UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2022/2023
MASTER'S DEGREE (MSC)	BIOMEDICAL ENGINEERING
SUBJECT	TISSUE ENGINEERING
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50351-Ingegneria Biomedica
CODE	18415
SCIENTIFIC SECTOR(S)	ING-IND/34
HEAD PROFESSOR(S)	LA CARRUBBA VINCENZO Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	12
INDIVIDUAL STUDY (Hrs)	192
COURSE ACTIVITY (Hrs)	108
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	2° 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 continuum mechanics: - stress/deformation, types of loads (tensile, compressive, shear), mechanical properties Fundamentals of applied chemistry: - classes of materials, their characteristics and properties Knowledge of thermodynamics - phase diagrams Knowledge of transport phenomena - mass transfer, mass balance Knowledge of cell biology Knowledge of anatomy and physiology
LEARNING OUTCOMES	Knowledge and understanding Introducing the tissue engineering and regenerative medicine concept. Define the key concepts of cell biology, bioengineering, istology and anatomy useful for undestanding the tissue engineering and regenerative medicice paradigm. Define properties and features of materials and processes used in tissue engineering. Define properties and features of biochemical engineering with reference to physiology. Applying knowledge and understanding Choosing the most appropriate processes and materials for a given tissue engineering application . Describe delivery and release processes taking place in physiology by using typical engineering modelling tools. Making judgements Identifying the most important processes and materials for tissue engineering applications, highlighting differences, analogies, advantages and disavantages in a comparative way. Identifying processes of delivery and release and their qualitative and quantitative description. Communication skills Students should be able to communicate with competence and language skills about materials and processes for tissue and biochemical engineering applications, including mechanical properties, biodegradation, surface properties, porosity requirements, physiology description (models). Learning skills Students should be able to assess with autonomy a basic release and tissue engineering problem, with the aim of defining the solution strategies
ASSESSMENT METHODS	The final exam consists of the global evaluation of various distinct assignments (for groups of 3-5 students): i) one written report (max 15-20 pages) on lab activities attended by the students (according to the topics listed at the end of this form) ii) one written assignment (max 25-30 pagine) related to a specific design problem of a tissue engineering scaffold, followed by an oral presentation by the students (see the topics at the end of this form) iii) one written numerical exercise on compartmental modelling (see the topic list at the end of this form) iv) a presentation concerning the project design of ii) 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). An evaluation according to the point a, b, c and d will be carried out for each item i), ii) and iii) iv), and an arithmetic averaging will be operated with a final round up. The exam and the related evaluation will be the same for non-attending students.
EDUCATIONAL OBJECTIVES	1. Introduce the fundamentals of prosthetic systems and regenerative medicine 2. Define the main structural and functional properties of the materials used for regenerative medicine and tissue engineering 3. Scrutinize the main production processes of tissue engineering scaffolds and regenerative medicine devices 4. Selecting the most appropriate production process with respect to a well defined target

	5. Define the delivery and release processes taking place in physiology and use the appropriate engineering tools to describe, quantify and model them
TEACHING METHODS	Frontal teaching, practise, lab experience
SUGGESTED BIBLIOGRAPHY	Reviews, book chapters, scientific articles and slides supplied in electronic format

SYLLABUS

Hrs	Frontal teaching
3	The History of prosthetic devices, Tissue Engineering and Regenerative Medicine.
4	Short notes on cell biology and cell cultures: culture media, growth and differentiation, tissue formation. Tissue types. Cell-biomaterial interaction. Inflammatory and immunitary response.
5	Short notes on istology and anatomy: skin, cartilage, bone, cardiovascular system (blood vessels) and respiratory system (bronchial tube), nervous system
4	Tissue Engineering and Regenerative Medicine paradigm: Goals and methods.
5	Scaffolds for tissue engineering. Strategies for design and production.
5	Materials used in tissue engineering applications: natural and synthetic polymers
5	Methods used in tissue engineering (scaffold production)
5	Methods for scaffold production based on phase separation: thermodynamics and kinetic implications
15	Case studies of tissue engineering: skin, blood vessels, bronchiole tube, bone, cartilage, peripheral nervous system
3	Biodegradation issues in tissue engineering: hydrolitic and enzymatic degradation. Testing of biomaterials
20	Introduction to biochemical engineering. Physiology. Drugs, active principles and excipients. Unitary operations. Transport phenomena in human body and modelling (compartments).

Hrs	Practice
12	Case studies of in-vitro tissue engineering: skin, blood vessels, bronchiole tube, bone, cartilage, peripheral nervous system
3	Flory-Huggins thermodynamic model for phase diagram calculation
3	Materials selection and design according to Ashby model
7	Examples of Transport phenomena in human body and compartmental modelling (one and two compartments)

Hrs	Workshops
9	Lab experience on tissue engineering scaffolds