DESCRIPTION OF THE COURSE OF STUDY

Course code		
Name of the course in	Polish	**Fizyka statystyczna**
	English	**Statistical Physics**

1. **LOCATION OF THE COURSE OF STUDY WITHIN THE SYSTEM OF STUDIES**

1.1. Field of study	physics
1.2. Mode of study	Full-time
1.3. Level of study	2nd degree
1.4. Profile of study	General academic
1.5. Person/s preparing the course description	Dr hab. Maciej Rybczyński, prof. UJK
1.6. Contact	**maciej.rybczynski@ujk.edu.pl**

2. **GENERAL CHARACTERISTICS OF THE COURSE OF STUDY**

2.1. Language of instruction	English
2.2. Prerequisites	-

3. **DETAILED CHARACTERISTICS OF THE COURSE OF STUDY**

3.1. Form of classes		15 hrs of lectures
3.2. Place of classes		Courses in the UJK teaching rooms of the Faculty of Exact and Natural Science
3.3. Form of assessment		Credit with grade
3.4. Teaching methods		Lectrure and problem solving
3.5. Bibliography	**Required reading**	K. Huang, Statistical Mechanics (John Wlley & Sons, New York, 1987) L. D. Landau and E. M. Lifshitz, Statistical Physics, Part I (Elsevier Ltd., Oxford, 1980)
	Further reading	K. Huang, Introduction to statistical physics (CRC Press, Boca Raton, 2001)

4. **OBJECTIVES, SYLLABUS CONTENT AND INTENDED LEARNING OUTCOMES**

4.1. Course objectives (including form of classes)
Knowledge (lectures and laboratories) C1. learning the physical and formal concepts of statistical physics C2. learning the methods of statistical physics as applied to specific problems **Abilities (laboratories and project)** C3. acquiring arithmetic skills in solving statistical physics problems

4.2. Detailed syllabus (including form of classes)

Lectures:

1. Introductory concepts - macroscopic systems, Avogadro's number, microscopic and macroscopic description, phenomenological thermodynamics and statistical mechanics, equilibrium and non-equilibrium systems, quasi-stationary processes.

2. Introduction to thermodynamics - intensive and extensive parameters, temperature, work, heat, internal energy, heat capacity and specific heat, equation of state, ideal gas.

3. 1st law of thermodynamics - isothermal, isobaric, isochoric and adiabatic processes, adiabatic equation

4. Entropy, various formulations of the 2nd law of thermodynamics, entropy as a state function, Clausius inequality, Carnot cycle, 3rd law of thermodynamics

5. Basics of classical Gibbs statistical mechanics - ergodic hypothesis and the concept of the ensemble, Liouville's theorem, postulates of statistical mechanics, microcanonical ensemble, relationship of phase volume with entropy and other thermodynamic quantities

6. Ideal gas in the microcanonical ensemble - phase volume, entropy and other thermodynamic parameters of an ideal gas, Gibbs paradox and its solution

7. Canonical ensemble - derivation of the canonical ensemble, connection with thermodynamics, average energy and energy fluctuations, ideal gas in the canonical ensemble.

8. Grand canonical ensemble - introduction of the grand canonical ensemble, chemical potential, relationship with thermodynamics, particle number fluctuations, mixture of ideal gases in the grand canonical ensemble, chemical equilibrium.

9. Gibbs quantum mechanics - postulates of quantum statistical mechanics, bosons and fermions, microcanonical, canonical, grand canonical ensembles. Specific heat of solids (Einstein's model, Debaye's model).

10. Quantum ideal gases - grand statistical sum for bosons and fermions, classical limit, degenerate Fermi gas, Bose-Einstein condensation, black body radiation.

10.1. Education outcomes in the discipline

Code	A student, who passed the course	Relation to learning outcomes
within the scope of **KNOWLEDGE:**		
W01	Knows the laws of statistical physics	SD_W01 SD_W02 SD_W07
W02	Knows computational methods of statistical physics	SD_W01 SD_W02 SD_W07
within the scope of **ABILITIES:**		
U01	Is able to apply the methods of statistical physics to describe specific systems	SD_U01 SD_U03 SD_U07
U02	Is able to perform mathematical calculations to solve a given physical problem	SD_U01 SD_U03 SD_U07
within the scope of **SOCIAL COMPETENCE:**		
K01	Is aware of the need for lifelong learning	SD_K04
K02	Can precisely formulate questions and problems	SD_K04

10.2. Methods of assessment of the intended learning outcomes

Teaching outcomes *(code)*	Method of assessment (+/-)																				
	Oral answer			**Project**			**Self-study**			**Group work**			**Effort in class**			**Exam**					
	Form of classes			***Form of classes***			***Form of classes***			***Form of classes***			***Form of classes***			***Form of classes***			***Form of classes***		
	L	*C*	*P*	*L*	*C*	*P*	*L*	*C*	*P*	*L*	*C*	*P*	*L*	*C*	*P*	*L*	*C*	*P*	*L*	*C*	*P*
W01													***X***			***X***					
W02													***X***			***X***					
U01													***X***			***X***					
U02													***X***			***X***					
K01													***X***								
K02													***X***								

10.3. Criteria of assessment of the intended learning outcomes

Form of classes	Grade	Criterion of assessment
lecture (L)	**3**	at least 50% and not more than 60% of the total number of available points
	3,5	more than 60% and not more than 70% of the total number of available points
	4	more than 70% and not more than 80% of the total number of available points
	4,5	more than 80% and not more than 90% of the total number of available points
	5	more than 90% of the total number of available points

11. **BALANCE OF ECTS CREDITS – STUDENT'S WORK INPUT**

Category	Student's workload	
	Full-time studies	**Extramural studies**
NUMBER OF HOURS WITH THE DIRECT PARTICIPATION OF THE TEACHER /CONTACT HOURS/		
Participation in lectures	15	
Participation in laboratories/project		
Preparation for the exam		
Others		
INDEPENDENT WORK OF THE STUDENT/NON-CONTACT HOURS/		
Preparation for the lecture	15	
Preparation for the laboratories		
Preparation for the exam		
Gathering materials for the project		
Preparation of multimedia presentation		
*Others**		
TOTAL NUMBER OF HOURS	**30**	
ECTS credits for the course of study	**2**	

Accepted for execution *(date and signatures of the teachers running the course in the given academic year)*

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