Module syllabus: ***Biophysics***

1. Overall information

Module coordinator	dr hab. prof. UŚ Jerzy Nakielski
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ECTS	**5**
Method for the verification of learning outcomes	The final grade for the module is calculated from the following student activities: - Each class begins with a written test. The average of all of the lab tests is 15% of the final grade. - A written or electronic report must be submitted from each laboratory class within the deadline set by the instructor. The average of all of the reports is 30% of the final grade. - 5% is related to the student's participation in the laboratory classes - During the last lecture, students are evaluated based on a written test on the knowledge presented during all of the lectures (50%) To be awarded a final grade, the student must pass each activity of the module. Grades: below 51% – fail (F); 52-60% – with minimum academic criteria (E); 61-65% – satisfactory (D); 66-75% – good (C); 76-85% – very good (B), ≥ 85% – excellent (A)

2. Description of student activity and work

Lecture/discussion sessions	
Responsible instructor	dr hab. prof. UŚ Jerzy Nakielski
Content	**The main objective of this module** is to give students a better understanding of biological processes and to develop their ability to interpret a problem at various levels with the possibility of using physical, mathematical and computer methods in modern biology as well as to analyse the results. **Lectures/discussion sessions** comprise selected topics of biophysics, such as thermodynamics, biomechanics, electromagnetism, radiation and waves. **Lecture/discussion session content:** Biophysics is an interdisciplinary science that applies the concepts and methods of physics in order to study biological systems, thus spanning the distance between the complexity of life and the simplicity of physical laws. In the frames of the module, the following topics will be considered. 1. The laws of thermodynamics in biological systems. 2. Equilibrium and non-equilibrium thermodynamics – transformation and flux in an open thermodynamic system 3. Plant cell biomechanics – osmosis as a vital process. 4. The basic rules of tensegrity. 5. Nuclear magnetic resonance spectroscopy.

	6. Ionising radiation, radioactive isotopes 7. Waves
Number of didactic hours (contact hours)	**15**
Literature	Cromer A. 1977. Physics for the life sciences. McGraw-Hill Book Company Niklas K. and Spatz H.Ch. 2012. Plant Physics. The University of Chicago Press

Laboratory	
Responsible instructors	Staff of the Department of Biophysics and Morphogenesis of Plants
Laboratory projects	Project 1: State quantities describing a thermodynamic state. Equation of state. Project 2: Brownian motion. Project 3: Cytoskeleton (microtubules). Project 4: Electrical parameters of tissues. Project 5: Plant cell growth and microtubules. Project 6: Stresses in the plant cell wall. Project 7: Mechanical properties of tissues. Young's modulus. Viscosity. Project 8: Mechanical force in the kinetochore during cell division. Project 9: Wave phenomena – calculating the parameters that characterise waves. Project 10: The Belousov-Zhabotinsky reaction as an example of non-equilibrium thermodynamics – chemical wave. Project 11: Electromagnetic phenomena and zeta potential.
Methodology of laboratory classes	Experiments are performed in pairs under the supervision of the instructor and include: • Designing and accomplishing a procedure • Calculating and presenting the results • Preparing a report
Number of didactic hours (contact hours)	45
Literature	Cromer A. 1977. Physics for the life sciences. McGraw-Hill Book Company Niklas K. and Spatz H.Ch. 2012. Plant Physics. The University of Chicago Press Selected articles, e.g.: Waters J.C. et al. 1996. The kinetochore microtubule minus-end disassembly. Associated with poleward flux produces a force that can do work. Molecular Biology of the Cell. Vol. 7:1547-1558

3. Forms of verification

Continuous evaluation of knowledge, activity and practical skills	
Grades	Grades are awarded on a scale of A-F, where A is the best and F is a fail. An excellent performance (A) – the student actively participates in the laboratory

	work, demonstrates an excellent understanding of the experimental procedures (their aims, sequence and outcomes), is engaged and creative in solving current problems and in assessing and presenting the experimental results. A good performance (C) – the student demonstrates good judgment and knowledge, correctly performs an experiment, correctly exhibits a sense of the experimental procedure, properly assesses and presents the experimental results. A satisfactory performance (E) – the student demonstrates satisfactory judgment and knowledge, is poorly engaged and needs additional help to finish the experiment and final assessment of the experimental results correctly, presents a satisfactory presentation of the experimental results. A performance that does not meet the minimum academic criteria (F) – the student is not engaged in the experiment, does not exhibit a sense of the experimental procedures, poorly interprets and presents experimental results.

Reports from realised laboratory projects	
Evaluation	Evaluation is comprised of judgment and knowledge related to the sense and methods of the laboratory project, engagement in the realisation, quality of the assessment and presentation of the experimental results, use of reference materials. Grades for the reports are awarded on a scale of A-F, where A is the best and F is a fail. An excellent report (A) – without any essential errors Fail (F) – no report

Lab tests	
Grades	Grades are awarded on a scale of A-F, where A is the highest and F is fail. Excellent (A) – the student presents a fluent knowledge concerning the lab topics, makes minimal errors that do not affect the quality of the presentation. Good (C) – the student presents a good knowledge concerning the lab topics, makes rare and subtle errors. Satisfactory (E) – the student exhibits a satisfactory knowledge, but with a poor understanding of the lab topics and makes subtle errors. Fail (F) – the student does not present a satisfactory knowledge concerning the lab topics and makes many substantial errors, which disqualifies the-presentation.

Lecture exam	
Grades	Grades are awarded on a scale of A-F, where A is the highest and F is a fail. Excellent (A) – the student presents a fluent knowledge of the presented biophysics topics, makes minimal errors that do not affect quality of the presentation. Good (C) – the student presents a good knowledge of the presented biophysics topics, makes rare and subtle errors. Satisfactory (E) – the student exhibits a satisfactory knowledge, but with a poor

	understanding of the presented biophysics topics and makes subtle errors. Fail (F) – the student does not present a satisfactory knowledge of the mechanisms of plant development and its regulation and makes many substantial errors, which disqualify their presentation.