Faculty of Science

FYSA23, Physics: Introduction to University Physics, with Electricity, 7.5 credits

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

First Cycle / Grundnivå

Details of approval

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

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, in the form of laboratory sessions or written assignments, may be given and assessed in English, comprising no more than 1.5 credits.

The course is given in full in English during spring semesters.

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 electricity as a foundation for other physics.

The aims of the course:
1-10 are milestones towards learning outcome 1 in the programme syllabus.
11-13 are milestones towards learning outcome 2 in the programme syllabus.
13-15 are milestones towards learning outcome 3 in the programme syllabus.
16 and 17 are milestones towards learning outcome 4 in the programme syllabus.
18-20 are milestones towards learning outcome 6 in the programme syllabus.
20 is a milestone towards learning outcome 7 in the programme syllabus.

21 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 knowledge of electricity 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 electricity in particular

3. describe elementary problems within electricity using vectors, including the dot and cross products.

4. give examples of current research topics within electricity as well as relate this to their own learning process

5. account for electricity with regard to its use in our surroundings

6. account for electric fields and their origin

7. describe simple electric circuits with basic components

8. account for the origin of magnetic fields, connections between these and current, as well as their influence on charges

9. describe magnetic materials and their applications at a general level

10. discuss alternating currents as well as account for their origin and the effects of basic components on alternating current circuits.

Competence and skills

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

11. use measurement instruments that are relevant for the course

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

13. carry out measurements and with supervision carry out laboratory sessions in the electricity subject contained in the course

14. use the basic concepts, carry out calculations and solve theoretical problems within the electricity subject contained in the course

15. in groups suggest procedure and methods to solve a given problem

16. write a laboratory report that follows a given principal layout, and therein be able to account for the aim of the laboratory work, the methods, the materials used and to illustrate the results in the form of tables and figures

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

Judgement and approach

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

18. based on the concepts of electricity, discuss phenomena and examples in the surrounding society

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

20. discuss risks and conditions for electricity in society, especially concerning power production and distribution

21. 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 physical measurements, 1 credit

The module includes introduction to basic concepts and simple methods of measurement in physics in the form of introductory laboratory sessions, as well as introduction and specialisation around mathematical tools such as vectors and basic differential calculus. The module also gives an introduction to laboratory safety.

Module 2 Electricity, 6.5 credits

In the module, the following topics are addressed:

Electrostatics

Electric charge, Coulomb's law, electric force on charged particles, electric field strength, the superposition principle and superposition of point charges, field lines, electric dipoles, electric flow, Gauss' theorem (formulate and give examples for certain given geometries), electric potential, electric potential energy, equipotential surfaces, capacitance, capacitors and how they are treated in simple electric circuits, charge polarisation, dielectrics, electrostatic energy in for example capacitors.

Electric current and circuit theory

Current, current density, resistivity, resistance and its temperature dependence, the resistor and how it is treated in electric circuits, Ohm's law, Kirchhoff's laws, Joule's law, electromotive voltage (EMS), charging and discharging of capacitors (RC-circuits), circuit analysis, the electrical motor, electric measurement instruments and how they are used/connected.

Magnetic fields

Magnetic fields, magnetic force on charged particles, magnetic forces on current carrying wires, Gauss' law for magnetic fields, Biot-Savart's law, torque on current carrying coils in magnetic fields, magnetic dipoles, Ampere's law on integral form (formulate and give examples with given geometries), the Hall effect and how to measure magnetic fields, magnetisation as well as orientation in magnetic materials (especially ferromagnetic materials).

Electromagnetic induction

Faraday's and Lenz' laws, mutual and self inductance, the dynamo, movement EMS, Eddy currents. LR circuits, magnetic field energy, induced electric fields.

Maxwell's equations

A short introduction to Maxwell's equations on integral form is derived, with special emphasis on Gauss' and Ampere's law with examples.

Alternating current

The concept of alternating current, rectification, resistances and reactances, LRC circuits, resonance, effect, electrical safety and ideal transformers.

Course design

The teaching consists of teaching sessions, lectures, group work, problem solving exercises and laboratory sessions. Participation in laboratory sessions and introductory meetings, as well as in components that treat laboratory safety is compulsory.

Assessment

Examination takes place in the form of written examination, written reports, and through compulsory components.

In module 1 Introduction to physical measurements, 1 credit, the examination takes place in the form of:

- active participation in introductory labs and associated compulsory components. This assesses the intended learning outcomes 11-13 and 15.

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

- written examination in electricity at the end of module 2, which assesses the intended learning outcomes 1-10, 14, 18, 21 and corresponds to 5 credits
- completed laboratory sessions and written laboratory reports, as well as peer review of another student's report. This assesses the intended learning outcomes 2 and 11-17, which corresponds to 1.5 credits.

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
The components in Module 1 are graded either Pass or Fail.

In module 2, the laboratory sessions are graded according to the scale Fail and Pass, while examination is graded according to the scale Fail, Pass, Pass with distinction.

To pass the whole course requires passed examination, laboratory sessions, and laboratory reports, as well as participation in all compulsory components:

- introductory meeting
- introductory lessons to laboratory sessions
- laboratory sessions.

Calculation of grade

- Reports and other compulsory components in the modules 1 and 2 give only grades Fail or Pass. 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 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.