Faculty of Science

FYSA14, Physics: Introduction to University Physics, with Thermodynamics, Climate and Experimental Methodology, 7.5 credits

Fysik: Introduktion till universitetsfysik, med termodynamik, klimat och experimentell metodik, 7,5 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2019-08-13 and was last revised on 2024-11-06 by The Education Board of Faculty of Science. The revised syllabus comes into effect 2024-11-06 and is valid from the autumn semester 2025.

General information

The course is a compulsory course for first-cycle studies for a Bachelor of Science in physics.

Language of instruction: Swedish and English
The course is given in Swedish during autumn semesters. Occasional components can be given, and are assessed in English. They include no more than 1.5 credits in the form of laboratory session or written assignment.

During spring semesters, the course in full is given in English.

Main field of study	*Specialisation*
Physics	G1F, First cycle, has less than 60 credits in first-cycle course/s as entry requirements

Learning outcomes

The course intends to give basic knowledge in thermodynamics and the Earth's climate as well as practise in carrying out, interpreting and describing the results of physical experiments (experimental methodology). On completion of the course, the student should be able to fulfil the aims stated below. The references to aims point to the intended learning outcomes in the programme syllabus of Degree of Bachelor in physics at Lund university which correspond to qualitative aims for general qualification in the Higher Education Ordinance in turn see "other".

The aims of the course:

- 1-8 are interim aims towards intended learning outcomes 1 in the programme syllabus
- 10,11 and 13 are interim aims towards intended learning outcomes 2 in the programme syllabus
- 9-11 are interim aims towards intended learning outcomes 3 in the programme syllabus
- 12 and 13 are interim aims towards intended learning outcomes 4 in the programme syllabus
- 11 is interim aim towards intended learning outcomes 5 in the programme syllabus
- 15 is interim aim towards intended learning outcomes 6 in the programme syllabus
- 15 and 16 are interim aims towards intended learning outcomes 7 in the programme syllabus.

Knowledge and understanding

On completion of the course, the students shall be able to:

1. Account for and use important basic concepts in thermodynamics such as temperature and pressure as well as their statistical interpretations.
2. Motivate the ideal gas law and use it for simple systems.
3. Account for different energy concepts in the form of heat, work and internal energy, as well as a basic understanding of entropy.
4. Describe and use the laws of thermodynamics for simple problems.
5. Carry out calculations and describe thermal expansion and heat transport through conduction, convection and radiation.
6. Describe cyclic processes and apply this argument on heat engines such as heat pumps.
7. Give an overview of how the climate system of the Earth works and based on thermodynamics explain climate changes.
8. Account for the concept of sustainable development and its applications in physics.

Competence and skills

On completion of the course, the students shall be able to:

9. Carry out calculations and solve problems concerning the course content.
10. Independently be able to carry out simple experimental trials and interpret the results.
11. Under supervision plan and carry out an experiment based on a question formulation of one's choice.
12. Describe in writing, in a popular scientific way, results in and discussions about physics.
13. Describe completed experiments and completed demonstrations orally.
14. Analyse critically one's own experimental work with regard to choice of method and limitations in the results.

Judgement and approach

On completion of the course, the students shall be able to:

15. Reflect on the role of physics to understand and tackle important problems in society.
16. Critically discuss sustainable development and how it influences the applications of physics.

Course content

The course covers basic thermodynamics, the climate of the Earth and the role of physics in connection with the problems in society that are connected to this. The course also gives practise in planning, carrying out, interpreting and presenting experimental trials. In the area of thermodynamics, temperature, temperature scales, thermal expansion, calorimetry, phase transitions, heat and heat transport, the ideal gas law, the kinetic gas theory, thermal capacity, phase diagrams, the laws of thermodynamics, entropy, radiation balance as well as black body radiation are treated. In the area of climate, the energy balance, greenhouse effect and global heating of the soil are treated, the heating and cooling effects of clouds as well as transport in the atmosphere with a focus on how water transports energy in the troposphere. Exercise in laboratory work is given through larger laboratory sessions which also highlight the theory that is included in the course. Through the laboratory sessions, error estimates and error propagation are brought up as well. The course also includes an experimental seminar exercise where the students carry out a larger experiment based on a question formulation of one's choice, and orally present the result of this.

Ecological, economic and social sustainability and its basis in and influence on physics and its applications are treated during a compulsory workshop.

Exercise in popular scientific writing is given as a part in the area of the climate of the Earth.

Course design

The course consists of lectures, exercises, workshops, laboratory sessions and experimental seminars. Participation in workshops, laboratory sessions and seminars is mandatory.

Assessment

Examination takes place in the form of a written examination at the end of the course, and during the course through mandatory components and reports:

- the written examination, 3.0 credits assesses intended learning outcomes 1-7 and 9
- a written assignment in popular scientific writing, 0.7 credits that assesses intended learning outcomes 12 and 14
- laboratory sessions including written presentation, 1.5 credits assesses intended learning outcomes 1-7, 11 and 13
- experimental seminars including oral presentation, 2.0 credits that assess intended learning outcomes 1-7 and especially 10, 11 and 13
- active participation in workshop and assignment around sustainability, 0.3 credits that assesses intended learning outcomes 8, 15 and 16.

Students who do not pass the regular examination will be offered another opportunity for examination soon thereafter.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Grades

Grading scale includes the grades: Fail, Pass, Pass with distinction
A Pass grade for the entire course requires approved examination, passed written assignment in popular science writing, passed laboratory sessions including written presentation, passed seminars including oral presentation, passed assignment around sustainability as well as passed compulsory components.

The grading scale for the assignment on sustainability and active participation in workshop is Fail, Pass, Pass with Distinction. The grading scale for the written examination, the written assignment in popular science writing, laboratory sessions, and the experimental seminars is Fail, Pass, Pass with Distinction.

Calculation of grade

Examination results are given as a percentage that corresponds to the score achieved in the examination, relative to the maximum possible score. The limit for Pass is normally 50% and for Pass with distinction 80%.
Laboratory sessions and seminars (where the implementation and the report/the presentation is weighed) are given the grades Fail, Pass or Pass with distinction. For compilation of grades, these are converted to a percentage according to: G = 65%, Pass with distinction = 90%.
For compilation of results to calculate the final grade for the whole course, a weighted mean is calculated using the percentages, where the credits for the components are used as weight. The limit for Pass with distinction is 80%.

Entry requirements

Admission to the course requires knowledge equivalent to FYSA22 Introduction to university physics with mechanics, 7.5 credits and FYSA23 Introduction to university physics with electricity, 7.5 credits.

Further information

The course is part of the Bachelor's program in physics, theoretical physics, astrophysics or of the medical physics program. The teaching is based on the assumption that the student follows the program and has assimilated the knowledge in the previous courses, and takes other program courses in parallel. For those who have acquired equivalent knowledge in other ways, the course can be taken as a stand-alone course.

The course may not be included in qualification together with FYSA01 Physics 1: General physics, 30 credits or ÄFYD01 General physics with didactics, 30 credits or the equivalent earlier courses.

The course is offered at the Department of Physics, Lund University.

Appendix 1: Aims stated in the programme syllabus of Degree of Bachelor of Science:

Knowledge and understanding
For Degree of Bachelor, the student should:

1. show knowledge and understanding in the main field of study for the education included knowledge of the disciplinary foundation of the field, knowledge of applicable methods in the area, specialisation in some part of the field as well as orientation in current research questions.

Competence and skills
For Degree of Bachelor, the student should:

2. demonstrate the ability to search, collect, evaluate and interpret relevant information in a problem critically as well as to discuss phenomena, issues and situations critically
3. demonstrate the ability to independently identify, formulate and solve problems as well as to carry out assignments within given time frames
4. demonstrate the ability to orally and in writing account for and discuss information, problems and solutions in dialogue with different groups and
5. demonstrate the skills required to work independently in the field of the programme

Judgement and approach
For Degree of Bachelor, the student should:

6. demonstrate the ability to in the main field of study for the education make assessments considering relevant scientific, social and ethical aspects
7. demonstrate an understanding of the role of the knowledge in society and if the responsibility of people for how it is used and
8. identify the personal need for further knowledge and ongoing learning