COURSE DESCRIPTION CARD - SYLLABUS

Course name
Nature inspired algorithms and their applications [S2IBio1-UMiR>AZN]

Course

Field of study
Biomedical Engineering

Year/Semester
2/3

Area of study (specialization)
Medical and Rehabilitation Devices

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

dr inż. Jakub Grabski
jakub.grabski@put.poznan.pl

Lecturers

Prerequisites

1. Basics knowledge in computer science and general programming. 2. Skills of using software and basic programming. 3. Understanding the need for learning and acquiring new knowledge.

Course objective

To familiarize students with the basics of algorithms inspired by processes occurring in the nature, as well as to provide them with examples of their use in biomechanics and biomedical engineering.

Course-related learning outcomes

Knowledge:
1. Student has extended knowledge of mathematics and computer science, necessary in biomedical engineering and useful for formulating and solving complex tasks related to biomedical engineering [K2_W01].
2. Student has knowledge related to IT systems in medicine [K2_W02].
3. Student has knowledge related to modelling biological structures and processes, including modelling and computer simulations in designing rehabilitation equipment [K2_W04].
4. Student knows basic methods, techniques, tools and materials used to solve complex engineering

tasks related to biomedical engineering [K2_W10].

Skills:
1. Student can obtain information from literature, databases and other properly selected sources (also in English or another foreign language) [K2_U01].
2. Student can use ICT techniques specific for the performance of typical engineering tasks. He/she can develop and use IT systems in medicine [K2_U07].
3. Student can perform computer modelling and simulations in biomedical engineering [K2_U09].
4. Student can evaluate the usefulness of methods and tools applied to solve an engineering task typical of biomedical engineering and observe their limitations [K2_U22].

Social competences:
1. Student is aware of the validity and understanding of non-technical aspects and results of engineering activity [K2_K02].
2. Student can set priorities regarding the performance of a given task by him/herself or others [K2_K04].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lecture – final test.
Depending on the percentage of the student"s performance on the tests, the following scores are awarded:
2 (not enough) <0 points; 50 points>
3 (sufficient) (50 points; 60 points>
3+ (positive plus) (60 points; 70 points>
4 (good) (70 points; 80 points>
4+ (good plus) (80 points; 90 points >
5 (very good) (90 points; 100 points>
Laboratory – credit based on:
- oral or written answer regarding the content of each laboratory exercise. To get credit, all exercises must be passed,
- final test - an individual task carried out by the student on his / her last class.
Depending on the obtained sum of points and resulting percentage, the following scores are awarded:
2 (not enough) <0%; 50%>
3 (sufficient) (50%; 60%>
3+ (positive plus) (60%; 70%>
4 (good) (70%; 80%>
4+ (good plus) (80%; 90%>
5 (very good) (90%; 100%>

Programme content

Nature-inspired algorithms, in particular genetic and evolutionary algorithms - their history, implementation and examples of applications in biomedical engineering.

Course topics

Lecture:
1. Bionics – the science of imitating nature in engineering activities.
2. Artificial neural networks and examples of their applications in medicine.
3. Genetic algorithms.
4. Examples of other evolutionary algorithms inspired by natural processes occurring in nature.
5. Examples of applications of optimization algorithms in biomedical engineering.
Laboratory:
1. Introduction to MATLAB.
2. Artificial neural networks in MATLAB.
3. Classification of the selected disease using artificial neural networks.
4. Generic algorithms in MATLAB.

5. Application of genetic algorithms in selected optimization problems in biomedical engineering.
6. Implementation of the selected evolutionary algorithm in MATLAB.

Teaching methods

1. Lecture: multimedia presentation supported by examples on the blackboard.
2. Laboratory: programming in MATLAB, performing tasks, discussion.

Bibliography

Basic
1. L. Rutkowski, Metody i techniki sztucznej inteligencji, Wydawnictwo Naukowe PWN, Warszawa 2012 [in Polish].
2. D. Goldberg, Algorytmy genetyczne i ich zastosowania, Wydawnictwa Naukowo-Techniczne, Warszawa 2003 [in Polish].
Additional
1. A. Semek, Bionika. Wiedza przyrodnicza dla inżynierów, Wydawnictwa AGH, Kraków 2010 [in Polish].
2. M. Ostwald, Podstawy optymalizacji konstrukcji w projektowaniu systemowym, Wydawnictwo Politechniki Poznańskiej, Poznań 2016 [in Polish].

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00