POLITEHNICA University of Bucharest (**UPB**)
Faculty of Engineering and Management of Technological Systems (**IMST**)
Study Programme: Industrial Engineering (**IE**)
Form of study: Licence (Bachelor)

COURSE SPECIFICATION

Course title:	Biomechanical structures	***Semester:***	5
Course code:	UPB.06.S.05.A.006	***Credits (ECTS):***	4

Course structure	Lecture	Seminar	Laboratory	Project	Total hours
Number of hours per week	2		2		4
Number of hours per semester	28		28		56

Lecturer	Lecture	Seminar / Laboratory / Project
Name, academic degree	Emil NUȚU, Lecturer	
Contact (email, location)	emil.nutu@upb.ro, Strength of Materials Departement	

Course description:

The course follows the current methods applied to study the mechanical interaction between bone tissue and human prosthetic implants. Such interaction plays a fundamental role in designing dental and orthopaedic implants which are mechanical components developed to replace parts of the skeleton incapable to fulfill their function. The long term success of the implantation is, among others, highly dependent on the mechanical biocompatibility between the implant and the bone tissue, i.e. the capacity of the bone-implant assembly to fulfill the physiological function for which the implantation is required (mastication, walking etc). In this context, the term "biomechanical structure" refers to any mechanical component which involves at least one living part and has to sustain loads.

Due to the complexity of human skeleton and to the difficulty/impossibility of measuring in vivo data, there are needed special methods to obtain the bony geometry, the tissue material properties and to estimate the local interaction loads, as essential data for mechanical analysis of living structures. In this respect, the course aims to give an overview of the methods currently applied to study the bone-implant mechanical interaction. Thus, the course describes methodsfor generating complex bone and bone implant assembly geometries, for characterizing material properties and for estimating the loads in different daily activities. The application of the finite element method, the photoelasticity and the strain gauge technique to the mechanical analysis of biostructures are also presented.

Seminar / Laboratory / Project description:

The laboratory is organized based on the course content. Thus, during the laboratory sessions, students will learn (beginning level) how to obtain 3D bony geometries, how to characterize the bone tissue as a structural material, how to estimate the forces acting upon the different parts of the human skeleton and how to create finite element models to analyze the behavior of biomechanical structures. In order to cover the above mentioned steps the laboratory comprises both experimental techniques and computational methods.

Intended learning outcomes:
The course aims to give the student an understanding of fundamental principles in biomechanics by applying concepts and methods from engineering, physical sciences and mathematics to problems in living structures. Upon completion of this course, students will be initiated to: perform musculoskeletal simulations in order to determine the forces in the muscles and joints for different segments of the osteoarticular system according to given activities; achieve a three-dimensional reconstruction based on computed tomography and export the model for use with the finite element method; use the finite element method for analysis of biomechanical strucures.

Assessment method:	% of the final grade	Minimal requirements for award of credits
Written exam	40	20
Report / project	-	-
Homework	40	20
Laboratory	20	10
Other	-	-

References:
1. S.S. Cowin (editor), Bone Mechanics Handbook Second Edition, New York, CRC Press, 2001; 2. M. Kojic, N. Filipovic, B. Stojanovic, N. Kojic - Computer Modeling in Bioengineering. Theoretical Background, Examples and Software, John Wiley & Sons Ltd,ISBN 978-0-470-06035-3, Chichester, West Sussex, England, 2008. 3. T. M. Keaveny, E. F. Morgan și O. C. Yeh, Bone mechanics, în Standard Handbook of Biomedical Engineering and Design, McGraw-Hill Companies, 2003

Prerequisites:	***Co-requisites*** ***(courses to be taken in parallel as a condition for enrolment):***
Mechanics, Mechanics of materials, Finite Element Method	Computer Aided Design

Additional relevant information:
The course is intended to give a general overview of the current methods and trends in the field of biomechanical structures. In order to acquire in-depthskills, other trainings are needed.

Date:14.07.2016
Professional degree, Surname, Name: Lecturer,Emil Nuţu