws or to determine the value of a physical quantity.
ASSESSMENT METHODS	Final assessment consists of an oral examination, a written test and a discussion on the laboratory reports. The written exam concerns the resolution, without the aid of textbooks or notes, of four problems recalling the teaching topics. It allows one to check, with the same conditions for all students, the degree of knowledge of the subjects of the teaching. In particular, it highlights the ability to analyze experimental data of a physical problem as well as the ability to obtain quantitative evaluations. Students who pass the written verification test (prova in itinere) can not do the first two problems of the written test. The oral exam consists of a discussion about the topics of teaching and a discussion on the laboratory reports. This exam allows one to evaluate, in addition to the knowledge of the candidate, also possession of analytical skills and ability in describing phenomena and procedures. The final evaluation, suitably graduated, will be formulated on the basis of the following conditions: a) Basic knowledge of the studied error evaluation and data analysis, sufficient ability in analyzing simple phenomena and sufficient ability of describing the adopted procedures (18-21); b) Fair knowledge of the error evaluation and data analysis, fair ability in analyzing simple phenomena and fair ability of describing the adopted procedures (22-25); c) Deep knowledge of the studied error evaluation and data analysis, ability to apply them to simple proposed physical phenomenon, good analytical skills and ability in describing phenomena and procedures (26-28); d) Thorough and widespread knowledge of the studied error evaluation and data analysis, ability to apply them promptly and correctly to simple proposed physical phenomenon, excellent analytical skills and excellent ability in presenting phenomena and communicating procedures (29-30L).
TEACHING METHODS	The teaching is annual and takes place in the two educational periods of the first year of the bachelor degree course in Physical Sciences. The didactic activity is developed through lectures, numerical exercises and laboratory practice with mandatory attendance. The laboratory activity concerns the realization of experiments in the framework of the concepts acquired during lectures; the aim is to help students getting skills related to the acquisition of experimental data. For each experiment, it is required the preparation of the experimental apparatus, the data analysis, and a report about the laboratory activity carried

	out. At the end of the first semester there is a written verification test (prova in itinere, not mandatory) The numerical exercises are intended to test the ability to apply knowledge and are a useful training to the exam. To evaluate the degree of learning, students are suggested to do online self-assessment tests proposed by the teacher. Attendance is mandatory only for the Laboratory section.

MODULE
THEORY OF ERRORS WITH LABORATORY

Prof. AURELIO AGLIOLO GALLITTO

SUGGESTED BIBLIOGRAPHY

•John R. Taylor, Introduzione all'analisi degli errori, Zanichelli 2006
•Dispense curate dal docente

AMBIT	50161-Sperimentale e applicativo
INDIVIDUAL STUDY (Hrs)	82
COURSE ACTIVITY (Hrs)	68

EDUCATIONAL OBJECTIVES OF THE MODULE

The aim of the first module is to give basic knowledge of error analysis for a correct interpretation of the data collected in the laboratory work. By the experimental work, students will learn how to apply a correct method of the data analysis concerning simple experiments on classical-physics phenomena and apply physical-mathematical methods for the processing of acquired data and the validation of the obtained results.

SYLLABUS

Hrs	Frontal teaching
8	Measurement methods and measuring errors as uncertainty of the result. Significant digits, compatibility and inconsistency. Error valuation in direct and indirect measurements. Absolute and relative errors. Random and systematic errors. Characteristics of measurement instruments.
8	Propagation of errors in indirect measurements. General expression for the propagation of the maximum errors in a function of at least two variables. Mean and standard deviation.
8	Statistical errors: Mean, Standard deviation and Standard error. Histogram and relative frequency distribution. Gaussian or Normal Error Distribution. Integral probability and confidence levels.

Hrs	Practice
6	Application examples on the extimation of errors in direct and indirect measurements.
6	Application examples on graphical representation of data and errors, graphical determination of the characteristic parameters of a linear function, the maximum error estimate, linearization functions and their graphical representation, use of logarithmic scales.

Hrs	Workshops
5	Description of the measuring instruments and their characteristics.
9	The laboratory work is carried out in groups and concerns the experimental investigation of phenomena of classical mechanics. 1 - Measurement of the density of solids: measurements and data analysis.
9	2a - Measurement of the oscillation period of a simple harmonic oscillator: measurements and data analysis.
9	2b - Determination of the spring constant of a simple harmonic oscillator: measurements and data analysis.

MODULE
STATISTICAL DATA ANALYSIS WITH LABORATORY

Prof.ssa TIZIANA DI SALVO

SUGGESTED BIBLIOGRAPHY

- John R. Taylor, Introduzione all'analisi degli errori, Zanichelli 2006
- Philip R. Bevington, Data Reduction and Error Analysis for the Physical Sciences, D. Keith Robinson, Case Western Reserve University
- Dispense curate dal docente

AMBIT	50163-Astrofisico, geofisico e spaziale
INDIVIDUAL STUDY (Hrs)	82
COURSE ACTIVITY (Hrs)	68

EDUCATIONAL OBJECTIVES OF THE MODULE

The main objective of the second Module the course of Laboratory of General Physics I, called Statistical Analysis of data with laboratory, is to provide a thorough understanding of the statistical analysis of data needed to develop mastery of the experimental data analysis methods, which is the basis of experimental physics and constitutes a fundamental background for students who will approach to scientific research . Data analysis techniques and laboratory instruments will be used to test laws of physics and known principles, to identify and separate the variables which determine the outcome of an experiment and to perform tests of the hypotheses. The students, organized in small groups, learn how to organize an experiment, taking the necessary precautions to ensuring the success of the same and organizing themselves to work in collaboration. Also they learn to write a descriptive report and to draw the appropriate physical and statistical conclusions from the data analysis.

SYLLABUS

Hrs	Frontal teaching
3	Rejection of data. Chauvenet criterion. Weighted average. Combination of different measures.
4	Best fit of data to a linear function. Method of least squares. Calculation of the parameters A and B. Uncertainty in measures of Y. Uncertainty in the parameters A and B. Best fit to other curves with the method of least squares.
3	Covariance and correlation. Correlation coefficient and p-value.
4	Binomial distribution and its properties; calculating the mean value and standard deviation. Gaussian approximation of the Binomial Distribution. Applications.
4	Poisson distribution and its properties; calculation of the mean value and standard deviation.
6	The Chi-square test for a statistical distribution and for a least-square fit. Degrees of freedom. Reduced Chi-squared. Probability for Chi-square.

Hrs	Practice
2	Exercises in classroom on the use of the Chauvenet criterion and the weighted average
2	Exercises in classroom on the Linear and Quadratic Regression.
2	Exercises in classroom on the binomial distribution, on the Gaussian approximation and probability calculations
3	Exercises in classroom on the Poisson distribution, on the Gaussian approximation and probability calculation
3	Exercises in classroom on the calculation of the chi-square for different types of distribution and the use of the chi-square to test a functional relationship

Hrs	Workshops
32	Laboratory experiments are carried out by groups of students and involve tests of General Physics (Mechanics: oscillatory motion, and uniformly accelerated motion and rotational motion), and the statistical analysis of the acquired data. The total amount of 32 hours dedicated to the laboratory activities include the execution of the experience and data acquisition (about 12 hours), the statistical analysis of the data (about 12 hours) and the preparation of a group report (about 8 hours).