UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria		
ACADEMIC YEAR	2023/2024		
BACHELOR'S DEGREE (BSC)	BIOMEDICAL ENGINEERING		
INTEGRATED COURSE	BIOMEDICAL TECHNOLOGIES AND APPLICATIONS - INTEGRATED COURSE		
CODE	23176		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	ING-IND/34		
HEAD PROFESSOR(S)	LA CARRUBBA VINCENZO	Professore Associato	Univ. di PALERMO
OTHER PROFESSOR(S)	LA CARRUBBA VINCENZO	Professore Associato	Univ. di PALERMO
CREDITS	12		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	3		
TERM (SEMESTER)	1° semester		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**LA CARRUBBA VINCENZO** Tuesday 11:00 12:00 Studio docente, edificio 6 secondo piano Thursday 11:00 12:00 Studio docente, edificio 6 secondo piano		

DOCENTE: Prof. VINCENZO LA CARRUBBA

PREREQUISITES	Fundamentals of materials science and technology - classes of materials, their characteristics and properties Fundamentals of anatomy and physiology - respiratory, vascular, musculoskeletal systems Fundamentals of mathematics and physics Fundamentals of transport phenomena
LEARNING OUTCOMES	Knowledge and understanding Introduction to the concept of biomedical device. Definition of the key concepts of cell biology, bioengineering, histology and anatomy and physiology useful for understanding the paradigm of biomedical device. Recall of the properties and characteristics of materials that can be used for biomedical devices to be used in clinical applications. Knowledge of the basic principles of hematology. Knowledge of the main technologies for the treatment of blood and devices for rapid screening of disease diagnostic. Ability to apply knowledge and understanding Choice of the most appropriate processes and devices for a given biomedical device to be used in clinical applications. Ability to apply the notions learned to real problems such as: design of an engineered device for specific diagnostic needs, sizing of the necessary unit operations, the choice of materials, the choice of strategies for separating red blood cells from plasma, analytical resolution fluid dynamics applied to microsystems for the treatment of blood. Autonomy of judgment Identification of the most important characteristics and materials for biomedical devices, highlighting differences, similarities, advantages and disadvantages in a comparative way. Autonomy in operating and evaluating the implications of the choices made in technological terms and their clinical impact. Communication skills Students will be able to communicate with competence and scientific language the working principles of a biomedical devices, by using the appropriate engineering and medical lexicon. Ability to face a technical-scientific discussion in a structured context of high educational level aimed at the implementation or design of processes or biomedical devices. Ability to deal with the same issues in a context of a non-expert audience. Learning skills Students will be able to address with a sufficient level of autonomy an anatomical/physiological issue that requires the use of a biomedical device, identifying the most suitable strategies for its choice and implementation in the clinical field. Ability to update through independent consultation of scientific publications of the Biomedical Engineering sector. Ability to follow, using the knowledge acquired in the course, second level courses, specialized in the sector and to understand elementary tasks in an biomedical engineering laboratory.
ASSESSMENT METHODS	The final examination consists of a written test followed by an oral examination. The written test, of the duration of about 4 hours, contains 4-6 open questions concerning all the subjects treated during the course. The oral examination will focus on aspects not sufficiently clarified by the student in the written test. The final assessment, properly graded, will be made on the basis of the following conditions: a) sufficient knowledge of subjects and theories addressed in the course; sufficient degree of awareness and autonomy in the application of theories to solve chemical problems (rating 18-21); b) Good knowledge of subjects and theories addressed in the course; fair degree of awareness and autonomy in the application of theories to solve chemical problems (rating 22-25); c) Good knowledge of subjects and theories addressed in the course; good degree of awareness and autonomy in the application of theories to solve chemical problems (rating 26-28); d) Excellent knowledge of subjects and theories addressed in the course; excellent level of awareness and autonomy in the application of theories to solve problems (rating 29-30L). The exam and the related evaluation will be the same for non-attending students.
TEACHING METHODS	Frontal teaching, practise

MODULE
DEVICES

Prof. VINCENZO LA CARRUBBA

SUGGESTED BIBLIOGRAPHY	
Medical Device Technologies A system based overview using engineering standards. Edited by: Baura G.D. Elsevier ISBN: 978-0-12-374976-5 Reviews, book chapters, scientifc articles and slides supplied in electronic format	
AMBIT	50296-Ingegneria biomedica
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
EDUCATIONAL OBJECTIVES OF THE MODULE	
1. Introduce the fundamentals of prosthetic systems 2. Define the main structural and functional properties of the materials used for biomedical devices 3. Review the main biomedical devices used in various zones of the human body 4. Choose the most appropriate device for the targeted anatomical district	

SYLLABUS

Hrs	Frontal teaching
3	Introduction to biomedical devices, engineering in diagnosis and therapeutic treatments
3	Classification of biomedical devices. Legislation
5	Overview of biomedical devices and artificial organs (cardiovascular, musculoskeletal, respiratory and other body areas)
5	Cardiac cycle. ECG. Cardiac pacing systems, defibrillators (external and internal), pacemakers, stents, endoprostheses, catheters, LVAD cardiovascular assist devices
4	Heart Valves. Mechanical and biological valves
4	Vascular grafts. Biological and synthetic grafts.
4	Respiration and gas exchange. Mechanical ventilators
5	Hip joint. Fundamentals of biomechanics
3	Knee, hip and shoulder prosthetics
5	Orthodontic implants, breast implants, ocular implants and cochlear implants

Hrs	Practice
13	Examination of case studies related to biomedical devices

MODULE
PHYSICAL TERATMENTS OF BLOOD

Prof. VINCENZO LA CARRUBBA

SUGGESTED BIBLIOGRAPHY

Rodak's Hematology (6th Edition)
Edited by: Elaine M. Keohane, Catherine N. Otto, and Jeanine M. Walenga, Springer, 2019
ISBN: 9780323530453
Paper Microfluidics: Theory and Applications (Advanced Functional Materials and Sensors) Edited by: Shantanu Bhattacharya •
Sanjay Kumar • Avinash K. Agarwal
ISBN: 978-981-15-0488-4

AMBIT	50296-Ingegneria biomedica
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54

EDUCATIONAL OBJECTIVES OF THE MODULE

The general purpose of the course is to introduce the student to the understanding, design and evaluation of technologies in the field of applied hematology, such as systems for separating red blood cells from blood on macro and microscale for specific diagnostic applications.
The primary objective is to correlate the technologies to a specific objective in the clinical setting and provide the student with the basic elements to identify the most suitable diagnostic classes and corresponding solutions.
At the end of the course the student must be in a position to choose the most suitable blood treatment strategy based on the clinical needs

SYLLABUS

Hrs	Frontal teaching
4	Introduction: History Red Blood Cells, White Blood Cells, Platelets and plasma components Complete Blood Count Hematopoietic development
4	Overview of Cellular Structure and Function Hemoglobin Structure and Function
4	Blood Coagulation and Blood–Material Interactions
6	Basic Haematological Techniques Manual, Semiautomated, and Point-of- Care Testing in Hematology
5	Fluid Transport Mechanisms in Paper-Based Microfluidic Devices
6	Fabrication Techniques for Paper-Based Microfluidic Devices
5	Flow Control in Paper-Based Microfluidic Devices
5	Paper Microfluidic Based Device for Blood/Plasma Separation
2	Paper Microfluidic-Based Devices for Infectious Disease Diagnostics

Hrs	Practice
5	Evolution of Paper Microfluidics as an Alternate Diagnostic Platform
8	Microfluidic devices for the preparation of blood plasma samples in circulating nucleic acid based medical applications