



DEPARTMENT OF PHYSICS

FYM325 Fundamentals of hard and soft materials, 7.5 credits

Hårda och mjuka material, 7,5 högskolepoäng

Second Cycle

Confirmation

This course syllabus was confirmed by Department of Physics on 2019-11-04 and was last revised on 2023-05-08 to be valid from 2024-01-15, spring semester of 2024.

Field of education: Science 100%

Department: Department of Physics

Position in the educational system

The course is elective within the master program in physics.

The course can be part of the following programmes: 1) Complex Adaptive Systems, Master's Programme (N2CAS) and 2) Physics, Master's Programme (N2PHY)

Main field of studies

Physics

Specialization

A1N, Second cycle, has only first-cycle course/s as entry requirements

Entry requirements

A Bachelor's degree in physics or equivalent, including thermodynamics and solid state physics or solid state chemistry.

Applicants must prove their knowledge of English: English 6/English B from Swedish Upper Secondary School or the equivalent level of an internationally recognized test, for example TOEFL, IELTS.

Learning outcomes

The broad field of materials science is looked at from a physics perspective. Properties of the materials are governed by atomic arrangements up to the macroscopic structures. The course is expanding from ideal crystals and simple liquids to real materials, such as

metallic alloys, ceramics, polymers, colloidal systems and biological materials.

The aim of this course is to provide a foundation for understanding and utilization of properties and behavior of soft and hard materials. The course provides core competence for students aiming at either a career in academia or in R&D-industry. It is also the foundation for the entire material physics track.

On successful completion of the course the student will be able to:

- Use thermodynamics to explain phase stability and phase diagrams.
- Use binary phase diagrams to determine the equilibrium phases and their compositions.
- Analyze the behavior and phenomena in materials based on energy and entropy arguments
- Explain the mechanisms of diffusion and use diffusion equations for calculations.
- Understand and explain crystal defects (point defects, dislocations, grain boundaries) and segregation
- Explain mechanical properties of hard and soft materials and interpret results from mechanical tests and rheology experiments
- Understand scattering techniques and their applicability
- Identify the relevant time-, length- and energy-scales in different material systems
- Apply the fundamental concepts to real materials
- Read and understand advanced literature, e.g. review articles

Course content

- Concepts, classifications and applications of soft and hard materials
- Thermodynamics of hard and soft materials
- Multi-component and supramolecular systems: Metallic alloys, ceramics, polymers, colloidal systems, biological materials
- Phase diagrams and phase transitions/transformations
- Dynamics and kinetics
- Defects and microstructure
- Intermolecular forces and molecular order in soft matter (e.g. semi-crystallinity, liquid-crystals, self-assembly, glasses)
- Mechanical properties (elastic and plastic) & rheology (viscous, viscoelastic)
- Scattering and diffraction techniques (light, X-rays, neutrons)

Form of teaching

The course is based on a series of lectures. There will be two lab-exercises covering experimental tools and a project work applying fundamental concepts to a specific material system.

Language of instruction: English

Assessment

There is a written examination at the end of the course. The course has two mandatory lab-exercises and a project work.

If a student, who has failed the same examined element on two occasions, wishes to change examiner before the next examination session, such a request is to be submitted to the department in writing and granted unless there are special reasons to the contrary (Chapter 6, Section 22 of Higher Education Ordinance).

In the event that a course has ceased or undergone major changes, students are to be guaranteed at least three examination sessions (including the ordinary examination session) over a period of at least one year, though at most two years after the course has ceased/been changed. The same applies to work experience and VFU, although this is restricted to just one additional examination session.

Grades

The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).

Course evaluation

The results of and possible changes to the course will be shared with students who participated in the evaluation and students who are starting the course.