COURSE DESCRIPTION CARD - SYLLABUS

Course name

Biomechanical modelling of human movement

Course

Field of study

Biomedical engineering

Year/Semester

1/1

Area of study (specialization)

-

Profile of study

general academic

Level of study

Second-cycle studies

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture

15

Laboratory classes

30

Other (e.g. online)

0

Tutorials

0

Projects/seminars

0

Number of credit points

4

Lecturers

Responsible for the course/lecturer:

dr hab. inż. Jacek Buśkiewicz

email: jacek.buskiewicz@put.poznan.pl

tel. 61 665 26 19

Institute of Applied Mechanics

Faculty of Mechanical Engineering

ul. Jana Pawła II 24, 60-965 Poznań

Responsible for the course/lecturer:

Prerequisites

Engineering knowledge of first cycle of study comprising mathematics, biomechanics and mechanics.

Course objective

Widening of knowledge of: dynamic modelling of biomechanical systems and devices for supporting human's organism. constructing of empirical models and performing numerical simulations in selected software aiding engineering calculations.

Course-related learning outcomes

Knowledge

1. The student has knowledge of load models and structure of human's bone-muscle system.

2. Has knowledge of differential equations and numerical integration.

3. Knowledge of fundamental methods and computer techniques applied for solving complex biodynamical problems.

4. Knowledge of various mathematical models in various human activities.

Skills

2. To work out a mathematical model for biodynamical system, formulate simplifications, perform numerical simulation and discuss model limitations.

3. To carry out numerical simulations to assess the strength of structures applied in rehabilitation and healing motion systems.

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 importance of engineering knowledge and its importance 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: Assessment of the skill to solve the assigned project: 2 tasks on numerical implementation of the problem (2,5 points for a task).

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

Programme content

Lecture

1. Analitycal statics.

2. Analitycal Dynamics.

3. Mathematical modelling, biomechanical models.

4. Dynamical models for analysis of selected human activities. Determination of muscle and joint forces.

5. Modeling of muscle forces. Problems of redundant control.

6. Modeling aimed at assesing the effect of vibrations on humabs body.

Laboratory

1. Introduction to softwareMathematica for symbolic and numerical calculations in engineering. Exemplary applications (matrices, systems of linear equations, minima of multivariable functions, linear interpolation).

2. Determination of muscle forces in statically determinate and statically indeterminete systems.

3. Determination of muscle forces in the upper limb in isometric contraction.

4. Determination of muscle forces in the upper limb during exercises with expander.

5. Two-mass dynamic model for jump analysis witout friction.

6. Two-mass dynamic model for jump analysis with friction.

7. Integrating of differential motion equation and numerical solutions of selected problems of sport biomechanics.

Teaching methods

1. Lecture: the presentation ilustrated with examples and problems solutions written down on the blackboard.

2. Laboratory: numerical modelling, implementation and simulations of the problems related with the human motion system.

Bibliography

Basic

1. Technical mechanics V. XII Biomechanics. Part 5 Problems of dynamics in biomechanics and modeling of human body (Mechanika Techniczna, t. XII Biomechanika, pod red. R. Będzińskiego, Część 5. Problemy dynamiki w biomechanice, Modelowanie ciała człowieka, Wojciech Blajer). IPPT PAN, Warszawa, 2011.

2.R. Będziński, Engineering biomechanics - selected problems (Biomechanika inżynierska - zagadnienia wybrane) Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 1997.

3. A. Morecki, J.Knapczyk, K. Kędzior, Teoria mechanizmów i manipulatorów, Dział 8 – wybrane zagadnienia biomechaniki ruchu człowieka, (Theory of mechanisms and manipulators. Section 8 – selected problems of human biomechanics) WNT, Warszawa, 2002.

Additional

1. J. Jóźwiak, J. Podgórski, Basics of statistics (Statystyka od podstaw), PWE Warszawa, 1994

2. R.S. Guter, A.R. Janpolski, Differential equations (Równania różniczkowe), PWN, Warszawa, 1989.

3. Praca zbiorowa pod redakcją D. Tejszerskiej, E. Świtońskiego, M. Gzika, Biomechanics of motion system (Biomechanika narządów ruchu), Wydawnictwo Naukowe Instytut Technologii Eksploatacji – PIB, Radom, 2011.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,0
Classes requiring direct contact with the teacher	45	2,0
Student's own work (literature studies, preparation for laboratory classes, preparation for tests,) [1]	55	2,0

[1] delete or add other activities as appropriate