



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Biomechanical engineering

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### Course

Field of study

Biomedical engineering

Area of study (specialization)

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

2/4

Profile of study

**general academic**

Course offered in

Requirements

**compulsory**

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### Number of hours

Lecture

15

Tutorials

Laboratory classes

15

Projects/seminars

Other (e.g. online)

### Number of credit points

3

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### Lecturers

Responsible for the course/lecturer:

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Institute of Applied Mechanics

Faculty of Mechanical Engineering

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Responsible for the course/lecturer:



### Prerequisites

Basic knowledge of anatomy, mechanics and strength of materials.

### Course objective

Acquisition of knowledge on the structure and mechanical properties of tissues of human motion system. Acquisition of skills of modelling of biomechanical systems and systems for analysis of the pathological and normal human gait.

### Course-related learning outcomes

#### Knowledge

1. To know the structure and mechanical properties of muscles, tendon, ligaments and bones of the human motion system.
2. To know the basic knowledge on the mechanical strength of human tissues.
3. To know the anatomy, function and biomechanics of the spine and the models for the determination of the forces exerted in the spine.
4. Knowledge of the anatomy, functions and biomechanics of joints: hip, knee and elbow. Knowledge of mathematical models for determination of forces exerted in joint tissues during various activities.
5. Knowledge of various approaches in modelling of human activities.

#### Skills

1. To carry out experiments to determine biomechanical parameters of human motion. To interpret results and formulate conclusions.
2. To operate BTS system for human gait analysis, electromyograph, dynamometric platforms, the use of computer software for analysis, interpret and error estimation.
3. To exploit relevant analytical, numerical and experimental methods to formulate and solve engineering problems.
4. To assess the forces exerted in human tissues.

#### Social competences

1. The student understands the need of life-long learning, of inspiring and organising other person's teaching process.
2. Is aware of the importance of engineering knowledge and its significance for society and environment.
3. Understands the need for popularisation of knowledge of biomedical engineering.

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:



Laboratory: Reports of the laboratory practices executed and tests of the knowledge written before each laboratory class.

Exam: Five theoretical questions: criteria of assessment 3.0 (50%-70%), 4.0 (71%-90%), 5.0 (>90%).

### Programme content

#### Lecture

1. Introduction to engineering biomechanics.
2. Structure of the human motion system: bone system in technical aspect, mobility of chosen motion units, muscle system, as a drive of the body.
3. Mechanical properties of the tissues of the human motion system.
4. Biomaterials.
5. Spine - anatomy, functions, force models. Spine stabilisation.
6. Hip joint - anatomy, functions and models for determination forces exerted in tissues.
7. Knee joint - anatomy, functions and models for determination forces exerted in tissues.
8. Elbow joint - anatomy, functions and models for determination forces exerted in tissues.
9. Chosen aspects of joints alloplasty.

#### Laboratory

1. Determination of centres of masses of body and segments of its own. Determination of torques exerted in joints.
2. Kinematics of joints.
3. Analysis of biomechanical parameters of jump.
4. Biomechanical analysis of human's gait.
5. Registration and analysis of electromyographic signal of muscle tissue in various phases of activity.

### Teaching methods

1. Lecture: the presentation illustrated with examples and problems solutions written down on the blackboard.
2. Laboratory: experiments, reports of the experiments, discussion.

### Bibliography



Basic

1. Engineering biomechanics – selected problems (Biomechanika inżynierska - zagadnienia wybrane), Będziński R., Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 1997.
2. Biomechanics of motion systems (Biomechanika narządów ruchu), praca zbiorowa pod redakcją D. Tejszerskiej, E. Świtońskiego, M. Guzika, Wydawnictwo Naukowe Instytut Technologii Eksploatacji – PIB, Radom, 2011.
3. Biocybernetics and biomedical engineering 2000 (Biocybernetyka i inżynieria biomedyczna 2000), pod redakcją Macieja Nałęcza, Akademicka Oficyna Wydawnicza, Warszawa, 2004.

Additional

1. Human anatomy (Anatomia człowieka), Bochenek A., Reicher M., Wydawnictwo Lekarskie PZWL, Warszawa, 1990.
2. Biomechanics of human motion system (Biomechanika układu ruchu człowieka), Bober T., Zawadzki J., Wydawnictwo BK, Wrocław, 2001.

**Breakdown of average student's workload**

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	30	1,0
Student's own work (literature studies, preparation for laboratory classes, preparation for tests/exam, report preparation) <sup>1</sup>	45	2,0

<sup>1</sup> delete or add other activities as appropriate