UNIVERSITY OF GOTHENBURG

PHYSICS

NBAF00 Introduction to Natural Science: Physics, 15 higher education credits

Naturvetenskapligt basår, Fysik, 15 högskolepoäng

Confirmation

This course syllabus was confirmed by Department of Physics on 2015-07-30 to be valid from 2015-07-30, autumn semester of 2015.

Field of education: Science 100%
Department: Physics

Position in the educational system

The course is given within the science preparatory year programme, but can also be taken as a freestanding course.
The course is a preparatory education and may not be included in a degree at university level. A pass mark on the course
gives entry requirements equivalent to the upper secondary courses Physics 1 and Physics 2.

The course can be part of the following programmes: 1) Introduction to Natural Sciences (Z1BAN) and 2) Introduction to Natural Sciences (Z1BAS)

Entry requirements

General entrance requirements for university studies and the Swedish upper secondary course Mathematics C or Mathematics 3b/3c or equivalent.

Learning outcomes

On successful completion of the course the student will:

Knowledge and understanding

- have knowledge of the mechanics of particles and bodies, electricity, electric circuits, wave physics, optics and modern physics. The emphasis of the acquired knowledge should be on classical experimental physics.
- be familiar with the concepts physical quantities, units and measurement numbers as well as have knowledge of different system of units and have oriented oneself about experimental measurements.
- know how speed and acceleration are defined for motion in a plane.
- understand what kinetic energy and potential energy are and understand the relationship between physical work and energy.
- understand the relationship between impulse and linear momentum.
- know what be meant with centripetal acceleration.
- have oriented oneself about the concepts internal energy, heat and temperature as well as specific thermal capacity.
- understand what the phase transitions at melting and evaporation implies and that it requires a certain amount of heat.
- understand the concept electric charge and how the sign influences the direction on forces and fields.
- understand the concepts of electric field strength and electric potential and relationship between these.
- understand how magnetic fields are generated and which direction it is given.
- be familiar with the concept induction and understand how an electromotive voltage is induced through movement or change of magnetic flux.
- know how light beams are reflected against mirrors, as well as are refracted by lenses and prisms.
- know what is meant by with harmonic oscillations and waves.
- understand the concepts wave velocity, frequency, period, angular velocity, wavelength, and the relationships between them.
- understand the concepts superposition, standing waves, interference and diffraction.
- be familiar with the fundamental features of the structure of the atom and how atoms can interact with light.
- know that nothing can travel faster than light according to the special relativity theory as well as what is meant by time dilation and length contraction.
- be familiar with the equivalence between mass and energy.
- know how the atomic nucleus is built-up of protons and neutrons and understand the principles of radioactive decay.

Skills and abilities

- be able to analyse the units of a physical expression and be able to check that the units are consistent in a physical equation.
- be able to add force vectors on a plane.
- be able to describe Newton's three basic laws of mechanics.
- be able to make a free-body diagram of an object and determine the resulting force on this.
- be able to calculate the torque on an object at torsion around a fixed axle.
- be able to use Archimedes principle to determine the bouyancy force on an object in a liquid or gas.
- be able to make calculations on projectile motion in the absence of air resistance.
- be able to make calculations on circular motion with constant speed.
- be able to make calculations on the amount of heat that is needed for heating as well as for phase transitions of different substances.
- be able to use Coulomb's law to calculate forces between charges.
- be able to analyse simple electric circuits by means of Ohm's law and Kirchhoff's laws.
- be able to calculate the forces on a charge that moves in a combination of an electric and magnetic field.
- be able to make calculations of the induced electromotive voltage in simple cases.
- be able to construct and calculate ray tracing in image formation with mirrors and lenses.
- be able to make calculations on interference phenomena and grating diffraction.
- be able to calculate resonance frequencies for oscillating systems.
- be able to make calculations on black-body radiation and the photoelectric effect.
- be able to make calculations on atomic emission and absorption of light.
- be able to analyse and make simple calculations on nuclear reactions.

Judgement and approach

- have understanding that experiments play a central role and that knowledge is built up in an
  interplay between observations, models and theories.
- be able to assess if the result of a calculation is reasonable.

Course content

Course intends to give the knowledge in Physics that is required for admission to higher educations in science. The course is divided into three equally large sub-courses and also

includes laboratory sessions.

Sub-courses

1. **Mechanics** *(Mekanik),* 4.5 higher education credits
   Grading scale: Pass with Distinction (VG), Pass (G) and Fail (U)

   Physical quantities, units, unit verification.
   Force vectors in two dimensions, force equilibrium.
   Torques and torque equilibrium around a given axis of rotation.
   Density and pressure, Archimedes principle.
   Newton's laws. Motion with constant acceleration.
   Energy and work, efficiency. Internal energy, heat and temperature.
   Linear momentum and impulse. Linear collisions.
   Projectile motion, circular motion and introduction to harmonic oscillatory motion.

2. **Electricity** *(Ellära),* 4.5 higher education credits
   Grading scale: Pass with Distinction (VG), Pass (G) and Fail (U)

   Electric charge and force, Coulomb's law.
   Electric field strength, energy, potential, voltage and current.
   Electric circuits, Ohm's law, resistance, series and parallel circuits, Kirchhoff's laws.
   Specific thermal capacity, melting and solidification, evaporation and condensation.
   Magnetic fields. Magnetic force on charges in motion and on current-carrying wires.
   Electromagnetic induction.

3. **Waves and modern physics** *(Vågrörelselära och modern fysik),* 4.5 higher education credits
   Grading scale: Pass with Distinction (VG), Pass (G) and Fail (U)

   Geometric optics.
   Simple harmonic motion. Mechanical waves. Sound waves.
   Light. Electromagnetic waves, wave and particle properties.
   Matter waves, atoms and energy levels.
   Relativity. Atomic nucleus and radioactivity.

4. **Laboratory class** *(Laborationer),* 1.5 higher education credits
   Grading scale: Pass (G) and Fail (U)

Form of teaching

Language of instruction: Swedish

Assessment

A written exam is given at the end of each sub-course 1, 2 and 3. The laboratory sessions are examined through attendance and active participation. For students did not pass the regular exam, additional exams are offered.

Grades

The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).
For final grade Pass (G) on the whole course, at least pass is required in all sub-courses. For final grade Pass with distinction (VG) is required furthermore that the total score from the sub-courses 1, 2 and 3 amounts to at least sum of the score limit for Pass with distinction on respective sub-course.

Course evaluation

Course evaluation is made through a questionnaire after each sub-course 1, 2 and 3 and through discussions with student representatives.

Additional information

This course syllabus of NBAF00 replaces the course NBAF20. The course syllabus of NBAF20 was established originally 18/10/2006 and replaced then the course NBAF10.