Subject card

Subject name and code	Statistical Physics, PG_00182574						
Field of study	Physics						
Date of commencement of studies	October 2025			Academic year of realisation of subject		2027/2028	
Education level	Bachelor’s studies			Subject group		Obligatory subject group in the field of study Optional subject group Subject group related to scientific research 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	
Semester of study	6			ECTS credits		6.0	
Learning profile	academic			Assessment form		exam	
Conducting unit							
Name and surname of lecturer (lecturers)	Subject supervisor			dr hab. Adam Rutkowski			
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	45.0	30.0	0.0	0.0	0.0	75
	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	75		0.0	75.0		150
Subject objectives	The aim of the course is to familiarize students with the fundamental principles of thermodynamics and their justification within statistical physics, to understand the application of statistical methods in explaining the phenomenological laws of classical physics, and to learn models illustrating the discussed concepts.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[FIZL3_W09] knows and understands thermodynamic phenomena and processes and their description in phenomenological thermodynamics and statistical physics	The student understands the statistical mechanisms underlying thermodynamic processes, such as energy dissipation, heat conduction, and thermodynamic equilibrium, and is able to describe these processes mathematically.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [SW3] text preparation/written work
[FIZL3_U04] can apply the formalism of phenomenological thermodynamics and statistical physics to describe complex systems	The student is able to apply the formalism of thermodynamics and statistical physics to determine the thermodynamic properties of complex systems, such as internal energy, entropy, and pressure, for different models of gases and molecular systems.	[SU1] oral statement/conversation/ discussion [SU3] text preparation/written work [SU4] test/exam - oral or written
[FIZL3_W01] has advanced knowledge of physical concepts, principles and theories, understands their historical development and significance not only for physics, but also for other exact and natural sciences and cognition of the world	The student knows the fundamental concepts and formalisms of statistical physics, including the Boltzmann, Fermi-Dirac, and Bose-Einstein distributions, and understands their application to the description of macroscopic systems.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [SW3] text preparation/written work

Subject contents	**I. Gas kinetics** • Maxwell model and Boltzmann equation • Issues of irreversibility of evolution, including Kacs clock model **II. Thermodynamics** • Basic concepts: internal energy, enthalpy, work, heat • Thermodynamic description of an ideal gas • Entropy phenomenological and statistical definitions; entropy of an ideal gas • Thermodynamic functions: free energy, free enthalpy, chemical potential • Laws of thermodynamics, reversible and irreversible processes, thermodynamic equilibrium • Closed, open, and isolated systems • Elements of nonequilibrium thermodynamics: flow equations, heat transport **III. Fundamentals of classical statistical mechanics of equilibrium states** • Elements of probability theory • Principle of equal a priori probabilities and microcanonical ensemble • Boltzmann principle and canonical ensemble; derivation of thermodynamic relations • Ideal gas and Gibbs paradox; grand canonical ensemble and thermodynamic limit • Phase transitions and the Ising model
Prerequisites and co-requisites	The student should have knowledge of: 1. classical mechanics, 2. basic physics, 3. differential and integral calculus, 4. fundamental mathematical methods used in physics.
Assessment methods and criteria	(see table below)

Subject passing criteria	Passing threshold	Percentage of the final grade
	51.0%	55.0%
	51.0%	45.0%

Recommended reading	Basic literature	1. J.P. Terlecki, *Fizyka Statystyczna*, PWN, Warszawa 1968 2. K. Huang, *Podstawy fizyki statystycznej*, PWN, Warszawa 2006 3. R.S. Ingarden, A. Jamiołkowski, R. Mrugała, *Fizyka Statystyczna*, PWN, Warszawa 1990
	Supplementary literature	1. E. Fermi, *Thermodynamics*, Dover Publications, New York 1937 (istnieje tłumaczenie rosyjskie) 2. K. Huang, *Mechanika Statystyczna*, PWN, Warszawa 1978 3. M. Bałaban, *Fizyka statystyczna i termodynamika*, Wydawnictwo Naukowe PWN, Warszawa 2015 4. P. Langevin, *Podstawy mechaniki statystycznej*, Wydawnictwo Naukowe PWN, 2010 5. D. Chandler, *Introduction to Modern Statistical Mechanics*, Oxford University Press, 1987 (dla chętnych po angielsku)
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	

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