UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Biomedicina, Neuroscienze e Diagnostica avanzata		
ACADEMIC YEAR	2023/2024		
BACHELOR'S DEGREE (BSC)	NEUROPHYSIOPATHOLOGY TECHNIQUES		
INTEGRATED COURSE	PRINCIPLES OF BIOPHYSICS, BIOENGINEERING AND ELECTROLOGY - INTEGRATED COURSE		
CODE	22323		
MODULES	Yes		
NUMBER OF MODULES	3		
SCIENTIFIC SECTOR(S)	FIS/07, ING-INF/07, ING-INF/06		
HEAD PROFESSOR(S)	CASCIO DONATO	Professore Associato	Univ. di PALERMO
OTHER PROFESSOR(S)	SPATARO CIRO CASCIO DONATO ANTONACCI YURI	Professore Associato Professore Associato Ricercatore a tempo determinato	Univ. di PALERMO Univ. di PALERMO Univ. di PALERMO
CREDITS	6		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	1		
TERM (SEMESTER)	2° semester		
ATTENDANCE	Mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**ANTONACCI YURI** Friday 16:00 18:00 Ed. 10 Stanza 0001 **CASCIO DONATO** Tuesday 16:00 18:00 -- Il ricevimento viene effettuato su teams. Si prega di richiedere appuntamento almeno due giorni prima via email (donato.cascio@unipa.it), indicando il Corso di Laurea di appartenenza. **SPATARO CIRO** Tuesday 11:00 13:00 Laboratorio Misure Elettriche (DEIM III piano)		

DOCENTE: Prof. DONATO CASCIO

PREREQUISITES	Basic knowledge of algebra and trigonometry
LEARNING OUTCOMES	Knowledge and understanding: Ability to interpret and describe natural phenomena on the basis of physical laws. Ability to use scientific language. Ability to apply knowledge and understanding: Knowing how to use physical laws to understand scientific experiments, including through the use of models. Autonomy of judgment: Being able to critically and independently comment on natural phenomena with the tools of physics. Knowing how to recognize causal/effect relationships, knowing how to logically and objectively evaluate the results of scientific experiments. Communication skills: Ability to present results through functions and graphs. Being able to describe in a simple, yet rigorous way, scientific observations. Learning skills: Ability to continue studies using the basic training received in the course. Ability to update with the consultation of texts scientific.
ASSESSMENT METHODS	The exam consists of an oral test in which the candidate will have to answer a minimum of three questions on all the parts of the program. The student will have to demonstrate, with adequate expository and argumentative skills, to possess knowledge and an organic understanding of the program. The final evaluation will be graded on the basis of the following conditions: A) Excellent knowledge of the teaching contents; the student demonstrates a high analytical-synthetic ability and is able to apply the knowledge to solve problems of high complexity (grade 30, 30 and honors). B) Excellent knowledge of teaching contents and excellent language properties; the student demonstrates analytical-synthetic ability and is able to apply knowledge to solve problems of medium complexity and, in some cases, even high (grade 27-29). C) Good knowledge of teaching content and good language skills; the student is able to apply knowledge to solve problems of medium complexity (grade 24-26). D) Fair knowledge of the teaching contents, in some cases limited to the main topics; acceptable ability to use the specific language of the discipline and to independently apply the acquired knowledge (grade 21-23). E) Minimum knowledge of teaching contents, often limited to the main topics; modest ability to use the specific language of the discipline and to independently apply the acquired knowledge (grade 18-20). F) Does not have an acceptable knowledge of the main teaching contents; very little or no ability to use the specific language of the discipline and to independently apply the acquired knowledge (Insufficient).
TEACHING METHODS	Frontal lessons.

MODULE
ELECTRIC AND ELECTRONIC MEASUREMENTS

Prof. CIRO SPATARO

SUGGESTED BIBLIOGRAPHY	
Materiale didattico fornito dal docente.	
AMBIT	10337-Scienze propedeutiche
INDIVIDUAL STUDY (Hrs)	30
COURSE ACTIVITY (Hrs)	20
EDUCATIONAL OBJECTIVES OF THE MODULE	
Provide basic knowledge of metrology. Provide the basic knowledge necessary for the use of measurement hardware and software systems. Develop skills for understanding the operation of measurement instrumentation and data processing. Use of multimeters and oscilloscopes.	

SYLLABUS

Hrs	Frontal teaching
2	Presentation of the course. Electrical measurements: generality, definitions and terminology. Classifications of physical quantities and measuring scales. The international system of units of measurement. Rules of writing the result of a measurement.
1	Scientific Technical Metrology and Legal Metrology. World, European and National Metrology Organization. Calibration system. Calibration and accreditation.
3	Measurement uncertainty. Classification of the causes of variability in the measurement process. The concept of error. Statistical fundamentals. Frequency distributions. Position and dispersion indices. Definition of probabilities. Significant distributions. Gaussian distribution. Sample mean.
2	JCGM 100. Classification of uncertainty components. Category A and B assessment of standard uncertainty. Extended uncertainty. How to declare measurement uncertainties. Significant digits and rounding. How to report the result of a measurement. Calculation of uncertainty in indirect measurements.
2	Measurement systems. Static and dynamic characteristics of the measurement instrumentation. Classification of electrical measuring instruments.
2	Voltmeters and ammeters. Measurements on DC electric bipoles. Digital instruments and their advantages over analog instruments.
2	Digital instruments for stationary quantities. Electronic multimeters. Digital instruments for variables quantities. Sampling. A/D conversion. Digital oscilloscopes.

Hrs	Practice
2	Exercises for the assessment of uncertainty in direct and indirect measurements.

Hrs	Workshops
2	Use of multimeters. Use of digital oscilloscopes.
2	Measurements on bipoles in direct current.

MODULE
APPLIED PHYSICS

Prof. DONATO CASCIO

SUGGESTED BIBLIOGRAPHY

A. Lascialfari, F. Borsa, A.M. Gueli: Principi di Fisica per indirizzo biomedico e farmaceutico. EdiSES. ISBN:978-8836230204
R.A. Serway: Fondamenti di fisica. 2022. EdiSES. 9788836230730

AMBIT	10337-Scienze propedeutiche
INDIVIDUAL STUDY (Hrs)	30
COURSE ACTIVITY (Hrs)	20

EDUCATIONAL OBJECTIVES OF THE MODULE

To provide the student with knowledge relating to basic physics principles useful for understanding phenomena and techniques
which will be presented in the Degree Course in Neurophysiopathology Techniques.
At the end of the course the student will have:
• learned the fundamental concepts of physics as a tool for understanding of physiological processes;
• learned about the physical laws and terminology preparatory to understanding and studying nerve conduction;
• learned the basic concepts useful for the understanding and correct use of instrumentation that is used in the professional field.

SYLLABUS

Hrs	Frontal teaching
2	PHYSICAL QUANTITIES: Operational concept of physical quantity. Fundamental and derivative grandizations. Systems of units of measure. Multiples and submultiples of units of measurement. Non-dimensional quantities. Measurement of angles. The radiant. Cause of error.
2	SCALAR AND VECTOR QUANTITIES. Operations with vectors. THE KINEMATICS: displacement, speed, acceleration. Uniform rectilinear motion, uniformly accelerated motion, uniform circular motion.
3	THE DYNAMICS: The concept of force and the principle of inertia. The concept of mass and the second principle of dynamics. The weight force and the acceleration of gravity. The third principle dynamics. Static equilibrium of a material point or of an object comparable to a point. Balancing of a system of forces. Rigid bodies and their properties. Center of severity
2	WORK AND ENERGY: Work of a force. The kinetic energy theorem. The energy concept Potential energy. Power. Physiological work and physical meaning of work.
2	ELECTRIC CHARGE AND ELECTRIC FIELD: Static electricity, electric charge and the law conservation. Conductors and insulators. Induced charge ed electroscope. Coulomb's law. The electric field. Field lines. Electric field and conductors
2	ELECTRIC POTENTIAL: Electric potential energy and potential difference. Relationship between electric potential and electric field. Equipotential surfaces. Potential electric generated by point charges. Electric dipole and moment of dipole. The electrical capacity. How to store electricity
3	ELECTRIC CURRENT: Electric current. Ohm's law, resistance and resistors. Thermal energy and the Joule effect. Electric power. CIRCUITS: Voltage between the terminals and f.e.m. Series resistors and in parallel. Kirchhoff's laws. Circuits with capacitors in series and in parallel. Risks related to electricity.
1	MAGNETIC PHENOMENA: the magnetic field, definition and unity of measure. Motion of an electric charge in a magnetic field, the Lorentz force
1	NERVOUS CONDUCTION AND PHYSICAL BASES OF ECG, EEG AND EMG TRACES
2	ELECTROMAGNETIC RADIATION: The electromagnetic spectrum. The phenomenon of ionization. Classification of ionizing radiation The ionization produced by various types of radiation. The action of radiation ionizing agents in animal tissues: physico-chemical phase and chemical phase. X-rays. Dosimetric quantities and units of measurement.

MODULE
ELECTRONIC BIO-ENGINEERING

Prof. YURI ANTONACCI

SUGGESTED BIBLIOGRAPHY	
materiale didattico fornito dal docente.	
AMBIT	10353-Scienze interdisciplinari
INDIVIDUAL STUDY (Hrs)	30
COURSE ACTIVITY (Hrs)	20
EDUCATIONAL OBJECTIVES OF THE MODULE	
Promote essential basic knowledge for the understanding and use of hardware and software measurement systems and data interpretation for biomedical applications. Develop skills, within a multidisciplinary context, aimed at comprehending the functioning of measuring instruments, data processing, and their subsequent application in neurophysiopathology techniques.	

SYLLABUS

Hrs	Frontal teaching
3	Introduction to biomedical signals: definitions, examples. Excitable cells, resting potentials, and action potentials. Biopotentials, characteristics, and requirements for acquisition
4	Electroencephalography: mechanisms of EEG signal generation, EEG signal acquisition systems, characteristics of EEG signals, and acquisition specifications. Application examples.
3	Neuromodulation techniques: Electric stimulation, intracranial and transcranial electrical stimulation, transcranial magnetic stimulation.
4	Brain-Computer Interfaces (BCIs): Operating principles, components of a BCI, functions of a BCI, P300-based BCI, and sensorimotor rhythms-based BCI. Examples
2	Electromyography: mechanisms of EMG signal generation, EMG signal acquisition, characteristics of EMG signals, and acquisition specifications. Application examples
2	Electrocardiography: mechanisms of ECG signal generation, ECG signal acquisition, characteristics of ECG signals, and acquisition specifications. Application examples

Hrs	Practice
2	Analysis of EEG signals: Extraction and study of visually evoked potentials in the MatLab environment.