Faculty of Science

FYSA12, Physics: Introduction to University Physics, with Mechanics and Electricity, 15 credits

Fysik: Introduktion till universitetsfysik, med mekanik och ellära, 15 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2019-06-10 to be valid from 2019-06-10, spring semester 2020.

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 been given, and are assessed in English. It includes no more than 1.5 credits in the form of laboratory sessions or written assignments.

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

Main field of studies	*Depth of study relative to the degree requirements*
Physics	G1N, First cycle, has only upper-secondary level entry requirements

Learning outcomes

The course intends to give an introduction to university physics as a basis for further studies in physics. Especially, basic mechanics and electromagnetism are highlighted as foundations of further physics. Intended learning outcomes in the programme syllabus refer to the programme syllabus of Degree of Bachelor in physics at Lund's university which corresponds to qualitative target for general qualification in the Higher Education Ordinance in turn see "other".

The AIMS of the COURSE: 1-12 is interim target against intended learning outcomes 1 in the programme syllabus. 13-15 is interim target against intended learning

outcomes 2 in the programme syllabus. 15-17 is interim target against intended learning outcomes 3 in the programme syllabus. 18 and 19 is interim target against intended learning outcomes 4 in the programme syllabus. 20-23 is interim target against intended learning outcomes 6 in the programme syllabus. 23 is interim target against intended learning outcomes 7 in the programme syllabus. 24 is interim target against intended learning outcomes 8 in the programme syllabus.

Knowledge and understanding

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

1. Describe and use mechanics and electromagnetism 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 and electromagnetism in particular.
3. Account at a general level for, use and discuss methods in the mechanics based on " Newton's laws?.
4. Describe dynamic systems in linear motion and rotation.
5. Describe elementary problems in mechanics and electromagnetism by means of vectors, dot product and cross product.
6. Give examples of current research topics in mechanics and electromagnetism as well as relate this to one's own learning process.
7. Account for mechanics and electromagnetism with regard to its use in our environment.
8. Account for electric fields and their origin.
9. Describe simple electric circuits with basic components.
10. Account for the origin of magnetic fields, connections between these and current as well as their influence on charges.
11. Describe magnetic materials and their applications at a general level.
12. Discuss alternating currents as well as account for their origin and the effects of basic components in alternating current circuits.

Competence and skills

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

13. Use measuring instruments relevant to the course.
14. Based on given instructions carry out a simple critical analysis of experimental data.
15. Carry out measurements and carry out, with supervision, laboratory work in mechanics and electromagnetism.
16. Use the basic concepts, carry out calculations and solve theoretical problems in the mechanics and electromagnetism that the course contains.
17. In groups suggest procedure and methods to solve a given problem.
18. Write a laboratory report that follows a given principal layout and 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.
19. Give simple and basic constructive feedback on a laboratory report.

Judgement and approach

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

20. Based on the concept of the mechanics and the electromagnetism discuss phenomena and examples in the surrounding society.
21. Give examples of ethical aspects, motives for or against and consequences of the application of mechanics and electromagnetism in different situations.
22. Give examples of how shortage of gender equality and diversity can be described and which effects it can have on quality and results of research and development.
23. Discuss risks and preconditions for electricity in society, especially concerning power production and distribution.
24. Reflect, based on learning objectives and one's own aims, on progress regarding knowledge and skills.

Course content

The course consists of three modules:

Module 1 Introduction to being a physicist, 2 credits

In the module, introduction to basic concepts and simple methods of measurement in physics as well as introduction and specialisation around mathematical tools are included such as vectors and basic differential calculus. The course gives an introduction to academic integrity and laboratory safety which are then central concepts in the entire course. The course covers ethical aspects on the use and application of the contents of the course, which is also expanded 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 end of the course).

Module 2 Mechanics, 6.5 credits

The course covers kinematics and dynamics based on Newtonian mechanics with application on both linear and rotational motion. Important concepts are principles of conservation, where the concepts energy, linear momentum and angular momentum are introduced and are used to describe the causality that is the dynamics between forces and change of motion. Important topic-specific concepts are:

Kinematics
Linear motion in a, two and three dimensions. Basic units: position, velocity and acceleration, both instantaneous and average. Freely falling bodies. Application of derivation and integration. Interpretation of position, velocity and acceleration diagrams as a function of time. Three-dimensional movement and vector formalism. Circular motion with angular velocity and acceleration.

Dynamics
The dynamics are described in the course with so-called Newtonian mechanics. Newton's three laws, their applications and conceptual interpretation. Free body diagrams. Particle dynamics, friction, circular dynamics. Fundamental forces. Work, kinetic and potential energy. The conservation of energy. Gravitation with applications for example escape velocity, Kepler's laws and dark matter. Elastic forces and energy diagrams. Linear momentum and preconditions for its conservation. Impulse. Introduction to inelastic and elastic collisions. Rocket motion.

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. Emphasis and its relation to centre of mass.

Fluid Mechanics
Bernoulli's law and Archimedes' principle.

Module 3 Electromagnetism, 6.5 credits

In the course is treated:

Electrostatics

Electric charge, Coulomb's law, electric force on loaded particles, electric field strength, the superposition principle and superposition of point charges, field lines, electric dipoles, electric flow, Gauss' theorem (show and formulate as well as example with 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 handled in electric circuits Ohm's law, Kirchhoff's laws, Joule's law, electromotive voltage (EMS), up and discharge of capacitor (RC-circuits), circuit analysis, the electrical engine, electric measuring instruments and how they are used/are connected.

Magnetic fields
Magnetic fields, magnetic force on loaded particles, magnetic forces on current carrying wires, Gauss' law for magnetic fields, Biot-Savart's law, torque on current carrying coil in magnetic fields, magnetic dipoles, Ampere's law on integral form (formulate as well as examples with given geometries), the Hall effect and how to measure magnetic fields, magnetisation as well as orientation in magnetic materials (particularly 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
Short introduction to Maxwell's equations on integral form is retrieved, with special emphasis on Gauss and Ampere's law with example.

Alternating current

The concept alternating current, rectification, resistance and reactance, LRC circuits, resonance, effect, electricity security and ideal transformer

Course design

The teaching consists of teaching sessions, lectures, group work, calculation exercises, laboratory sessions, workshop and project. Participation in laboratory sessions and introductory meetings, as well as in components that treat academic integrity, laboratory safety, ethics as well as gender and diversity perspectives is compulsory.

Assessment

Examination takes place in writing in the form of examination and reports as well as through compulsory components.

In module 1 Introduction to being a physicist, 2 credits the examination takes place in the form of:

- An individual written report about and participation in introductory labs. This assesses the intended learning outcomes of the course 13-15 and 17 and corresponds to 1 credit.
- A written group report about and participation in components about academic integrity and safety as well as ethics. This assesses the intended learning outcomes of the course 21 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 of the course 22 and 24. This 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 of the course 1-7, 16, 20 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 of the course 2 and 13-19, which corresponds to 1.5 credits.

In module 3 Electromagnetism, 6.5 credits the examination takes place in the form of:

- Written examination in electromagnetism at the end of module 3, that assesses the intended learning outcomes of the course 1.2, 5-12, 16, 20, 23 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 of the course 2 and 13-19, which corresponds to 1.5 credits.

Students who do not pass the regular exam are offered a new possibility shortly after the regular exam.

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.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
Component in module 1 includes only scale Failed and Passed.

To pass on the whole course is required passed examinations, passed laboratory sessions, laboratory reports, group reports and passed self-reflection as well as participation in all compulsory components:

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

Calculation of grade

- Group reports and other components in module 1 give only grades Fail or G. 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 examination, relative to the maximum possible score. The limit for Pass is normally 50% and for Pass with distinction 80%.
- Laboratory sessions (where the implementation and the report are taken into account) be given the grades Fail, Pass or Pass with distinction. For compilation of grades, these are converted to a percentage according to: Pass = 65%, Pass with distinction = 90%. The grade for the laboratory course is decided by the mean of these percentages. The limit for Pass with distinction is 80%.
- 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

General and courses corresponding to the following Swedish Upper Secondary School Programs: Chemistry 1, Mathematics 4, Physics 2.

Further information

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.

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

Subcourses in FYSA12, Physics: Introduction to University Physics, with Mechanics and Electricity

Applies from V20

2001 Introductory laboratory work, 1,0 hp
Grading scale: Fail, Pass
In module 1 Introduction to being a physicist
2002 Academic conduct, security and ethics, 0,5 hp
Grading scale: Fail, Pass
In module 1 Introduction to being a physicist
2003 Gender and diversity, 0,3 hp
Grading scale: Fail, Pass
In module 1 Introduction to being a physicist
2004 Self reflection, 0,2 hp
Grading scale: Fail, Pass
In module 1 Introduction to being a physicist
2005 Written exam in mechanics, 5,0 hp
Grading scale: Fail, Pass, Pass with distinction
In module 2 Mechanics
2006 Laboratory work in mechanics, 1,5 hp
Grading scale: Fail, Pass, Pass with distinction
In module 2 Mechanics
2007 Written exam in electricity, 5,0 hp
Grading scale: Fail, Pass, Pass with distinction
In module 3 Electromagnetism
2008 Laboratory work in electricity, 1,5 hp
Grading scale: Fail, Pass, Pass with distinction
In module 3 Electromagnetism