COURSE DESCRIPTION CARD - SYLLABUS

Course name
Systems Biology [S2Bioinf2>BSYS]

Course

Field of study
Bioinformatics

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

The student starting this subject should have knowledge and skills in discrete mathematics, calculus, linear algebra, should know the phenomena and processes taking place in the living world and understand their biochemical basis. Moreover, the student should present such attitudes as: honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

The aim of the course is to present to students systems approaches to modeling and analysis of complex biological systems, explain the need of their use and teaching selecting appropriate methods and tools for solving problems of systems biology.

Course-related learning outcomes

Knowledge:
1. The student knows and understands the basic biological phenomena and processes, and bases their interpretation on empirical basis using mathematical methods.
2. The student knows and understands in depth the issues of selected exact sciences useful for modeling biological processes.

3. The student knows and understands the methods, techniques and tools used for solving complex bioinformatics problems, mainly of an engineering nature.
4. The student knows and understands specialized technologies related to bioinformatics.
5. The student knows and understands detailed issues in the field of biological system modeling and analysis based on reliable theoretical foundations.
6. The student knows and understands the principles of research planning in the field of bioinformatics.
7. The student knows and understands the development trends of bioinformatics.

Skills:
1. The student is able to fluently use and integrate information obtained from literature and electronic sources, in Polish and in English, interpret and critically evaluate them.
2. The student is able to draw conclusions, clearly formulate and exhaustively justify his/her opinions on the basis of data from various sources.
3. The student is able to use advanced computer science techniques and tools to solve biological problems and evaluate their usefulness.
4. The student is able to plan and perform research tasks under the supervision of an academic tutor using analytical and simulation methods.
5. The student is able to use statistical methods and specialized computer science techniques and tools to describe processes and analyze biological data.
6. The student is able to apply a systems approach for solving bioinformatics problems taking into account non-technical aspects.
7. The student is able to formulate and test hypotheses related to bioinformatics problems.

Social competences:
1. The student is ready to learn throughout the whole life, inspiring and organizing the learning process of other people.
2. The student is ready to systematically read scientific and popular science journals in order to expand and deepen his/her knowledge in bioinformatics.
3. The student is ready to demonstrate a creative attitude in professional and social life.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

In terms of lectures on the basis of a writing exam. To obtain a positive grade it is necessary to receive at least 50% of the maximal number of points.
In terms of laboratory classes on the basis of the reports on the exercises done by students.

Programme content

The course concerns selected issues related to systems approaches to the analysis of complex biological phenomena.

Course topics

The lectures covers the following topics:
1. Introduction to systems sciences.
2. Elements of general systems theory.
3. Selected types and properties of systems.
4. Systems approaches in biological sciences.
5. System modeling and analysis methods.
6. Network models of biological systems.
7. Differential models of biological systems.
8. Multi-agent models of biological systems.
9. Stochastic models of biological systems.
10. Modeling and analysis of gene expression mechanisms.
11. Modeling and analysis of signaling and metabolic pathways.
12. Populations as systems.
As part of the laboratory classes students solve problems related to the issues discussed during the lectures.

Teaching methods

Lecture: multimedia presentation.
Laboratory classes: solving exercises in the classroom, discussion with students, describing the results in the form of reports.

Bibliography

Basic:
1. L. v. Bertalanffy. Ogolna teoria systemow. Podstawy, rozwoj, zastosowania. PWN, Warszawa 1984.
2. E. Klipp, W. Liebermeister, Ch. Wierling, A. Kowald, H. Lehrach, R. Herwig. Systems Biology. A Textbook. Wiley-Blackwell, Weinheim 2009.
3. B. Ø. Palsson. Systems Biology. Properties of Reconstructed Networks. Cambridge University Press, Cambridge 2006.
4. C. Priami, M. J. Morine. Analysis of Biological Systems. Imperial College Press, London 2015.
5. Z. Szallasi, J. Stelling, V. Periwal (Eds.). System Modeling in Cellular Biology. From Concepts to Nuts and Bolts. The MIT Press, Cambridge, Massachusetts 2006.

Additional:
1. J. D. Murray. Wprowadzenie do biomatematyki. PWN, Warszawa 2006.
2. J. B. Reece, L. A. Urry, M. L. Cain, S. A. Wasserman, P. V. Minorsky, R. B. Jackson. Biologia Campbella.
REBIS, Poznań 2016.
3. H. Sayama. Introduction to the Modeling and Analysis of Complex Systems. OPEN SUNY Textbooks. Milne Library State University of New York at Geneseo, Geneseo, NY, 2015.
4. C. H. Taubes. Modeling Differential Equations in Biology. Cambridge University Press, Cambridge 2008.

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	60	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	65	2,00