UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria		
ACADEMIC YEAR	2021/2022		
MASTER'S DEGREE (MSC)	ELECTRONICS ENGINEERING		
INTEGRATED COURSE	ELECTRONICS AND IOT FOR BIOMEDICAL APPLICATIONS - INTEGRATED COURSE		
CODE	20251		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	ING-INF/01, ING-INF/03		
HEAD PROFESSOR(S)	TINNIRELLO ILENIA	Professore Ordinario	Univ. di PALERMO
OTHER PROFESSOR(S)	TINNIRELLO ILENIA ROSSANO LORENZO	Professore Ordinario Professore a contratto	Univ. di PALERMO Univ. di PALERMO
CREDITS	12		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	2		
TERM (SEMESTER)	1° semester		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**TINNIRELLO ILENIA** Monday 9:00 12:00 Ufficio del docente, presso il DEIM, secondo piano.		

MODULE
BIOMEDICAL ELECTRONICS

Prof. LORENZO ROSSANO

SUGGESTED BIBLIOGRAPHY

Lorenzo Rossano, Bioingegneria Elettronica, Modelli di Simulazione dei Sistemi Biomedici Vol. 1, Elettronica e Strumentazione Biomedica Vol. 2, Ed. McGraw-Hill, 2007

AMBIT	50364-Ingegneria elettronica
INDIVIDUAL STUDY (Hrs)	102
COURSE ACTIVITY (Hrs)	48

EDUCATIONAL OBJECTIVES OF THE MODULE

The module allows to deepen the functional and technical electronic characteristics of the medical diagnostic equipment; this is done starting from the in-depth analysis of the operating principles and control circuitry of the most used transducers in medicine and from concepts and methods of measurement of the most significant physiological signals (ECG, EEG, EMG, evoked potentials, etc.), and developing, in the various lessons, the application, functional and circuit knowledge of the following medical equipment, here in order of complexity: physiological signal detection systems (electrocardiographs, polygraphs, electroencephalographs, myographs), diagnostic imaging systems (radiographic equipment, computerized axial tomography, ultrasound tomography and doppler velocimeters, NMR - nuclear magnetic resonance, PET - positron emission tomography, scintigraphs, angiographs), electrophysiological monitoring systems (for operating room, resuscitation unit, intensive cardiology care unit). A final section is dedicated to analogies, models and simulation of biological systems, with particular reference to the human organism and the ECG signal interpretation algorithms, more commonly used in the medical field. The main objective of the module is to provide the student with a basic preparation for the management (technical, technical-commercial service, user support) of high-tech medical equipment and to acquire skills to support the medical class in learning, evaluation of features and use of technologically advanced diagnostic tools (this is the activity of bioengineering laboratories, now foreseen in hospitals, where they will eventually be able to work as graduates). Visits to hospital departments are planned to attend in using of the tools mentioned.

SYLLABUS

Hrs	Frontal teaching
2	Electricity and magnetism in histology: engineering approach of measurements on: cell, nerve, muscle. Synaptic transmission. Electromechanical activity of the cardiovascular and respiratory systems. Filtering system of the renal system. Effects of electromagnetic fields on the electrical activity of cells: thermal, microscopic and macroscopic effects, microwave effects, physical, mathematical and circuit investigation models.
2	Transducers: electronic circuits for measurement and control. Examples: electromechanical, potentiometric, strain gauges, capacitive, piezoelectric, magnetic, photoelectric; mathematical schemes (functions and transfer matrices). Measurement and control of physiological signals: translation, electronic manipulation, automatic interpretation of the corresponding signals.
4	Electromedical equipment: - electrocardiographs; - electroencephalographs.
4	Electromedical equipment: - polygraphs; - hemodynamic and angiographic investigations; espiratory and pressure curves relief.
6	Diagnostic imaging systems: - ultrasound; - Doppler velocimeters and flow meters.
6	Radiology: - traditional and digital equipments; - T.A.C. (Computerized axial tomography)
6	NMR - nuclear magnetic resonance.
4	Nuclear medicine: P.E.T. - positron emission tomography; scintigraph, gamma camera, angiograph (traditional, digital, to magnetic resonance); f.M.R.I. - functional magnetic resonance.
4	Analogies, models and simulation of biological systems (systems approach to the study of organisms; systems in biology and systems in engineering; anatomical - functional schemes; circuit analogies and behavioral simulators of simple and complex physiological systems. Most common application examples: food system, cardiovascular, respiratory, digestive and renal, thermoregulation, neuromuscular, sensory and cerebral.

Hrs	Workshops
10	Presence in medical examinations, with use of the instrumentation object of the module.

MODULE
PERSONAL AREA NETWORK

Prof.ssa ILENIA TINNIRELLO

SUGGESTED BIBLIOGRAPHY

Matthew Gast, "Wireless Networks: The Definitive Guide", O'Reilly, ISBN: 9780596100520
Jamil Y. Khan, Mehmet R. Yuce - "Internet of Things (IoT): Systems and Applications", 2019, ISBN 9789814800297

AMBIT	20925-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	102
COURSE ACTIVITY (Hrs)	48

EDUCATIONAL OBJECTIVES OF THE MODULE

The focus of this course is to explore the basic building blocks that make the Internet of Things possible, including the underlying core hardware components, basic input/output operations, wireless radio technologies, and sensing/actuation devices. We will discuss fundamental concepts of IoT systems and their usage in a wide range of applications.The course also incluso various lab modules and projects, for integrating various IoT components, such as sensing, actuation, and networking (using Raspberry Pi and Arduino devices).

SYLLABUS

Hrs	Frontal teaching
2	Radio channel characterization. Propagation and fading models.
2	Introduction to modulations, channel capacity and models.
4	Short/medium range wireless technologies. 802.11 technology: network architectures, infrastructure and ad-hoc modes, addressing. Physical layers and Medium Access Control Layer (DCF and PCF).
6	Short-range wireless technologies: 802.15.1 and 802.15.4 standards.
6	Long-range communication technologies: LoRaWAN and NB-IoT.
6	IP Network protocols and adaptations for sensor networks; ad-hoc routing protocols.
4	IoT Session Layer protocols: MQTT and CoAP
6	IoT Boards for Prototyping.
2	Introduction to IoT clouds and analytics.

Hrs	Practice
10	Examples of IoT node integrazions and case studies.