UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2020/2021
MASTER'S DEGREE (MSC)	BIOMEDICAL ENGINEERING
SUBJECT	MECHANICAL AND THERMAL MEASUREMENTS FOR BIOMEDICS
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	20909-Attivit Formative Affini o Integrative
CODE	20275
SCIENTIFIC SECTOR(S)	ING-IND/12
HEAD PROFESSOR(S)	D'ACQUISTO LEONARDO Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**D'ACQUISTO LEONARDO** Thursday 08:30 10:00 Edificio 8 - stanza docente

DOCENTE: Prof. LEONARDO D'ACQUISTO

PREREQUISITES	Knowledge of basic mathematical tools and physical phenomena related to mechanics, fluid dynamics and wave phenomena.
LEARNING OUTCOMES	Knowledge and understanding. The teaching has the educational goal of providing the basic knowledge to be able to correctly design and use the instrumentation for measurement of mechanical, thermal and fluid dynamics quantities, with particular reference to biomedical instrumentation and measures on and for man. Ability to apply knowledge and understanding. In the field of training in Biomedical Engineering the teaching will provide the student with the knowledge to be able to correctly design and use the instrumentation for measurements of mechanical, thermal and fluid dynamics, with particular reference to biomedical instrumentation and measurements on and for man . This knowledge is acquired through lectures and laboratory exercises / seminars. The student will develop the ability to analyze the most important measurement systems and transducers. Making judgments The student will have acquired the ability to integrate knowledge and manage the complexity, as well as to formulate judgments based on limited information. Communication skills The student will be able to communicate his / her conclusions, as well as the knowledge and the underlying rationale about problems related to the approach, definition and development of a measurement process. Learning skills The student will have developed those learning abilities that will allow him to deepen independently issues such as the optimization of the resources used to reduce the uncertainty associated with the result of the measurement operation.
ASSESSMENT METHODS	Oral exam Evaluation criteria for the oral examination The oral test consists of an interview, in order to check that you have skills and knowledge disciplinary provided by the course; the evaluation is expressed in thirtieths. The questions, both open both semi-structured to test the results of learning provided for, will tend to occur: a) the knowledge captured; b) the processing capacity, c) have adequate display capacity on the course contents. The final evaluation will be formulated according the following graduation of knowledge of the student. Excellent 30-30 and praise, very good knowledge of the topics, excellent properties of language, good analytical ability, the student is able to apply knowledge to effectively solve measurements problems proposed 26-29 Very Good, Good command of the topics, full of language, the student is able to apply knowledge to solve measurements problems proposed 24-25 good, basic understanding of the main topics, discrete properties of language, with limited ability to independently apply the knowledge to the solution of the proposed problems Satisfactory 21-23, has not fully mastered the main teaching subjects but it has the knowledge, satisfactory property language, poor ability to independently apply the knowledge acquired Sufficient 18-20, Minimum basic understanding of the major teaching and technical language issues, very little or no ability to independently apply the knowledge acquired Insufficient, it does not have an acceptable knowledge of the contents of the topics covered in the teaching
EDUCATIONAL OBJECTIVES	COURSE OBJECTIVES The main purpose of the course is to present the topics of measurement systems as an integrated and coherent subject. Sensors and the measurement instrumentation are nowadays extremely important in a large variety of application fields. Recent increase in the level of sophistication of the measurement instrumentation has been particularly significant, and yet there is still limited attention to the validation of measurement data, i.e. to the correct use of the uncertainty associated with the collected measurement data. Particular attention will be paid to how to arrive at a correct evaluation of the measurement result: accuracy, response time, residual life and other characteristics of the instrumentation used. The course aims to provide practical tools to identify all these factors; to assess their impact and to solve the problems related to them. Therefore, the aim of the course is to provide a solid basis for the configuration of effective measurement systems for biomedical engineering, to obtain valid experimental data.

TEACHING METHODS	Frontal teaching, laboratory / seminar exercises.
SUGGESTED BIBLIOGRAPHY	- Ernest O. Doebelin, "Strumenti e Metodi di Misura", McGraw-Hill, - Francesco Paolo Branca, "Ingegneria Clinica", Springer-Verlag - J.W. Webster, “Medical Intrumentation: Application and Design”, Houghton. R.S. Khandpur, “Biomedical Instrumentation”, McGraw-Hill - J.D. Bronzino, “The Biomedical Engineering - Handbook” Vol I & II, CRC Press E.A. Cromwell, F.J. Weibell, E.A.Pfeiffer, “Biomedical Instrumentation and Measurements”, - Prentice-Hall, Vera Lucia da Silveira Nantes Button, “Principles of Measurement and Transduction of Biomedical Variables” Academic Press, 2015.

SYLLABUS

Hrs	Frontal teaching
3	1 .Fundamentals of the measurement process and definitions according to current legislation. Quantity and measurement concepts. The International System of Units (S.I.).
6	2. Classification of errors in measurement operations. Basic elements of statistic for the analysis of measurement data. Measurement uncertainty and its application in the biomedical field.
8	3. Basic elements of biomedical instrumentation: General information on measurement instrumentation and biomedical instrumentation. Functional elements of an instrument. Static and dynamic characteristics of measuring instruments.
24	4. Main sensors of mechanical and thermal quantities used in the biomedical instrumentation : Displacement and strain sensors used in biomedical instrumentation (potentiometers, electrical resistance and FBG optical fiber strain gauges, ultrasonic sensors, encoders, etc.). Speed and acceleration sensors used in biomedical instrumentation (accelerometers, echo and ultrasound probes, piezoresistive transducers and ICP). Strength sensors of common use in biomedical instrumentation. Pressure and acoustic sensors of common use in biomedical instrumentation (stethoscopes, phonocardiographs, etc.) . Speed and flow rate sensors used in biomedical instrumentation (Pitot tube, hot wire anemometer, ultrasonic, turbine, blood flow meters, PIV etc.). Sensors for temperature measurement (Thermocouples, thermoresistances, thermistors, infrared thermography, FBG fiber optic sensors).
4	5. Measurement of blood pressure and heart sounds: Non-invasive measurement methods. Sphygmomanometer. Oscillometric method. Ultrasonic method. Phonocardiography. Invasive measurement methods.
3	6. Measurements on the system respiratory: Measures for lung function. Spirometer. Pneumotach. Plethysmograph.

Hrs	Practice
3	8. Exercises: - Evaluation of the uncertainty of the measurement results
3	9. Exercises: - Design of a temperature, acceleration and force measurement chain.