Joint Faculties of Humanities and Theology

ÄFYA03, Physics: Electricity and Magnetism, 7.5 credits

Fysik: Elektricitet och magnetism, 7,5 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by The Education Board of Faculty of Science on 2025-12-10. The syllabus comes into effect 2025-12-10 and is valid from the autumn semester 2026.

General information

The course is part of the subject teacher education programme at Lund University.

Language of instruction: Swedish
Certain elements may be carried out in English in connection with laboratory work.

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 aims to provide an introduction to areas of university physics relevant for subject teachers in physics, serving as a foundation for further studies in the field. Particular emphasis is placed on basic electricity and magnetism, as a fundamental basis for the rest of physics.

Knowledge and understanding

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

1. describe and use knowledge of electricity and magnetism 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 and magnetism in particular

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

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

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

6. account for electric fields and their origin, as well as their influence on charges

7. describe simple direct current 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 cursorily magnetic materials and their applications at a general level

10. account for alternating currents as well as their origin and the effects of basic components on alternating current circuits, including the frequency dependence of amplitude and phase

11. desribe cursorily electromagnetic waves.

Competence and skills

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

12. use measurement instruments that are relevant for the course

13. based on given instructions, carry out a simple critical analysis of experimental data, including measurement uncertainty estimates

14. carry out measurements and with supervision carry out laboratory sessions in electricity and magnetism

15. use the basic concepts, carry out calculations and solve theoretical problems within electricity and magnetism, including calculations with complex exponential functions in the context of alternating currents

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

17. write a laboratory report that follows a given principal layout, and therein 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

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

Judgement and approach

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

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

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

21. discuss risks and conditions for electricity and magnetism in society, especially concerning power generation and distribution

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

Course content

The course covers fundamental concepts and models in electricity and magnetism. Through the laboratory exercises, measurement uncertainty estimates and error propagation are also addressed.

Important subject-specific concepts are:

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 flux, Gauss's law (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 in integral form (formulate and give examples with given geometries), the Hall effect and how to measure magnetic fields, magnetisation as well as overview of 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 and electromagnetic waves

A short introduction to Maxwell's equations in integral form is derived, with special emphasis on Gauss' and Ampere's law with examples. A general introduction to how electromagnetic waves are generated and propagate.

Alternating current

The concept of alternating current, representation of alternating current with complex numbers and complex exponentials, rectification, resistances and reactances, LRC circuits, resonance, power, transmission lines, electrical safety and ideal transformers.

Course design

The teaching consists of 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 a written examination, written reports, and through compulsory components.

- written examination in electricity and magnetism at the end of the course, which assesses the intended learning outcomes 1-11, 15, 19-21 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 12-18, which corresponds to 2,5 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 laboratory sessions are graded according to the scale of Fail and Pass, while the examination is graded according to the scale of Fail, Pass, and Pass with distinction.

To pass the whole course, the student must have a passing grade on the written exam, pass all laboratory sessions and laboratory reports, and participate in all compulsory activities:

- introductory meeting
- introductory sessions for laboratory work
- aboratory sessions.

Calculation of grade

- Reports and other compulsory components only grade Fail or Pass. These components are not included in the calculation of the 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 entry requirements and studies equivalent of courses Physics 2, Mathematics 4 and English 6 from Swedish uppper secondary school, as well as 15 credits in university-level mathematics.

Further information

The course may not be included in a degree in combination with FYSA33, Physics: Introduction to University Physics, with Electricity and Magnetism (7.5 credits) or ÄFYD11, Physics 1: Introductory Physics including Physics Education (30 credits), or equivalent earlier courses.