# Physical Metallurgy

Programme course

6 credits

Materialvetenskap

TFYA21

Valid from: 2017 Spring semester

**Determined by**
Board of Studies for Electrical Engineering, Physics and Mathematics

**Date determined**
2017-01-25

**Offered for the last time**
Spring semester 2024

**Replaced by**
TFYB11

## Main field of study
Applied Physics, Physics

## Course level
Second cycle

## Advancement level
A1F

## Course offered for
- 
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Physics and Nanoscience, Master's programme
- Materials Science and Nanotechnology, Master's programme
- Applied Physics and Electrical Engineering - International, M Sc in Engineering

## Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

## Prerequisites
Thermodynamics and Statistical Mechanics, Physics of Condensed Matter

## Intended learning outcomes
This course gives the essence of materials science and advanced surface engineering as well as the thermodynamic conditions for nanotechnology. The aim is to give an understanding and control of the structure of matter at the ultramolecular level and the relation of this structure to properties (mechanical, electrical, etc.). This includes phase transformations based on a thermodynamical description of the liquid and solid state. We study the more complex features of the behaviour of functional materials and materials in extreme states. Focus is on aspects controlled by atomic diffusion and crystal defects. The course is tangential to physical metallurgy, crystallography, and semiconductor technology, as well as continuum and atomistic mechanics of solids. A goal is also to learn about the design and processing of electronic device materials and construction materials engineering.

## Course content

This is a fundamental course in materials science following an international tradition. It concerns different classes of functional materials including metals, alloys, semiconductors, ceramics. It further deals with the thermodynamics of binary systems,; Phase diagrams; Equilibrium in solid solutions; Metastable states; Phase transformations; Precipitation; Kinetics for grain growth; Crystalline phases; Polytypism; Defects in crystals incl. vacancies, interstitials and dislocations; Solutions and alloys. Atomic processes: diffusion; Multiphase materials; Microstructure; Nanostructure; Relationships between theory, materials synthesis and processing, structure/bonding, and properties; Elasticity; Plasticity and Fracture; Materials Design and Processing

LABORATION 1: Metallography (identify phases and grains with the electron microscope)
LABORATION 2: Fractography (CSI-Linköping for a day)
LABORATION 3: Calorimetry (applied thermodynamics to create phase diagrams)

## Teaching and working methods

Lectures and laborations

## Examination

| | | | |
|---|---|---|---|
| LAB1 | Laboratory work | 1.5 credits | U, G |
| TEN1 | Written examination | 4.5 credits | U, 3, 4, 5 |

The exam consists of 9 topical questions chosen from some 90 questions, which will be distributed and discussed already during the course. A well prepared and active participation in the laboratory work sessions is mandatory. A number of optional home problem can be solved to give extra points to the exam.

## Grades

Four-grade scale, LiU, U, 3, 4, 5

## Other information

Supplementary courses: Thin Film Physics, Analytical Methods in Materials Science, Nano Physics

## Department

Institutionen för fysik, kemi och biologi

## Director of Studies or equivalent

Magnus Johansson

## Examiner

Per Eklund

## Course website and other links

http://www.ifm.liu.se/undergrad/fysikgtu/coursepage.html?selection=all&sort=kk

## Education components

Preliminary scheduled hours: 42 h
Recommended self-study hours: 118 h

## Course literature

D.A. Porter and K.E. Easterling: Phase transformations in Metals and Alloys (Van Nostrand Reinhold, London). Lab-PM, IFM

# Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.