UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2021/2022
BACHELOR'S DEGREE (BSC)	BIOMEDICAL ENGINEERING
SUBJECT	INNOVATIVE MANUFACTURING PROCESSES
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	10657-Attività formative affini o integrative
CODE	21191
SCIENTIFIC SECTOR(S)	ING-IND/16
HEAD PROFESSOR(S)	BARCELLONA ANTONIO Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	144
COURSE ACTIVITY (Hrs)	81
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	3
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**BARCELLONA ANTONIO** Monday 8:00 10:00 Stanza docente Tuesday 8:00 10:00 Stanza docente Wednesday 8:00 10:00 Stanza docente Thursday 8:00 10:00 Stanza docente

DOCENTE: Prof. ANTONIO BARCELLONA

PREREQUISITES	In order to understand the topics and to easily achieve the learning goals of the teaching course, the student must know the mechanical properties of the mechanics of solids. Additionally, he must be confident with the following subjects: Physics, Technical Physics, Science of Construction, Materials Technology.
LEARNING OUTCOMES	Knowledge and understanding At the end of the module the student will have acquired knowledge on the main traditional and innovative manufacturing techniques (casting, machining, plastic deformation, welding, additive manufacturing) of the materials utilized in biomedical applications. The didactic approach is aimed to define the technological and physical problem and to link it with the basic knowledge and similar problems Applying knowledge and understanding The student will be able to understand the most advanced manufacturing techniques and optimize the process parameters Ability to identify and discuss the following topics: •Linear and non linear visco-elasticity •Rheologic properties •Main technological operations •Relations properties-structure-processing Making judgements The student will be able to understand the choice of the main parameters for the different processes and to modify them based on specific needs. Additionally, he will have acquired the ability to identify the correct material for a given application. Communication skills The student will acquire the ability to express and discuss the main issues related to the studied processes. He will be able to hold a conversation on topics related to the manufacturing of metals Learning skills The student will be able to independently tackle any issue related to the identification of the main mechanical properties of non-polymeric materials, to their characterization and to the optimization of the production process and applications
ASSESSMENT METHODS	The evaluation will be based on an interview. 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.
EDUCATIONAL OBJECTIVES	Proper knowledge of the methodology and operative aspects of the main manufacturing processes of materials used in bio engineering as well as the capability to use this knowledge to identify, understand and describe the main issues relative to the studied processes
TEACHING METHODS	Knowledge and understanding At the end of the module the student will have acquired knowledge on the main traditional and innovative manufacturing techniques (casting, machining, plastic deformation, welding, additive manufacturing) of the materials utilized in biomedical applications. The didactic approach is aimed to define the technological and physical problem and to link it with the basic knowledge and similar problems Applying knowledge and understanding The student will be able to understand the most advanced manufacturing techniques and optimize the process parameters Ability to identify and discuss the following topics:

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SUGGESTED BIBLIOGRAPHY	-- Lecture notes and presentations -- Serope Kalpakjian, Steven R. Schmid, Manufacturing Engineering & Technology, Seventh Edition ISBN-10 : 9810694067 ISBN-13 : 978-9810694067 -- Milewski, John O. Additive Manufacturing of Metals Softcover ISBN 978-3-319-86348-1 Series ISSN 0933-033X

SYLLABUS

Hrs	Frontal teaching
6	Mechanical characterization of materials. Static and dynamic tests, Effect of temperature and strain rate
6	Sand casting. Die casting. Defects in casting parts. Production costs
8	Machining operations. Process mechanics in turning, milling, drilling and grinding. Machines for cutting. Machine tools. Costs and production time. Machining optimization
8	Plastic deformation processes. Recall of Plasticity theory. Bulk and sheet forming processes
8	Welding and joining techniques. Fusion welding processes. Solid state processes
8	Additive manufacturing. Bioprinting and scaffolds production for metallic and non metallic materials. Principles of tissue engineering
6	Principles of numerical simulations of manufacturing processes. Approaches (flow, solid, implicit/explicit)

Hrs	Practice
6	Casting technology: pattern and moulds design
6	Machining operations. Machine and tool geometry. Turning optimization
6	Bulk and sheet forming: extrusion, drawing, rolling, forging, deep drawing, sheet stamping and springback
6	Fusion and solid state techniques
6	Additive manufacturing processes