Cracow University of Technology

Course syllabus

binding for the doctoral students of the CUT Doctoral School commencing their studies in the academic year 2022/2023

Information on the course

Name of the course in Polish	Biomechanika
Name of the course in English	Biomechanics
Number of the ECTS points	1
Language of instruction	Polish
Category of the course	Choosable
Field of education	Engineering and technology
Discipline of education	Mechanical engineering
Person responsible for the course Contact	Grzegorz Milewski, *doctor habilitatus,* prof. of CUT grzegorz.milewski@pk.edu.pl

Type of course, number of hours in the study programme curriculum

Semester	Credit type (G / NG)*	Lecture	Practical classes	Laboratory	Computer Lab	Project Class	Seminar
2, 3, 4, 5	G	15	0	0	0	0	0

*G – graded credit, NG – non-graded credit

Course objectives

Code	Objective description
Objective 1	Introduction to analytical and numerical methods of formulating and solving biomechanical models of the human musculoskeletal system.
Objective 2	Introduction to the issues of formulating the constitutive equations of hard (bone) and soft tissue (muscles, tendons, articular cartilage).
Objective 3	Acquiring skills in modelling and FEM strength analyses of human bone and articular structures.

Learning outcomes

Code	Description of the learning outcome adjusted to the specific characteristics of the discipline	Learning outcome symbol in the CUD DS	Methods of verification
OUTCOMES RELATED TO KNOWLEDGE			
EUW1	The doctoral student knows the methods of modelling the human musculoskeletal systems.	E_W01, E_W02	Involvement in class activities, a presentation
EUW2	The doctoral student knows the constitutive models of biological tissues and their application in the strength analysis of bone and joint structures of humans.	E_W01, E_W02	Involvement in class activities, a presentation

OUTCOMES RELATED TO SKILLS			
EUU1	The doctoral student is able to carry out a kinematic and dynamic analysis of selected human musculoskeletal systems.	E_U01	A presentation, discussion.
EUU2	The doctoral student is able to perform FEM numerical analyses of the strains of bone structures, taking into account complex cases of material and geometric nonlinearities.	E_U01	A presentation, discussion.
OUTCOMES RELATED TO SOCIAL COMPETENCES			
EUK1	The doctoral student is able to use their knowledge of the methods of engineering biomechanics in the broadly understood field of health protection.	E_K01, E_K03	A presentation, discussion.

Course outline

No.	Contents	Learning outcomes for the course	No. of hours
LECTURE			
W1	Biomechanical models of the human skeletal system.	EUW1, EUW2, EUU1	2
W2	Biomechanics of muscles and tendons. Articular biotribology.	EUW1, EUW2, EUU1	2
W3	Physical methods and biomechanical aspects of biological tissue research.	EUW1, EUW2	2
W4	Selected issues of biomechanics of collisions and injuries	EUW2, EUU2, EUK1	2
W5	Functional adaptation theory in biomechanics. Wolff's law and the issues of bone tissue reconstruction	EUW1, EUW2	2
W6	Constitutive equations of bone tissue.	EUW1, EUW2	2
W7	Selected issues of modelling and FEM strength analyses of human bone and joint structures	EUW1, EUW2, EUK1, EUK3, EUU1	3

The ECTS points statement

WORKING HOURS SETTLEMENT	
Type of activity	Average number of hours (45 min.) dedicated to the completion of an activity type
SCHEDULED CONTACT HOURS WITH AN ACADEMIC TEACHER	
Hours allotted in the syllabus	15
Consultations	1
Examination / course credit assignment	2
HOURS WITHOUT THE PARTICIPATION OF AN ACADEMIC TEACHER	
Independent study of the course contents	8
Preparation of a paper, a report, a project, a presentation, a discussion	4
ECTS POINTS STATEMENT	
Total number of hours	30
The ECTS points number	1

Preliminary requirements

No.	Requirements
1	Basic knowledge of mechanics, strength of materials and finite element methods

2	Knowledge of the English language

Course credit assignment conditions / method of the final grade calculation

No.	Description
COURSE CREDIT ASSIGNMENT CONDITIONS	
1	75% attendance in class.
2	Presentation of a paper.
METHOD OF THE FINAL GRADE CALCULATION	
Assessment of the presented paper, taking into account the attendance.	

Additional information

The thematic scope of the lecture, including the level of advancement of the presented theories, models and examples of modelling and numerical analysis, takes into account the scope of knowledge in the subject matter acquired by doctoral students at earlier stages of education.

The course reading list

1	Będziński R., *Biomechanika inżynierska*, Wrocław, 1997, Oficyna Wydawnicza Politechniki Wrocławskiej.
2	Nałęcz M. (red.), *Biocybernetyka i Inżynieria Biomedyczna 2000, t. 5, Biomechanika i Inżynieria Rehabilitacyjna*, Warszawa, 2004, Akademicka Oficyna Wydawnicza EXIT.
3	Będziński R. (red.), *Biomechanika tom XII, s. Mechanika Techniczna*, Warszawa, 2011, Wydawnictwo IPPT PAN.
4	Tadeusiewicz R., Augustyniak P., *Podstawy inżynierii biomedycznej*, Kraków, 2009, Oficyna Wydawnicza AGH.
5	Kutz M. (ed.), *Biomedical engineering and design handbook vol.1, 2*, New York, 2009, McGraw-Hill.