Faculty of Science

FYSA22, Physics: Introduction to University Physics, with Mechanics, 7.5 credits

Fysik: Introduktion till universitetsfysik, med mekanik, 7,5 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2023-11-27 and was last revised on 2024-10-11 by The Education Board of Faculty of Science. The revised syllabus comes into effect 2024-10-11 and is valid from the autumn semester 2025.

General information

The course is a compulsory course at first-cycle studies for a Degree of Bachelor of Science in physics and can also be taken as a freestanding course.

Language of instruction: Swedish and English

Main field of study	*Specialisation*
Physics	G1N, First cycle, has only upper-secondary level entry requirements

Learning outcomes

The overall goal of the course is to give the students an introduction to university physics as a basis for further studies in physics. Especially, the students should acquire knowledge of basic mechanics as a foundation for other physics.

The aims of the course:

- 1-7 are milestones towards learning outcome 1 in the programme syllabus.
- 8-10 are milestones towards learning outcome 2 in the programme syllabus.
- 10-12 are milestones towards learning outcome 3 in the programme syllabus.
- 13-14 are milestones towards learning outcome 4 in the programme syllabus.
- 15-17 are milestones towards learning outcome 6 in the programme syllabus.
- 18 is a milestone towards learning outcome 8 in the programme syllabus.

Learning outcomes in the syllabus refer to the programme syllabus for the bachelor's degree in physics at Lund University, which in turn corresponds to degree objectives for general degrees in the Higher Education Ordinance.

Knowledge and understanding

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

1. describe and use mechanics to solve conceptual problems

2. account for the methods, ideas and preconditions of physics at a general level as a basis for studies in physics in general and mechanics in particular

3. account for, use and discuss methods in the mechanics at a general level based on Newton's laws

4. describe dynamic systems in linear and rotational motion

5. describe elementary problems in mechanics using vectors, including the dot and cross products

6. give examples of current research topics in mechanics as well as relate this to one's own learning process

7. account for mechanics with regard to its use in our surroundings.

Competence and skills

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

8. carry out experiments that are relevant for the course

9. based on given instructions, carry out a simple critical analysis of experimental data

10. carry out measurements and with supervision carry out laboratory sessions in mechanics

11. use the basic concepts, carry out calculations and solve theoretical problems using Newtonian mechanics as contained in the course

12. suggest procedures and methods for solving a given problem in groups

13. write a laboratory report that follows a given layout, which accounts for the aims, methods, and materials used in the experiment, as well as illustrating the results in the form of tables and/or figures.

14. give simple and basic constructive feedback on a laboratory report.

Judgement and approach

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

15. based on the concepts of mechanics discuss phenomena and examples in the surrounding society

16. give examples of ethical aspects, motives for or against and consequences of the application of mechanics in different situations

17. give examples of how lack of gender equality and diversity can be described and the effects this may have on the quality and results of research and development

18. reflect on their progress in terms of knowledge and competence based on the course goals and their own goals.

Course content

The course consists of two modules:

Module 1 Introduction to being a physicist, 1 credit

The course gives an introduction to academic integrity, which will be a key concept throughout the entire course. The course covers ethical aspects on the use and application of the contents of the course, which extends to a general discussion about natural sciences and ethics. An introduction is also given to gender and diversity perspectives on physics. A final workshop with reflection over the student's learning during the course is an important part of the course (this component may be placed a week after the examination).

Module 2 Mechanics, 6.5 credits

The course covers kinematics and dynamics based on Newtonian mechanics with application to both linear and rotational motion. The concepts of energy, linear momentum and angular momentum are introduced. The key principle of conservation is use to describe the relationship between forces and changes of motion (i.e. dynamics). Important subject-specific concepts are:

Kinematics

Linear motion in one, two and three dimensions. Fundamental quantities: position, velocity and acceleration, both instantaneous and average. Freely falling bodies. Applications of differentiation and integration. Interpretation of diagrams of position, velocity and acceleration as a function of time. Three-dimensional motion and the vector formalism. Circular motion with angular velocity and acceleration.

Dynamics

Dynamics is described in the course using Newtonian mechanics. Newton's three laws, their applications and conceptual interpretation. Free body diagrams. Particle dynamics, friction, circular dynamics. Work, kinetic and potential energy. Conservation of energy. Gravitation with applications, for example escape velocity and Kepler's laws. Elastic forces and energy diagrams. Linear momentum and preconditions for its conservation. Impulse. Introduction to inelastic and elastic collisions.

Rotational dynamics

Rotation of particles and rigid objects. Angular momentum and preconditions for its conservation. The analogy between linear and rotational dynamics. Rotational energy. The parallel axis theorem. Torque and angular acceleration.

Statics

Conditions for equilibrium. Centre of gravity and its relation to the centre of mass.

Fluid mechanics

Bernoulli's law and Archimedes' principle.

Course design

The teaching consists of teaching sessions, lectures, group work, problem solving exercises, laboratory sessions, workshop and group project. Participation in laboratory sessions and introductory sessions, as well as components on academic integrity, ethics and laboratory safety, is compulsory.

Assessment

The course is assessed by written examination and written reports. Participation in the compulsory components is also required.

In module 1 Introduction to being a physicist, 1 credit, the assessment takes the form of:

- A written group report on ethics as well as participation in the components on academic integrity and safety. This assesses the intended learning outcome 16, and corresponds to 0.5 credits.
- A written group report about gender and diversity perspectives in the natural sciences as well as a written self-reflection about one's own learning process. This assesses the intended learning outcomes 17 and 18, and corresponds to 0.5 credits.

In module 2 Mechanics, 6.5 credits, the examination takes place in the form of:

- written examination in mechanics at the end of module 2, that assesses the intended learning outcomes 1-7, 11, 15, and corresponds to 5 credits
- completed laboratory sessions and written laboratory reports, as well as peer review of other student's report. This assesses the intended learning outcomes 2 and 8-14, which corresponds to 1.5 credits.

Students who do not pass a regular assessment will be offered another opportunity for assessment 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
The components in Module 1 are graded either Pass or Fail.

In Module 2, the laboratory components are graded Pass or Fail, while the written examination is graded Fail, Pass or Pass with Distinction.

To pass the whole course requires passes in the written examination, the laboratory sessions, the laboratory reports, the workshop reports and for participation in the compulsory components.

- introductory meetings
- teaching sessions and group work about safety, academic integrity as well as ethics
- teaching sessions and group work about gender and diversity perspectives
- introductory lessons to laboratory sessions
- laboratory sessions
- workshop about self-reflection on learning.

Calculation of grade

- Reports and other compulsory components in Modules 1 and 2 are given grades of Pass or Fail. These components are not included in the calculation of final grade.
- Examination results are given as a percentage that corresponds to the score achieved in the written examination, relative to the maximum possible score. The threshold for a Pass is normally 50%, and 80% for a Pass with Distinction.

- The final grade for the course is determined by the grade of the written examination.

Entry requirements

General requirements and studies equivalent of courses Physics 2, Mathematics 4/D and English 6 from Swedish Upper Secondary School.

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 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 a degree together with FYSA01 Physics 1: General physics, 30 credits, FYSA12 Physics: Introduction to university physics with mechanics and electricity, 15 credits, or ÄFYD01 General physics with didactics, 30 credits, or equivalent earlier courses.

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