Description of course

Code of course	EM16	
Name of course	Biomechanics	
Version of course	2019	
A. Place of the course in system of studies		
Level of education	Second cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	WMEiL	
Coordinator of course	dr hab. inż. Cezary Rzymkowski	
B. General characteristic of the course		
Block of courses	Robotics	
Group of courses	Obligatory courses	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	3 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	None. However, basic knowledge of classical mechanics will be helpful.	
Limit of students	100	
C. Effects of education and manner of teaching		
Purpose of course	The aim of the course is to provide knowledge on conducting analyses of complex biological systems and processes applying theoretical and experimental methods used in machine theory and system dynamics. Objectives: This course presents the fundamental knowledge on the mechanics of the human body considering the skeleton and muscular system. The students will learn how to analyse static and dynamic forces and torques acting on the body parts during the motion and in working conditions. Abilities: After completing this course, the students will be able to: evaluate the load effort to the human body parts and relate them to the requirements meet during the design of exoskeletons or humanoid robots, evaluate the key biomechanical parameters of human motion and to propose the method of its measurement, elaborate the preferred human postures when manipulating loads using the strength analysis, etc.	
Effects of education	See Table 23.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	LECTURES: 1. Outline of the history of biomechanics. 2. Elements of human anatomy and anthropometry. 3. Biomechanical analysis of the human motion system – kinematics and kinetics	

Description of course

	(system approach). 4. Structure, operation, energy sources, work, power and efficiency of skeletal muscles. 5. Skeletal muscle control. 6. Biomechanics of bone tissue, functional adaptation of bone. 7. Electromyography (EMG). 8. Muscle cooperation. 9. Modeling and computer simulation of the human movement system for the needs of ergonomics, medicine and sport. 10. Fundamentals of occupational biomechanics – ergonomics, assessment and design of workplace, biomechanics of impact/injury, assessment and simulation of consequences of road accidents. 11. Application of the principles of mathematical modeling, optimization and control theory for the study of complex biological systems, technology inspired by nature. TUTORIALS/LABORTORY WORK: Measurement of biomechanical parameters of human motion (EMG signals, displacements, velocities, forces, moments, ...) – tools, methods, specialized equipment. Fundamentals of methods for planning and conducting experimental research as well as processing and analysis of results.
Methods of evaluation	Class work, student presentations and reports – 30%, end-semester exam/final test – 70%
Methods of verification of effects of education	See Table 23.
Exam	yes
Literature	1) K. Kędzior: Occupational Biomechanics. In: Karwowski W. (ed.), International Encyclopedia of Ergonomics and Human Factors, Vol. III, Taylor and Francis, London – New York 2001, 1545-1558. 2) Nigg B.M., Herzog W.: Biomechanics of the Musculo–skeletal System, John Wiley and Sons Ltd, 2007 (third edition). 3) Nordin M.,Frankel V.H. (eds): Basic Biomechanicsof the Musculoskeletal System, Lippincott Williams and Wilkins 2001 (third edition). 4) Panjabi M.M. and White A.A.: Biomechanics of the Musculoskeletal System, Churchill Livingstone, New York, Edinburg, London, Philadelphia, 2001. 5) Stewart G.J.: The Skeletal and Muscular Systems, Infobase Publishing, New York, 2009. 6) Schmitt, K.-U., Niederer, P.F., Cronin, D.S., Muser, M.H., Walz, F.: Trauma Biomechanics -- An Introduction to Injury Biomechanics, Springer, 2014. 7) Winter D.A.: Biomechanics and motor control of human movement, 4th ed., John Wiley & Sons, Inc., 2009. FURTHER READINGS: will be provided by lecturers.
Website of the course	xxx

D. Student's activity

Number of ECTS credits	5
Number of hours of student's work to achieve effects of education	1. Number of hours that require the presence of a teacher – 45 h, including: a) lectures – 30 h., b)

Description of course

	tutorials/laboratory – 15 h. 2. Private study/self-studying hours: 85, including: a) preparation for tutorials/laboratory exercises, literature studies – 50 h, b) preparation for the final test – 35 h. Total: 130 h, 5 ECTS.
Number of ECTS credits on the course with direct participation of academic teacher	2 ECTS (45 h), including a) lectures – 30 h., b) laboratory – 15 h.
Number of ECTS credits on practical activities on the course	0,6 ECTS, tutorials/laboratory exercises (15 h)

E. Additional information

Notes	-
Date of last edition	2019-09-27 10:04:23

Table 23. Learning outcomes

General academic profile - knowledge

Code of effect:	**EM16_W1**
Description:	The student has a well-established knowledge on the measurement of selected dynamic quantities in biomechanical systems.
Verification:	Final test
Field of study related learning outcomes	AiR2_W06
Area of study related learning outcomes	I.P7S_WG, III.P7S_WG.o
Code of effect:	**EM16_W2**
Description:	The student knows the basics of kinematics and dynamics of mechanical and biomechanical systems.
Verification:	Final test
Field of study related learning outcomes	AiR2_W08
Area of study related learning outcomes	I.P7S_WG, III.P7S_WG.o
Code of effect:	**EM16_W3**
Description:	The student has a well-established knowledge on application of advanced computer methods in modelling and analysis of biomechanical and biorobotic systems.
Verification:	Final test
Field of study related learning outcomes	AiR2_W10
Area of study related learning outcomes	I.P7S_WG, III.P7S_WG.o

General academic profile - skils

Code of effect:	**EM16_U1**
Description:	The student is able to collect and integrate information from literature and other sources as well as to make a critical selection for the purpose of solving a specific problem in the field of biomechanics.
Verification:	Final test, classroom presentation
Field of study related learning outcomes	AiR2_U01, AiR2_U12
Area of study related learning outcomes	III.P7S_UW.1.o, III.P7S_UW.3.o, I.P7S_UW, III.P7S_UW.2.o, III.P7S_UW.4.o
Code of effect:	**EM16_U2**
Description:	The student is able to prepare a presentation and a concise report regarding selected biomechanical problems.

Table 23. Learning outcomes	
Verification:	Classroom presentation, report assessment
Field of study related learning outcomes	AiR2_U04
Area of study related learning outcomes	I.P7S_UK
Code of effect:	**EM16_U3**
Description:	The student is able to use the known mathematical and modeling methods to conduct various analyses of biomechanical and biorobotic systems.
Verification:	Final test
Field of study related learning outcomes	AiR2_U06
Area of study related learning outcomes	III.P7S_UW.2.o, III.P7S_UW.4.o, I.P7S_UW
Code of effect:	**EM16_U4**
Description:	The student is able to use knowledge from research/observation of biological systems as the basis for proposing new solutions in the field of biorobotics.
Verification:	Final test
Field of study related learning outcomes	AiR2_U17
Area of study related learning outcomes	I.P7S_UW, III.P7S_UW.3.o