University of Gdańsk

Subject card

Subject name and code	Biothermodynamics with elements of statistical physics, PG_00155882		
Field of study	Medical Physics		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2026/2027
Education level	undergraduate studies	Subject group	Obligatory subject group in the field of study
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish Polish
Semester of study	5	ECTS credits	5.0
Learning profile	academic	Assessment form	
Conducting unit	Faculty of Mathematics, Physics and Informatics -> Rektor		
Name and surname of lecturer (lecturers)	Subject supervisor	dr Anita Dąbrowska	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	30.0	0.0	0.0	0.0	60

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	60	0.0	90.0	150

Subject objectives

Familiarization with the apparatus of statistical physics as a representation of thermodynamic processes in biology

Learning outcomes

Course outcome	Subject outcome	Method of verification
[FIZMEDL3_K01] knows the limitations of his own knowledge and understands the need for further education	Demonstrated commitment and motivation	[SK8] observation of student's independent or team work
[FIZMEDL3_U04] can apply the formalism of phenomenological thermodynamics and statistical physics to describe complex systems	Students can: - apply basic concepts of thermodynamics; - describe a perfect gas thermodynamically; - use the principles of thermodynamics to solve thermodynamic problems; - use statistical ensembles to solve thermodynamic problems; - describe the functioning of living organisms in the language of thermodynamics.	[SU4] test/exam - oral or written
[FIZMEDL3_W08] knows and understands basic thermodynamic phenomena and processes and their description on the basis of phenomenological thermodynamics and statistical physics, as well as the apparatus of statistical physics as a representation of thermodynamic processes in biology	The student knows: - basic concepts of thermodynamics; - The thermodynamic description of a perfect gas; - definitions of entropy and thermodynamic potentials; - principles of thermodynamics; - types of thermodynamic processes and systems;	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion

Subject contents	1. Basic concepts of thermodynamics. Internal energy, enthalpy, work, heat. 2. A perfect gas - thermodynamic description. 3. Entropy - phenomenological and statistical definition, entropy of a perfect gas. 4. Free energy, free enthalpy, chemical potential. 5. Principles of thermodynamics. Reversible and irreversible processes, spontaneous and forced. 6. Thermodynamic equilibrium. Closed, open and isolated systems. 7. Elements of thermodynamics of non-equilibrium processes - flow equations, heat transport. 8. Thermodynamics in biological systems, equilibrium and nonequilibrium states in biological systems, fundamentals of thermokinetics. 9. Fundamentals of classical statistical mechanics of equilibrium states: statistical ensembles - microcanonical, canonical, large canonical distribution. 10. Thermodynamic basis of life - the organism as an open system.
Prerequisites and co-requisites	Formal requirements: 1. Fundamentals of Theoretical Physics for Medical Physics II - 4 sem, 2. Fundamentals of Physics for Medical Physics III - 3 sem, The student should have knowledge of basic physics (heat, statistical physics)

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Test	51.0%	40.0%
Exam	51.0%	60.0%

Recommended reading

Basic literature	1. K. Huang, Podstawy fizyki statystycznej, PWN 2006 .2. R.P. Feynman, Wykłady z mechaniki statystyczne, PWN 1980 3. C. Blomberg, Physics of Life, Elsevier 2007 4. R. K. Hobbie, B. J. Roth, Intermediate Physics for Medcine and Biology, Springer, 2007
Supplementary literature	1. J. P. Terlecki, Fizyka Statystyczna, PWN 1968 2. K. Huang, Mechanika Statystyczna, PWN 1978 3. R. S. Ingarden, A. Jamiołkowski, R. Mrugała, Fizyka Statystyczna, PWN 1990
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	not required
Work placement	Not applicable

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