Reg No: FYGL12/20192

Board of Teacher Education
Physics

Syllabus

Physics I and Physics Education

Course Code:	FYGL12
Course Title:	Physics I and Physics Education *Fysik I med didaktisk inriktning*
Credits:	30
Degree Level:	Undergraduate level
Progressive Specialisation:	First cycle, has less than 60 credits in first-cycle course/s as entry requirements (G1F)

Major Field of Study:
FYA (Physics)

Course Approval
The syllabus was approved by the Board of Teacher Education 2019-02-11, and is valid from the Autumn semester 2019 at Karlstad University.

Prerequisites
Field-specific eligibility A6C (Physics 2 and Mathematics 4), plus completed courses in Mathematics (15 ECTS credits)

Learning Outcomes
The aim of the course is that students acquire knowledge in physics and physics education with an emphasis on the interplay between experiment and theory and how this affects teaching and learning in physics. The course comprises four modules and theoretical as well as laboratory components.

Module 1. Measuring and Modelling, 7.5 ECTS cr
Upon completion of the module, students should be able to
1. design and assess the validity of a mathematical model for a mechanical system,

2. give an account of basic mechanical concepts and laws and demonstrate ability to apply them regarding equilibrium problems and motion sequences,
3. develop and carry out laboratory investigations and experiments adapted to educational needs,
4. independently seek information of the development of physics and physics education,
5. give an account of the history and development of ideas in physics and connect this to the development of learners' conceptual understanding in the physical sub-field of mechanics, and
6. analyse steering documents and instructions for assessing and grading.

Module 2. Energy and Sustainable Development, 7.5 ECTS cr
Upon completion of the module, students should be able to
1. give an account of energy concepts, energy forms and work, and electromagnetic radiation,
2. give an account of the radiation balance of the earth in the solar energy flow,
3. give an account of the relationship between energy for sustainable development and aspects of energy extraction as well as relationships between humans, energy, and the environment in relation to basic physical principles,
4. give an account of different basic physical concepts such as pressure, heat, magnetism, and induction, which are prerequisites for energy production and its consequences,
5. reflect on research results regarding meaningful learning in the physics classroom,
6. independently plan and conduct investigations and laboratory experiments to seek answers to questions that they themselves formulate in relation in the field, and
7. give an account of the development of the history of ideas in physics and relate to the development of learners' conceptual understanding in the physical sub-field of energy.

Module 3 The Universe, 7.5 ECTS cr
Upon completion of the module, students should be able to:
1. give an account of the formation and structure of the solar system, the emergence, evolution, and final stage of stars, and
2. give an account of black hole theories, the structure of galaxies, and the large-scale structure and development of the universe.

Module 4. Electric Circuits, 7.5 ECTS cr
Upon completion of the module, students should be able to
1. demonstrate knowledge of basic concepts and components within electric circuit theory,
2. demonstrate basic knowledge of measurement methods for electric circuits and the use of measuring instruments,
3. perform calculations on basic electric circuits using Ohm's law, Kirchoff's laws, node and loop analysis, the superposition theorem, and Thevenin's and Norton's theorems,
4. perform calculations on basic alternating current circuits using phasors and the jw-method,
5. perform simple connections with passive components,
6. perform measurements on electric circuits, and
7. present the results of laboratory experiments in a written report.

Content
Module 1 Measuring and Modelling, 7.5 ECTS cr
Students are introduced to basic physical concepts through laboratory sessions and group study. They plan and conduct physical experiments, including analysing sources of error and applying accuracy to data measurements and drawing relevant physical conclusions. They also practise compiling written reports with the help of computer-based presentation software. The physical concepts and phenomena studied in the course are energy and motion, velocity and acceleration, and Newton's laws.

The teaching methodological perspective deals with how laboratory components can be used to develop pupils' understanding of physics, and students also analyse summative and formative assessment and grading in physics education.

Module 2 Energy and Sustainable Development, 7.5 ECTS cr
The course includes study of basic concepts in the area of energy, especially the radiation balance of the earth in the solar energy flow. Active use of ICT is an element of several course components. The particle model is studied to describe and explain the properties of gases and phase transitions, pressure, volume and density and how particle movement can explain the spread of matter in nature. Field descriptions of electric and magnetic forces and relation between magnetism and electricity including induction. Applications such as solar cells, solar thermal collectors, heat pumps, heat exchangers, bio fuel, and water and wind energy are used in the students' own laboratory experiments. Energy for sustainable development and aspects of energy gain are discussed, and the relation between humans, energy, and the environment are problematised. Research results relating to meaningful learning in the physics classroom are applied in instruction and in the planning of teaching in school. Students plan and carry out investigations independently to find answers to their problem formulations. Diversity and gender aspects of physics as a subject discourse are problematised.

Module 3 The Universe, 7.5 ECTS cr
The course includes lectures, film screenings, interactive computer use of astronomy software, and telescope observations of stars.
The module deals with the formation and structure of the solar system with a focus on the particular circumstances of our solar system. The formation, evolution, and final stage of stars are also treated along with the black holes assumed to exist, the structure of galaxies, the large-scale structure and evolution of the universe, as well as speculations on the creation and future destiny of the universe.

Module 4. Electric Circuits, 7.5 ECTS cr
Instruction is in the form of lectures, exercises, and laboratory sessions.

Basic concepts: Charge, current, potential, voltage, conductors, resistance, power and energy, capacitance, inductance, and electric and magnetic fields.

Knowledge of components: Passive components (resistors, capacitors, and inductors) and ideal transformers.

Circuit theory: Calculations using Ohm's law, Kirchoff's laws, the superposition theorem, Thevenin's and Norton's theorems, and node and loop analysis. Power and power matching, equivalent circuits. Sinusoidal current and voltage, calculations using phasors and the jw-method, resonance circuits. Charging and discharging of a capacitor.

Reading List
See separate document.

Examination
Assessment is based on:

Module 1
Learning outcomes 1 and 2: an individual written exam or individual hand-in assignments (to be announced at the start of course)
Learning outcome 3: oral presentation
Learning outcomes 4, 5, and 6: seminar participation

Module 2
Learning outcomes 1 and 4: written exam
Learning outcome 6: laboratory work
Learning outcomes 2, 3, 5, and 7: seminar participation

Module 3
All learning outcomes: written exam.

Module 4
Learning outcomes 1, 2, 3, and 4: written exam.
Learning outcomes 2, 5, 6, and 7: laboratory work and written lab reports

Individual performance must be clearly displayed for assessment.

Grades
One of the grades Distinction (VG), Pass (G) or Fail (U) is awarded in the examination of the course.

Quality Assurance
Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

Course Certificate
A course certificate will be provided upon request.

Additional information
The local regulations for studies at the Bachelor and Master levels at Karlstad University stipulate the obligations and rights of students and staff.

Teacher Education: Secondary levels