Basics of Thermophysics
Educational subject description sheet

Basic information

Field of study Joint Bachelor in Sustainability	**Education cycle** 2025/26
Speciality Sustainable Physics & Chemistry	**Subject code** UJ.WPAJBSSPCS.880.16407.25
Organizational unit Faculty of Law and Administration	**Lecture languages** english
Study level first cycle (joint degree programme)	**Subject related to scientific research** Yes
Study form full-time degree programme	**Disciplines** Physical sciences
Education profile General academic	**ISCED classification** 0533 Physics
Mandatory obligatory	**USOS code**

Subject coordinator	Piotr Szwedo

Lecturer	Giray Enkavi

Period Semester 4	**Examination** graded credit **Activities and hours** Lecture: 28 Classes: 14	**Number of ECTS points** 5.0

Goals

C1	The course focuses on teaching the fundamentals of thermodynamics. We will cover the following topics: mathematical tools for thermodynamics, introduction to thermodynamics (equation of state of an ideal gas, thermal equilibrium and other basic concepts, Van der Waals equation of state), Zeroth law of thermodynamics, First law of thermodynamics (work, reversible processes, conservation of heat and energy, heat capacities, ideal gas processes), Heat engine and Second law of thermodynamics (Carnot engine, fridge and heat pump, cycle processes, Clausius inequality), Entropy (entropy and the second fundamental law of thermodynamics, statistical interpretation of entropy, examples of calculating entropy, Maxwell rations, fundamental equation, chemical potential, Gibbs and Duhem equation, Third law of thermodynamics).

Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
Knowledge – Student knows and understands:			
W1	the basic concepts of thermodynamics: thermodynamic state, state variables, equation of state, heat capacities, ideal gas processes, reversible change or process, entropy	JBS_K1_W06, JBS_K1_W07	written credit, credit with grade
W2	the contents of the four fundamental laws of thermodynamics	JBS_K1_W06, JBS_K1_W07	written credit, credit with grade
W3	if a differential is exact or not, understands the concepts of total differential and integrating factor.	JBS_K1_W06, JBS_K1_W07	written credit, credit with grade
Skills – Student can:			
U1	apply the four fundamental laws of thermodynamics to simple practical problems.	JBS_K1_U03	written credit, credit with grade, credit
U2	calculate the entropy change associated with simple processes and, using entropy, can derive relationships between measurable thermodynamic quantities	JBS_K1_U03	written credit, credit with grade, credit
U3	solve simple thermodynamic problems using partial derivatives.	JBS_K1_U03	written credit, credit with grade, credit

Calculation of ECTS points

Activity form	Activity hours*
Lecture	28
Classes	14
preparation for classes	18
exercises performance	52
preparation for final test	23

Student workload	Hours 135	ECTS 5.0

* hour means 45 minutes

Study content

No.	Course content	Subject's learning outcomes
1.	Interactive lecture: Introduction to the Course Material and the Concept of Thermophysics	W2
2.	Interactive lecture: Mathematical methods in thermodynamics	W2, W3, U3
3.	Interactive lecture: Presentation of the group exercise solutions by the students	W2, W3, U3
4.	Interactive lecture: Ideal Gas Law, Kinetic Theory of Gases, Thermodynamic Systems	W1, W2, U3
5.	Interactive lecture: Presentation of the group exercise solutions by the students	W1, W2, U3
6.	Interactive lecture: Zeroth law of Thermodynamics, Work, Reversible Processes, First Law of Thermodynamics, Heat Capacities	W1, W2, U1, U3
7.	Interactive lecture: Presentation of the group exercise solutions by the students	W1, W2, U1, U3
8.	Interactive lecture: First Law of Thermodynamics (continued), Ideal Gas Processes	W1, W2, W3, U1, U3
9.	Interactive lecture: Presentation of the group exercise solutions by the students	W1, W2, W3, U1, U3
10.	Interactive lecture: Heat Engines and the Second Law of Thermodaynamics	W1, W2, W3, U1, U3
11.	Interactive lecture: Presentation of the group exercise solutions by the students	W1, W2, W3, U1, U3
12.	Interactive lecture: Entropy, the fundamental equation and Gibbs-Duhem equation	W1, W2, W3, U1, U3
13.	Interactive lecture: Presentation of the group exercise solutions by the students	W1, W2, W3, U1, U2, U3
14.	Interactive lecture: Third Law of Thermodynamics, Chemical Potential	W1, W2, W3, U1, U2, U3
15.	Exercise session: Exercises on this week's lecture material	W1, W2, W3, U1, U2, U3

Course advanced

Teaching methods :

conversation lecture, solving tasks, practicals

Activities	Examination methods	Credit conditions
Lecture	written credit, credit with grade	Individual pen and paper exercises, group exercises, self-assessment, and final exam – 45% of points required to pass the course.
Classes	credit	45% of points required to pass the course

Entry requirements

None

Literature

Obligatory

1. Hand-outs by Hanna Vehkamäki, Ismo Napari, and Inkeri Kontro

Effects

Code	Content
JBS_K1_U03	The graduate can apply adequate methods and tools, including selected IT tools, to solve problems related to data collection, analysis, and management in the context of sustainability.
JBS_K1_W06	The graduate can describe interconnections between various aspects of sustainability and identify their significance in the context of natural and social sciences, with a special focus on disciplines included in the selected specialisation track (law and politics; chemistry and physics; chemistry and biology; economics and geography; economics, management and engineering; humanities).
JBS_K1_W07	The graduate can apply the theory and methodology of disciplines included in the selected specialisation track to sustainability-related problems, taking into consideration practical limitations such as protection of intellectual property.