University of Gdańsk

Subject card

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| Subject name and code | Thermodynamics, PG_00182292 | | |
| Field of study | Physics | | |
| Date of commencement of studies | October 2025 | Academic year of realisation of subject | 2025/2026 |
| Education level | Bachelor's 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 | 1 | Language of instruction | Polish<br>Classes may be conducted in English in the following cases: - when the course is taught by an English-speaking instructor, - when a non-Polish-speaking international student is present in the group, - when the course is delivered by an invited external expert, - at the request of the students in the group. |
| Semester of study | 2 | ECTS credits | 3.0 |
| Learning profile | academic | Assessment form | credit |
| 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 | 15.0 | 30.0 | 0.0 | 0.0 | 0.0 | 45 |
| 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 |
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| Number of study hours | 45 | 0.0 | 45.0 | 90 |

**Subject objectives**

The aim of the course is to familiarize students with the laws of physics in the field of phenomenological thermodynamics. Students will learn the basic concepts of thermodynamics, such as energy, entropy, work, and heat, and how to describe thermodynamic transformations of gases and liquids. The course provides an understanding of the operation of heat engines and reversible and irreversible processes. Additionally, students will gain knowledge of the kinetic-molecular interpretation of thermodynamic processes and the application of statistical methods in physics.

Learning outcomes

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [FIZL3_U04] can apply the formalism of phenomenological thermodynamics and statistical physics to describe complex systems | The student is able to:<br><br>determine thermal and calorimetric properties of materials;<br><br>calculate quantities describing the changes of ideal gas parameters under various thermodynamic conditions;<br><br>determine physical quantities of gases based on the Boltzmann and Maxwell distributions;<br><br>determine thermodynamic probabilities;<br><br>apply the principles of thermodynamics in practice;<br><br>explain the operating principles of heat engines;<br><br>calculate physical quantities describing the properties and behavior of real fluids;<br><br>calculate and interpret parameters describing the physical kinetics of gases. | [SU1] oral statement/conversation/ discussion<br>[SU3] text preparation/written work<br>[SU4] test/exam - oral or written |
| [FIZL3_W09 ] knows and understands thermodynamic phenomena and processes and their description in phenomenological thermodynamics and statistical physics | The student knows:<br><br>phenomena related to changes in the properties of matter with changing temperature;<br><br>fundamental thermodynamic concepts and quantities;<br><br>the behavior of ideal gases during thermodynamic processes;<br><br>phenomenological thermodynamics;<br><br>the laws of thermodynamics and their applications;<br><br>the thermodynamic foundations of the operation of heat engines. | [SW4] test/exam - oral or written<br>[SW1] oral statement/ conversation/discussion<br>[SW3] text preparation/written work |
| [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:<br><br>the physical kinetics of gases;<br><br>the molecular structure and properties of liquids;<br><br>the kinetic theory of gases with elements of statistical physics. | [SW4] test/exam - oral or written<br>[SW1] oral statement/ conversation/discussion<br>[SW3] text preparation/written work |

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| Subject contents | **I. Zeroth law of thermodynamics thermometry**<br>• Basic concepts and definitions<br>• Temperature and its measurement<br>• Formulation of the zeroth law of thermodynamics<br>**II. Gas transformations**<br>• Thermodynamic state of a system<br>• Ideal gas model<br>• Real fluids<br>**III. First law of thermodynamics**<br>• Internal energy and its changes<br>• Formulation of the first law of thermodynamics<br>• Heat engines and their operation<br>**IV. Second and third laws of thermodynamics**<br>• Kinetic-molecular theory of the ideal gas<br>• Formulation of the second law of thermodynamics<br>• Thermodynamic potentials<br>• Third law of thermodynamics<br>**V. Kinetic-molecular theory of the ideal gas in practice**<br>• Microscopic interpretation of the pressure of an ideal gas<br>• Statistical thermodynamics<br>• Applications of probability distributions<br>• Reversibility of mechanical laws versus irreversible thermodynamic processes arrow of time |
| Prerequisites and co-requisites | The student should have completed:<br>1. Classical mechanics<br>2. Skills in processing and analyzing measurement data |

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td></td><td>51.0%</td><td>45.0%</td></tr>
<tr><td></td><td>51.0%</td><td>55.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. D. Halliday, R. Resnick, Fizyka, PWN, Warszawa 2003/2004<br>2. W. Demtröder, Fizyka doświadczalna, Tom 1: Mechanika i ciepło, Wydawnictwo Naukowe UMK, Toruń 2011<br>3. I. V. Sawieliew, Wykłady z fizyki, PWN, Warszawa 1987<br>4. R. Feynman, Feynmana wykłady z fizyki, PWN, Warszawa 1974</td></tr>
<tr><td>Supplementary literature</td><td>1. M. Bałaban, Termodynamika i fizyka statystyczna, Wydawnictwo Naukowe PWN, Warszawa 2015<br>2. P. Langevin, Podstawy termodynamiki i mechaniki statystycznej, Wydawnictwo Naukowe PWN, 2010<br>3. R. K. Pathria, Statistical Mechanics, Elsevier 2011</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2"></td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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