GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Thermodynamics, PG_00061912		
Field of study	Materials Engineering, Materials Engineering		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2025/2026
Education level	first-cycle 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	2	Language of instruction	Polish
Semester of study	4	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Physical Chemistry -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Dorota Warmińska	
	Teachers	dr hab. inż. Dorota Warmińska	

Lesson types

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

E-learning hours included: 0.0

eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=3673

Moodle ID: 3673 Termodynamika
https://enauczanie.pg.edu.pl/2025/course/view.php?id=3673

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	5.0	35.0	100

Subject objectives

The aim of the subject is familiarizing the students with fundamentals of thermodynamic analysis of physico-chemical systema, esp. those including chemical equilibria and phase equilibria.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U06] can integrate obtained information, interpret it and draw conclusions, as well as formulate and justify opinions.	The student can describe and analyze physicochemical systems from thermodynamic point of view, especially chemical and phase equilibria.	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject
[K6_K01] Understands the need to improve professional and personal competencies; is conscious of own limitations and knows when to turn to experts, properly establishes priorities helping to accomplish tasks defined by oneself or others.	The students understand the need expanding their knowledge and are aware of their own limitations.	[SK5] Assessment of ability to solve problems that arise in practice [SK3] Assessment of ability to organize work
[K6_W02] has knowledge of physics and chemistry, useful for formulating and solving simple problems within the scope of materials science	The student is able to use knowledge in mathematics, physics and chemistry for thermodynamic description.	[SW1] Assessment of factual knowledge

<table>
<tr><td>Subject contents</td><td>Course content – lecture
Introduction to thermodynamics: basic concepts and definitions, thermometry and temperature scales. The First Law of Thermodynamics concepts of heat and work, internal energy of a system. Thermodynamic processes of ideal and real gases, cyclic processes. Molar heat capacity of an ideal gas. Fundamentals of thermochemistry: thermal effects of chemical reactions, Hesss law, standard enthalpies of formation and combustion of chemical compounds. The effect of temperature and physical state of reactants on the standard enthalpy change of a process. Reversible and irreversible processes. The Second Law of Thermodynamics, entropy as a measure of the degree of disorder of a system. The Third Law of Thermodynamics. Thermodynamic potentials: Helmholtz free energy and Gibbs free energy. Dependence of the Gibbs free energy on temperature and pressure. States of matter and phase transitions in a one-component system. Polymorphism and allotropy. Analysis of selected phase diagrams; monotropic and enantiotropic systems. Phase diagrams of binary liquidvapor systems and phase equilibria in condensed binary systems. Real gases: compressibility factor, virial equation of state, van der Waals equation. Gas fugacity. Chemical equilibrium: homogeneous and heterogeneous systems with a single chemical reaction. Effect of temperature on the position of chemical equilibrium. Le Chateliers principle.
Course content – laboratory
1. · Measurement of the physicochemical constants of liquids
2. · Calorimetry
3. · Liquidvapor phase diagram in a binary system
4. · Measurement of the saturated vapor pressure of a liquid
5. · Determination of the thermodynamic functions of an electrochemical cell</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Knowledge of mathematics, physics and chemistry at BSc level.</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>performing 5 experiments and delivering the reports</td><td>100.0%</td><td>50.0%</td></tr>
<tr><td>written exam</td><td>50.0%</td><td>50.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>1. Henryk Buchowski, Waldemar Ufnalski, "Podstawy termodynamiki", WNT, Warszawa 1998.
2. Henryk Buchowski, Waldemar Ufnalski, Gazy, cieczy, płyny", WNT, Warszawa 1994.
3. Atkins P.W.: Chemia Fizyczna, PWN, Warszawa, 2007.
4. Krzysztof Pigoń, Zdzisław Ruziewicz, Chemia Fizyczna, PWN, Warszawa, 2005</td></tr>
<tr><td>Supplementary literature</td><td>1. Wykłady z chemii fizycznej (praca zbiorowa). Wydawnictwo NT

3.Eksperymentalna chemia fizyczna.Red.: H.Strzelecki, Wydawnictwo PG</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>Define and discuss the concept of thermodynamic equilibrium.

Discuss the concepts of specific heat at constant volume and constant pressure. Derive a general relationship between them and give its physical meaning. Apply the results obtained to perfect gas.

Discuss the relationships between thermodynamic potentials U (V, S), H (S, p), F (V, T), G (p, T).

Formulate, drive and discuss the Gibbs phase rule.</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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