Fundamentals in Materials Science

Programme course

6 credits

Grunder i materialvetenskap

TFYA77

Valid from: 2017 Spring semester

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

Date determined
2017-01-25

Main field of study

Applied Physics, Physics

Course level

Second cycle

Advancement level

A1X

Course offered for

- Physics and Nanoscience, Master's Programme
- Materials Science and Nanotechnology, Master's Programme
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Mechanical Engineering, 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

Calculus in one and several variables, linear algebra, and mechanics.

Intended learning outcomes

Materials science is a fusion of multidisciplinary knowledge since 1980s, and covers a wide range of scientific and engineering aspects. The primary goal of this introductory course is to provide students a physics and chemistry foundation of the quantum theory, thermodynamics and kinetics, in order to facilitate further studies and understand the inter-relationship among preparation techniques, structures, and properties of various materials, in particular crystalline solids and semiconductors in bulk, thin film, and nano-scale form. Following the course, the students are expected to:

- get insight of matters from individual atom, interatomic bonding, to crystalline periodic structure, with a quantum mechanic description.
- understand how the structure dictates the property of various materials at both microscopic and macroscopic levels.
- to explain mass action and phase transformation processes of solid materials based on both thermodynamic and kinetic considerations.
- learn physics and chemistry behind some commonly used methods for materials synthesis and growth, and how the preparation technique affects the structures and properties of the material.
- be able to design a process to prepare (synthesize or grow) the desired material, and calculate the synthesis (growth) rate using kinetic equations of the corresponding chemical reaction.

Course content

Quantum theory and atomic structures: Light, particles and waves, the Bohr atom, the Schrödinger equation and basic quantum mechanics, electronic configurations of an atom …
Chemical bonding and molecular structures: Molecules, properties of bonded atoms, models of chemical bonding, molecular-orbitals and -geometry …
Solid-state chemistry: Properties of bonded atoms, states of matter, phase diagram, crystalline solids and structural symmetry, fundamental properties of various matter …
Thermodynamics and kinetics in materials science: Chemical energies and the 1st law of thermodynamics, chemical equilibrium and the 2nd law of thermodynamics, chemical kinetics and reaction mechanisms …

Teaching and working methods

Lectures, problem solving classes, and laboratory experiments in small groups.

Examination

TEN1	Optional written examination for higher grade	U, 3, 4, 5	0 credits
UPG1	Hand-in assignments	U, G	5 credits
LAB1	Laboratory work	U, G	1 credits

Homework assignment (6 sets) for grade 3 (if more than 70% approved). Optional written examination for higher grades.

Grades

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

Department

Institutionen för fysik, kemi och biologi

Director of Studies or equivalent

Magnus Johansson

Examiner

Wei-Xin Ni

Education components

Preliminary scheduled hours: 0 h
Recommended self-study hours: 160 h

Course literature

Additional literature

Books

W. D. Callister & D. G. Rethwisch, (2010) *Materials Science and Engineering: An Introduction*
ISBN: 0470419970
John Wiley & Son Inc

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.