UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2022/2023
MASTER'S DEGREE (MSC)	CHEMICAL ENGINEERING
SUBJECT	BIOMATERIALS
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50352-Ingegneria chimica
CODE	17371
SCIENTIFIC SECTOR(S)	ING-IND/22
HEAD PROFESSOR(S)	SCAFFARO ROBERTO Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	BIOMATERIALS - Corso: BIOMEDICAL ENGINEERING BIOMATERIALS - Corso: INGEGNERIA BIOMEDICA
YEAR	1
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**SCAFFARO ROBERTO** Monday 10:00 12:00 Viale delle ScienzeEdificio 6DICAM (ex Dip. Ingegneria Chimica)III piano, stanza 323 Tuesday 10:00 12:00 Viale delle ScienzeEdificio 6DICAM (ex Dip. Ingegneria Chimica)III piano, stanza 323 Wednesday 10:00 12:00 Viale delle ScienzeEdificio 6DICAM (ex Dip. Ingegneria Chimica)III piano, stanza 323 Thursday 10:00 12:00 Viale delle ScienzeEdificio 6DICAM (ex Dip. Ingegneria Chimica)III piano, stanza 323 Friday 10:00 12:00 Viale delle ScienzeEdificio 6DICAM (ex Dip. Ingegneria Chimica)III piano, stanza 323

DOCENTE: Prof. ROBERTO SCAFFARO

PREREQUISITES	In order to understand the topics and to easily achieve the learning goals of the teaching course, the student must be confident with topics related to: polymers and polymer based composites, Transport Phenomena in Biological Systems, Tissue Engineering, regenerative medicine techniques
LEARNING OUTCOMES	Knowledge and understanding ability The student, at the end of the teaching course, will know classes of materials compatible with processes and living organisms, for application in prosthetic engineering, in drug controlled release, in the fabrication of external biomedical devices (e.g. contact lenses, sensors, active bandages, suture threads, catheters, …). The student will have full knowledge of biodegradable and non-biodegradable materials, obtained by renewable sources and by biological origin. The student will also able to program the main processing methods and chemical-physical characterizations, beyond those in vitro and in vivo. The most part of the characterizations will be supported by lab experiences. Ability to apply knowledge and understanding The student will be able to describe equipments and to interpret the related data to describe the properties of the biomaterials studied. The student will also be able to intervene on the biomaterials both in terms of verification and in term of project. The student will be able to verify the adequateness and the durability of a biomaterial based device, already in use or to be installed, by knowing the initial characteristics of the material and the tests necessary to evaluate the properties. At the same time, the student will be able to assess the best choice among different biomaterials in order to obtain a determined device based on the requested specifications. Judging autonomy The student will be able to choose the most appropriate biomaterial for a certain application based on the requested characteristics. The student will also be able to choose tools and tests necessary to describe the applicability range of a biomaterials and the performance of the final device, in both design and verification questions. Communication ability The student will acquire the capability to communicate and express problems inherent the course topics. The student will be able to highlight questions related to the preparation and processing of different biomaterials, exposing the information in an adequate technical language. The student will also be able to expose the results of a scientific research, to propose biomaterials-related techniques and devices and to explain eventual project plans connected with them. Learning ability At the end of the course, the student will have learnt how to choose the most suitable biomaterial for a certain application ordevice, by evaluating properties and function. This will allow continuing the studies with improved autonomy, dynamism and with the awareness to be able to make supported choices when realizing potential projects.
ASSESSMENT METHODS	The evaluation will be based on two tasks: a written composition under the form of project proposal (evaluation of learning ability and evalution of the ability to apply knowledge and understanding); interview (evaluation of knowledge and understanding ability and of communication ability). The preparation of the project proposal is based on a format provided at the beginning of the course. The choice of the project topic is open in the frame of the arguments described during the course i.e. related to production, transformation, processing, fabrication and applications of biomaterials and related devices. The project is prepared in English. The interview aims to assess the competences and the knowledge learnt during the course. The questions will verify: acquired knowledge; elaboration capability; talking capability; ability to build autonomous connections not bound to the referring textbooks; capability to produce autonomous evaluations inherent the course topics; capability to understand the applications connected with the discipline areas; capability to connect the discipline topics with the referring professional and technological context. The final assessment is on a 30 basis according to the criteria reported below: 30-30+: excellent knowledge of the topics, excellent language and vocabulary, good analytical capability, the student is able to apply knowledge to solve the proposed problems 26-29: Good management of the topics, nice language and vocabulary, the student is able to apply knowledge to solve the proposed problems 24-25: basic knowledge of the topics, fair language and vocabulary, limited capability to apply autonomously knowledge to solve the proposed problems 21-23: the student does not show full management of the main topics while possessing the knowledge, satisfactorily language and vocabulary, poor capability to apply autonomously the acquired knowledge 18-20: minimal basic knowledge of the main topics and of the technical language and vocabulary, poor or no capability to apply autonomously the acquired knowledge.

	The exam will be not passed if the student will show a not acceptable knowledge of the topics. The exam and the related evaluation will be the same for non-attending students.
EDUCATIONAL OBJECTIVES	Goals The class aims to study the main biomaterials currently in use by describing the characteristics, the properties, the main processing techniques and the related biomedical applications. It will be studied also the different kinds of tests and essays to acquire the information necessary to describe the biomaterial and to drive it to the most appropriate processing methodology. Some basic information will be given also about the preparation of devices based on biomaterials and, generally, devoted to biomedical and tissue engineering applications Program Biomaterials processing – Electrospinning, Solvent casting, 3D printing. Stereolithography. Laser sintering. Fused deposition modeling. Organ printing. Dip coating. Selective leaching. Additives and modification of biomaterials Surface modification. Functionalization. Compatibilization. Nanofillers. Composties and Nanocomposites. Metallic biomaterials – Overview on the use of metal sas biomaterials. Titanium. Nitinol. Stainless Steel. Amalgams and other alloys for dentistry applications. Polymeric biomaterials – Polyolefins. Polyesters. Polyamides. Polyurethanes. Polyanhydrides. Cilicon based polymers. Acrylic polymers. Alogenated polymers. Biodergadable (co)polyesters: poly(lactic acid), poly(glycolic acid). Polyphosphazenes. Polycyanoacrylates. Polyhydroxyalcanoates. Polydioxanone. Polycarbonates. (bio)polymeric based composites. Glassy and ceramic biomaterials – (Bio) glasses. (Bio) ceramics. Polycrystyalline cast ceramics. Sintered ceramics. Glass-ceramic. Hydroxyapatite. Alumina. Natural based biomaterials and hydrogels – Alginate. Chitosan. Hyaluronic acid. Collagen. Fibrin. Elastin. Glycosaminoglycans. Bioerosion. Biodegradation. Chemical and physical degradation. Basics on tissue engineering – Preparation of supports for tissue engineering. Prosthetic materials. Biomimicking materials. Smart materials. Biomaterials characterization – mechanical, morphologica, spectroscopical Basics on biomedical devices - Temporary supports. Scaffolds. Prostheses. Barrier devices. Drug controlled release. Multifunctional devices. Contrast fluids.
TEACHING METHODS	Lectures, lab, exercise
SUGGESTED BIBLIOGRAPHY	TESTI CONSIGLIATI - Biomaterials: Principles and Practices Edited by Joyce Y. Wong, Joseph D. Bronzino, Donald R. Peterson, CRC Press – qualsiasi edizione (any edition) ISBN 9781439872512 - Biomaterials Science, An Introduction to Materials in Medicine Buddy Ratner,Allan Hoffman,Frederick Schoen,Jack Lemons, Academic Press, ogni edizione a partire dalla (any edition since) 3, ISBN 9780123746269 - Characterization of Biomaterials, Amit Bandyopadhyay, Susmita Bose, Elsevier, qualsiasi edizione (any edition), ISBN: 9781493301379

SYLLABUS

Hrs	Frontal teaching
5	Polymeric biomaterials
5	Metallic biomaterials
5	Glassy and ceramics biomaterials
5	Natural based biomaterials and hydrogels
5	Additives and modifications of biomaterials
5	Biomaterials processing
4	Basics on tissue engineering
7	Biomaterials characterization
4	Basics on biomedical devices

Hrs	Practice
3	Lab exercise on preparation and characterization of biomaterials
6	Project design exercise