UNIVERSITY OF GOTHENBURG

DEPARTMENT OF PHYSICS

FYP300 Statistical Physics, 7.5 credits

Statistisk fysik, 7,5 högskolepoäng

First Cycle

Confirmation

This course syllabus was confirmed by Department of Physics on 2017-08-08 and was last revised on 2020-03-02 to be valid from 2020-03-02, spring semester of 2020.

Field of education: Science 100%
Department: Department of Physics

Position in the educational system

The course is included in the Physics, Bachelor of Science Programme and is also given as a freestanding course.

Advanced course in the main subject physics.

The course can be part of the following programme: 1) Bachelor of Science in Physics (N1FYS)

Main field of studies	*Specialization*
Physics	G2F, First cycle, has at least 60 credits in first-cycle course/s as entry requirements

Entry requirements

For admission to the course, completed courses from the first four semesters of the Physics program are required, or that the equivalent knowledge has been acquired in a different way.

Learning outcomes

After having gone through the course Statistical physics the student is expected to be able to:

Knowledge and understanding

- describe the energy concept in thermodynamics as well as distinguish between the concepts energy, heat and work
- account for the entropy concept based on a microscopic description
- explain the relationship between the microscopic description of statistical mechanics and phenomenological thermodynamics
- describe the first and second law of thermodynamics for closed and open systems
- explain the concept of free energy and its applications
- describe the fundamental concepts of phase equilibrium in one- and two-component systems
- understand the meaning and differences of quasi-static and irreversible processes
- describe the basic distribution functions in statistical mechanics
- describe the concept of black-body radiation
- describe quantum statistics and explain how it compares to classical statistics
- understand theoretical models used to describe thermodynamic properties of matter

Competence and skills

- carry out calculations for different thermodynamic processes
- apply quantum statistics to ideal quantum gases
- calculate entropy and other thermodynamic quantities based on a microscopic description of simple model systems
- apply the free energy concept in connection with thermodynamic equilibrium and available work
- use basic distribution functions in a broad spectrum of application areas
- apply the laws of thermodynamics for closed and open systems
- set up equations describing radiation balance
- apply free energies in conjunction with thermal equilibrium and available work
- apply thermodynamic models for matter in basic physics problems

Judgement and approach

- adopt a critical way of thinking regarding statements and applications related to energy, work and energy supply
- use the principles of thermodynamics to assimilate technological and scientific advances within the field

Course content

Fundamental thermodynamical concepts such as thermodynamic equilibrium, reversible and irreversible processes, state functions, as well as heat and work. Statistical descriptions of many-particle systems and the concepts multiplicity and entropy. The fundamental laws of thermodynamics. Applications of thermodynamics to heat engines, refrigerators and heat pumps. Thermodynamic potentials, free energies and chemical potential. Phase equilibrium in one- and two-component system. Microcanonical, canonical and grand canonical distributions. The equipartition theorem. Maxwell's velocity distribution. Applications to classical ideal gases, lattice vibrations, paramagnetism and adsorption problems. Fermi-Dirac and Bose-Einstein distributions for ideal quantum gases as well as the concept of density of states. Applications to electrons in metals and semiconductors, stellar stability and Bose-Einstein condensation. Planck´s distribution law, black-body radiation and radiation balance applied to the earth atmosphere.

Form of teaching

Lectures, tutorials and one laboratory session.

Language of instruction: Swedish

Assessment

The course ends with a written examination with assignments of mainly problem solving character. In addition to passing the written exam, active participation in the laboratory sessions is required. Active participation is assessed on an individual basis by the responsible teacher present during the laboratory session.

Grades

The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U). Grading is based on the performance on the written exam.

Course evaluation

A course evaluation should be arranged after the course has ended where all participating students are given the possibility to provide anonymous feedback via a course survey. The course responsible should, together with student representatives, discuss and assess the completed survey. Meeting notes should afterwards be made available via the university learning platform.