POZNAN UNIVERSITY OF TECHNOLOGY
EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)
pl. M. Skłodowskiej-Curie 5, 60-965 Poznań

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Bionics

Course

Field of study	Year/Semester
Biomedical engineering	1/2
Area of study (specialization)	Profile of study
Bionics and virtual engineering	general academic
Level of study	Course offered in
Second-cycle studies	Polish
Form of study	Requirements
full-time	elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
30	0	0
Tutorials	Projects/seminars	
0	30	

Number of credit points

4

Lecturers

Responsible for the course/lecturer:
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Zakład Inżynierii Wirtualnej
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Responsible for the course/lecturer:
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Prerequisites

- basic knowledge of design, computer science and programming basics,

- ability to use selected engineering software and basic programming skills,

- understanding the need to learn and constantly acquire new knowledge.

Course objective

Getting familiarized students with selected aspects of bionics and to awaken in them a desire to lern about phenomena occuring in nature and to draw inspiration from them in technical solutions in the field of biomedical engineering and other engineering fields

Course-related learning outcomes

Knowledge

1. Student has an extended and deepened knowledge of mathematics and computer science, useful for formulating and solving complex engineering tasks in the field of biomedical engineering.

2. Student has knowledge of engineering information systems.

3. Student has knowledge of the modeling of biological structures and processes, as well as the methods of their use in biomedical engineering and technology.

4. Student knows the basic methods, techniques and tools used in solving complex engineering tasks.

Skills

1. Student is able to obtain information from literature, databases and other properly selected sources (also in English).

2. Student is able to use information and communication techniques appropriate to the implementation of tasks typical for engineering activities.

3. Student has the ability to computer modeling and simulation in biomedical engineering and technology.

4. Student is able to assess the usefulness of methods and tools for solving an engineering task.

Social competences

1. Student is aware of the importance and understanding of non-technical aspects and effects of engineering activities

2. Student is able to set priorities for the implementation of the tasks set by himself or others

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Credit for the lecture on the basis of a written work. The student obtains a grade on the basis of the obtained result:

below 50% - insufficient

(50%; 60%> - sufficient

(60%; 70%> - a sufficient plus

(70%; 80%> - good

(80%; 90%> - a good plus

over 90% - very good

Assessment of the project on the basis of the final effects of work, ongoing progress control and the involvement of individual group members in achieving the set goal.

Programme content

Lectures:

1. Bionics as science.

2. Inspiration from nature over the centuries.

3. The similarity between the principles of building machines and organisms.

4. Methods of innovative design with the use of bionics.

6. Mode of using the achievements of nature in technology.

7. Bionics, or imitating nature in the ways of achieving the goal.

8. Structural optimization - ways to obtain light and durable structures.

9. Nature-inspired algorithms - introduction.

10. Genetic algorithms and other nature-inspired algorithms in selected optimization applications.

11. The relationship of structural optimization and the use of genetic algorithms.

12. Organs and ways of movement of organisms: swimming, walking, crawling, flying (passive and active).

13. Bionic drives in flows: wings and fins

14. Manipulation and grasping organs, types and structure. Handling devices, concepts and technical solutions. Grasping organs as models of gripper construction.

15. Artificial muscles: pneumatic, electric, shape-memory material.

16. Biomimetics in the design of implants and medical devices.

17. Bionic prosthesis.

As part of the project, students will undertake bionic modeling (conceptual design), during which they will learn in practice the basic principles of bionic design. During the classes, they will carry out in groups topics related to the design and analysis of a device inspired by phenomena occurring in the nature, e.g. a walking / swimming robot inspired by the way a selected animal moves.

Teaching methods

1. Lecture: multimedia presentation supported by examples on the board and in advanced engineering software.

2. Project: solving project tasks, discussion.

Bibliography

Basic

1. Andrzej Samek, Bionika. Wiedza przyrodnicza dla inżynierów, Wydawnictwa AGH, Kraków 2010 [in Polish].

2. Z. Michalewicz, Algorytmy genetyczne + struktury danych = programy ewolucyjne, WNT, Warszawa 1996 [in Polish].

3. D.E. Goldberg, Algorytmy genetyczne i ich zastosowania, WNT, Warszawa 2003 [in Polish].

Additional

1. Andrzej Samek, Bionika w kształceniu, Wydawnictwa AGH, Kraków 2013 [in Polish].

2. Kazimierz A. Dobrowolski, Jak poruszają się zwierzęta? Struktura i funkcja - bioarchitektura zwierząt, Wydawnictwa Szkolne i Pedagogiczne, Warszawa 1977 [in Polish].

3. Kazimierz A. Dobrowolski, Jak pływają zwierzęta?, Państwowe Zakłady Wydawnictw Szkolnych, Warszawa 1971 [in Polish].

4. Boye K. Ahlborn, Zoological Physics. Quantitative Models of Body Design, Actions, and Physical Limitations of Animals, 2006.

5. Iwo Białynicki-Birula, Iwona Białynicka-Birula, Modelowanie rzeczywistości. Jak w komputerze postrzega się świat, WNT, Warszawa 2013 [in Polish].

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,0
Classes requiring direct contact with the teacher	60	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	40	2,0

[1] delete or add other activities as appropriate