UNIVERSITÀ DEGLI STUDI DI PALERMO

SCHOOL	POLYTECHNIC SCHOOL
ACADEMIC YEAR	2016/2017
FIRST CYCLE COURSE	BIOMEDICAL ENGINEERING
SUBJECT	BIOMATERIALS TRANSFORMATION- BIOMATERIALS WORKSHOP
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50301-Ingegneria dei materiali
CODE	18478
SCIENTIFIC SECTOR(S)	ING-IND/22
HEAD PROFESSOR(S)	SCAFFARO ROBERTO Professore Ordinario Univ. di PALERMO LA MANTIA FRANCESCO PAOLO Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	144
COURSE ACTIVITY (Hrs)	81
PROPAEDEUTICAL SUBJECTS	
YEAR	3
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**LA MANTIA FRANCESCO PAOLO** Tuesday 08:00 10:00 Ufficio al terzo piano dell'edificio & Viale delle Scienze Thursday 08:00 10:00 Ufficio al terzo piano dell'edificio & Viale delle Scienze **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- *Gruppo G2*

TEACHING METHODS	Lectures, Class exercise, lab visits
ASSESSMENT METHODS	The evaluation will be based on three tasks: a preliminary written composition followed by an interview and a practical design project. The written composition consist in a test containing five questions (four related to Materials Science and Technology and one related to Materials Design) to be answered openly in a maximum time of 120 minutes. This first task aims to evaluate some basic competences and problem solving capability of the student. 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 interview consists in questions about the written task. It 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 practical design project consists in the development of a device-object in the frame of a theme assigned at the beginning of the course. In this task, the student will have to apply the notions learnt to produce a conceptual design and, eventually, a prototype. 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.
LEARNING OUTCOMES	Knowledge and understanding ability The student, at the end of the teaching class, will possess knowledge of the main questions regarding characteristics, properties, processing, application fields of the most common biomaterials with an insight about processing technologies and characterization. Particular attention will be paid to typical engineering questions (design and verification) connected with the described processes and the consequent characterization tests. Ability to apply knowledge and understanding The student will be able to describe and use the different biomaterials studied in the course to evaluate which is the best to realize a certain object-device. The student will also be able to identify the possible interactions and synergy among different biomaterials to optimize the performance of an object-device. The student will be able to set and interpret lab tests on biomaterials. Judging autonomy The student will be able to interpret known data on materials in order to evaluate the range of their applicability. The student will be also able to recognize and acquire all the properties of a material necessary for the implementation/solution of design-verification problems. 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 materials, to their lifetime behavior and to their recycling, by proposing solutions to solve possible shortcomings and critically assessing their effectiveness. Learning ability At the end of the course, the student will have learnt how to choose the most suitable material for a certain application, by evaluating properties in connection with the functions of the object-device. This will allow acquiring autonomy and awareness to be able to make supported choices when realizing potential projects.
EDUCATIONAL OBJECTIVES	Goals (Processing of Biomaterials) The module aims to provide the student with information related to biomaterials processing, bith in the solid state and in the melt. In particular, typical processing methodologies such as extrusion, injection moulding, film blowing,

	spinning, will be described and deeply analyzed. All the processing methodologies will be related to the thermal and rheological characteristics of the biomaterials and to the respective processing windows. Mechanisms of thermal and thermooxidative degradation will be studied too. Program: Rheology: shear and elongational flow. Extrusion. Film blowing. Spinning. Injection moulding. Blow moulding. Machine tool processing. Goals (lab of biomaterials) The module aims to provide the students with information related to the design and the management of the most common lab tests on biomaterials. In particular, it will be given basic concepts on the measurement techniques, on the preparation and the conditioning of the samples/specimens, on the execution of the tests and on their possible changes as a function of different materials to be tested. The theoretical part will be followed by lab practical exercise in which there are illustrated the tests described during the lectures. Program (lab of biomaterials) Conditioning and preparation of samples – drying methods; compression moulding; injection moulding; transfer moulding; extrusion; cutting Morphological analysis – Basics on optical microscopy , scanning electron microscopy, transmission electron microscopy, atomic force microscopy; preparation of the samples and execution of the tests Mechanical properties – static; dynamic; impulsive; destructive and non-destructive; differential calorimetry; thermogravimetry; preparation of the samples and execution of the tests Spectoscopical properties – Basics on vibrational spectroscopy; FTIR; UV-VIS; Raman; XPS; preparation of the samples and execution of the tests
PREREQUISITES	In order to understand the topics and. to easily achieve the learning goals of the teaching course, the student must be confident with the subjects in the area of Chemistry, Material Science and Technology, Transport Phenomena, Termodynamics.
SUGGESTED BIBLIOGRAPHY	- W.F. Smith, J. Hashemi, Scienza e Tecnologia dei Materiali, Mc Graw Hill - Dispense del corso

SYLLABUS

Hrs	Frontal teaching
6	Shear flow rheology, non Newtonianism
3	Elongational flow rheology
6	Extrusion
3	Film blowing
3	Spinning
6	Injection moulding
3	Blow moulding
12	Machine tool processing
3	Conditioning and preparation of samples
3	Morphological analysis
6	Mechanical, thermomechanical, calorimetric properties
6	Spectroscopical properties

Hrs	Practice
9	Lab visit and experiments descrption: sample preparation, morphological analysis, mechanical properties, spectroscopical properties
12	Processing: extrusion, film blowing, spinning, injection moulding