COURSE CONTENT

(1) GENERAL INFO

SCHOOL	ENGINEERING			
DEPARTMENT	BIOMEDICAL ENGINEERING			
MSc PROGRAM	BIOMEDICAL ENGINEERING AND TECHNOLOGY			
STUDY LEVEL	POSTGRADUATE, MSc			
COURSE CODE	**BMET109**	**SEMESTER**	**A**	
COURSE TITLE	**Biomechanics and Biomaterials**			
TEACHING			**HOURS**	**ECTS**
		LECTURES	26	5
COURSE TYPE	SPECIALIZATION			
COURSE REUIREMENTS:	-			
TEACHING AND EXAMINATION LANGUAGE:	ENGLISH			
IS THIS COURSE OFFER TO ERASMUS STUDENTS	YES (IN ENGLISH)			
COURSE WEBPAGE (URL)	https://eclass.uniwa.gr/courses/305/			

(2) LEARNING OUTCOMES

Learning outcomes

Course Objectives:
The aim of the course is to understand the basic principles of biomechanics, focusing on the field of rehabilitation through prosthetic and orthotic systems of the human body, especially for the upper and lower limbs using robotic systems and the concept of human performance. Also, after defining the concept of biomaterials, all their types and basic applications and their microscopic structure will be presented. Applications in molecular simulation of biomaterials will be mentioned and the basic concepts of the use of supercomputers in biomaterials research, advanced multi-purpose biomaterials and their use in targeted cancer therapies will be discussed. The basic parts of tissue engineering systems will be analysed and the types of materials used will be presented. In this context, modern applications in the field of nano-materials in medicine and dentistry, antibacterial coatings on medical and dental implants will be presented. Finally, the basic concepts of regenerative medicine and its connection with tissue engineering will be presented.

Learning Outcomes:
1. Comprehensive understanding of the scientific field of biomechanics and biomaterials, including tissue engineering, knowledge of definitions and key concepts.
2. Description and discrimination of the used prosthetic and orthotic systems, quantitative and qualitative analysis of human performance.
3. Understanding basic principles of robotics and interface between brain and prosthetic body parts.
4. Understanding of the types of biomaterials and ability to distinguish and compare between them.
5. Distinguish and evaluate specific characteristics by type of biomaterials.
6. Understanding basic principles of nanomaterials and their applications in medicine and dentistry as coating materials and antibacterial protection of implants.
7. Understanding of new technologies in targeted cancer therapies and regenerative medicine, using multi-purpose biomaterials.

Achievement of Course Objectives and Learning Outcomes:
To achieve the above, students will first be taught basic concepts of biomechanics and biomaterials. Then, the applications of biomechanics in the assessment of human performance and rehabilitation (prosthetics/orthotics) of mainly the upper and lower limbs of the human body will be analyzed. In addition, all types of biomaterials and their applications will be analysed over time. In this way, students will be able to distinguish the types of biomaterials from each other, as well as to compare

their potential depending on the application. Students will have the knowledge to be able to define criteria and conditions to assess the suitability and overall compatibility of biomaterials. The basic principles of robotic rehabilitation, which now incorporates the interface between the brain and the artificial parts of the human body, and tissue engineering and its interface with regenerative medicine will then be presented.

The last modules of the course, include all the cutting-edge technologies of the subject of biomaterials, focusing on their application in dentistry and the coating of implants with provision for their antibacterial protection using nanomaterials. Multi-application nanomaterials will be understood how they find application in cancer therapies, advanced vaccine development and regenerative medicine.

General abilities

- Search, analysis and synthesis of data and information, using the necessary technologies
- Adaptation to new situations
- Decision-making
- Autonomous work
- Teamwork
- Working in an interdisciplinary environment
- Generating new research ideas

(3) COURSE CONTENT

"Basic principles of biomechanics"
Definitions, basic concepts, interface with biomedical engineering, historical background, human body mechanics, applications of biomechanics, rehabilitation and artificial limbs, modelling of physiological systems of the human body and design and instrumentation of sports medicine.

"Concepts and technologies related to the assessment of human performance"
Definitions, basic concepts, movements of the human body, internal movements and functions of the human body, quantitative and qualitative assessment of human performance, kinematic and kinetic analysis and gait analysis.

"Rehabilitation of human functions affected by accident, disease and/or by paraplegia"
Definitions, key concepts, problems leading to rehabilitation, presentation of the global market and robotic rehabilitation.

"Prosthetic limbs/parts as artificial limbs in the human body"
Definitions, basic concepts, prosthetic and orthotic systems, types of upper and lower limb prosthetic systems, sensory prosthetics, sensory feedback, brain-prosthetic limb interface and other prosthetic limbs.

"Biomaterials"
Definitions, basic concepts, interface with biomedical engineering, definition and types of biomaterials, history, evolution of biomaterials, global market, applications and biocompatibility and critical characteristics of biomaterials.

"Tissue engineering"
Definitions, basic concepts, interface with biomedical engineering, categories of tissue engineering, basic parts of tissue engineering systems, biomaterials used and regenerative medicine.

(4) TEACHING AND LEARNING METHODS - EXAMINATIONS

COURSE DELIVERY	Physical presence, face to face at the auditorium
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	The course is conducted with a projector (for the presentation of basic theory) and on the blackboard.

TEACHING ORGANIZATION	***Activity***	***Semester workload***
	Teaching / lectures	26
	Lecture material study	30
	Unsupervised literature review and preparation of the final project	69
	Total	***125***
STUNDET EVALUATION	100% final examination with multiple choice, short answer questions, essay development and problem-solving questions.	

(5) SUGGESTED LITERATURE

Books, scientific articles and related scientific resources:

[1] Huston RL. Principles of biomechanics. Boca Raton: CRC Press;2009.
[2] Levy JH. Biomechanics: Principles, Trends and Applications. New York: Nova Science Publishers Inc.;2010.
[3] Archer C, Ralphs J. Regenerative medicine and biomaterials for the repair of connective tissues. Boca Raton: CRC Press;2010.
[4] Helmus MN. Biomaterials in the Design and Reliability of medical devices. Georgetown: R.G. Landes Company;2002.
[5] Hench LL, Jones JR. Biomaterial, artificial organs and tissue engineering. Boca Raton: CRC Press;2005.
[6] Huston RL. Principles of biomechanics. Boca Raton: CRC Press;2009.
[7] Levy JH. Biomechanics: Principles, Trends and Applications. New York: Nova Science Publishers Inc.;2010.
[8] Park J, Lakes RS. Biomaterials An Introduction. 3rd edition. New York: Springer;2007.
[9] Peterson DR, Bronzino JD. Biomechanics principles and applications. Boca Raton: CRC Press;2008.
[10] Rosen Y, Elman N. Biomaterials Science: An Integrated Clinical and Engineering Approach. Boca Raton: CRC Press;2012.
[11] Chambers HG, et al. A Practical Guide to Gait Analysis. J Am Acad Orthop Surg. 2002 May-Jun;10(3):222-31.
[12] Ratner BD. Biomaterials: Been there, done that, and evolving into the future. Annu. Rev. Biomed. Eng;2019, 21:171-91.
[13] Bhat S, Kumar A. Biomaterials and bioengineering tomorrow's healthcare. Biomatter. 2013;3(3):e24717.
[14] Parida P, Behera A, Mishra SC. Classification of Biomaterials used in Medicine. IJAA. 2012 Sep;1(3):125-9.