UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2022/2023
BACHELOR'S DEGREE (BSC)	BIOMEDICAL ENGINEERING
SUBJECT	SCIENCE AND TECHNOLOGY OF MATERIALS
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50301-Ingegneria dei materiali
CODE	06328
SCIENTIFIC SECTOR(S)	ING-IND/22
HEAD PROFESSOR(S)	MAIO ANDREA Ricercatore a tempo determinato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	144
COURSE ACTIVITY (Hrs)	81
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**MAIO ANDREA** Monday 11:00 13:00 Friday 11:00 13:00

DOCENTE: Prof. ANDREA MAIO

PREREQUISITES	Knowing the atomic structure, chemical bonds. Understanding the chemical balance and its rules, the acid-base and redox reactions.
LEARNING OUTCOMES	Knowledge and understanding Knowledge will refer to: - engineering materials with focus on materials for bioengineering - the correlation between the properties and the different kinds of materials The understanding will refer to: - the interpretation of the materials properties - the methods to choose most suitable the materials - identification and methods of materials characterization - the understanding of the most significant characteristics of materials Applying knowledge and understanding The skills transferred to the student are: - the interpretation of the experimental tests - modeling the behavior of a composite material under particular stresses Making judgements - The student will be able to choose the most suitable material for the designed structure. - the student will be able to make the choice of the most suitable technology for manufacturing the artifact suitable to the project, individually evaluating the effectiveness of the different solutions. Communication - The student will have acquired the ability to communicate and express issues regarding the innovative materials for application in bioengineering. - The student will be able to hold conversations on topics related to the choice of the most suitable and sustainable materials for the project , of exploring ideas and offer solutions to specialists and non-specialists. Learning skills - Based on the obtained information, the student will be able to learn from sources from the scientific literature and keep abreast of new techniques and new materials. - During the course, the student will be directed in order to gain awareness of the importance of a permanent update to the maintenance of a good level of knowledge and professionalism.
ASSESSMENT METHODS	The evaluation will be based on two tasks: a written test followed by an oral examination. The written test will require the numerical and/or graphic resolution of exercises regarding the various topics addressed during the course in a maximum time of 2 hours. The oral examination (which can be accessed after passing the written one) includes questions relating to the written test and at least three questions about different topics covered during the course. These examinations aim to evaluate some basic competences and problem solving capability of the student. Furthermore, the aim is to assess the competences and the knowledge learnt during the course. The stimuli, well defined, clear and univocally interpretable allow formulating the answer in full autonomy. Moreover, they are structured in order to allow the comparability. 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.
EDUCATIONAL OBJECTIVES	

	The course aims to provide knowledge about the structure, properties and technological applications of the main types of materials used in biomedical engineering.
TEACHING METHODS	Lectures and exercises.
SUGGESTED BIBLIOGRAPHY	- W. F. Smith, J. Hashemi. "SCIENZA E TECNOLOGIA DEI MATERIALI". McGraw-Hill. 4 edizione. ISBN: 9788838667657 - W. D. Callister Jr., D. G. Rethwisch. “Scienza ed Ingegneria dei Materiali”, Edises. IV edizione. ISBN: 9788833190433 - W. D. Callister Jr., D. G. Rethwisch. "Materials Science and Engineering: An Introduction, 10th Edition". Wiley. ISBN: 9781119405498

SYLLABUS

Hrs	Frontal teaching
2	Introduction to main types of materials: metals, ceramics and polymers.
3	Crystalline and amorphous structure of materials: Crystalline systems and Bravais lattices. Main metallic crystal structures. Number of coordination. Atomic packing factor. Positions of atoms, directions and planes in cubic elementary cells. Polymorphism.
2	Solidification and crystal defects: solidification of metals; metal solid solutions; crystalline defects (point, line and surface defects)
3	Phase diagrams: phase diagrams; cooling curves; phase transformations; isomorphic binary systems; eutectic systems and other systems;. microstructures; examples of metal alloys.
8	Ferrous alloys: steels and cast irons. Production of crude steel and cast iron. Iron-Carbon phase diagram: Eutectic, peritectic and eutectoidic transformations. TTT and CCT diagrams. Thermal and thermochemical treatments: hardening, annealing, carburization of steel.
12	Polymeric materials: thermosets, thermoplastics and elastomers; structure, properties, processing and applications.
8	Ceramic Materials: structure, properties and applications. Chemical and physical properties of clays. The manufacturing process. Glass: structure, properties and applications.
9	Composite Materials: Structure, properties, manufacturing and applications.
4	Hybrid materials. Foams and honeycomb structures.
2	Application examples of materials in the bioengineering sector.

Hrs	Practice
4	Determination of crystal lattices: Electron Microscopy and X-Ray. Calculation of theoretical density, determination of the Miller indices
8	Calculation of the composition of the phases and their quantity through the use of the phase diagrams.
10	Mechanical characterization of materials: tensile, compression and bending tests, impact tests, hardness tests, creep tests, fatigue behavior.
3	Crystal structures of the main ceramic materials.
3	Determination of stresses in a composite material structure.