KF2380 Material Physics 7.5 credits

Material Physics

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for KF2380 valid from Spring 2009

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Specific prerequisites

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After the course the students should be able to: (i) describe the different physical (structural) states of polymers (crystalline, liquid-like, glassy and rubbery states); (ii) describe the relationship between chemical structure, molecular architecture and physical state of polymers; (iii) describe the conformational states of simple polymers and mastering calculation of conformational states of polymers as a function of temperature and goodness of solvent; (iv) describe the principals for obtaining the conformational states of polymers in crystals; (v) describing and evaluating (in molecular terms) the elasticity of rubbery polymers; (vi) describe also in quantitative terms basic thermodynamic concepts for polymer solutions: bimodal concentrations, spinodal phase separation and interaction parameter; (vii) describe, understand shortcomings and apply Flory-Huggins mean-field theory for polymer solutions; (viii) use the solubility parameter concept in the calculation of solubility of polymers in low molar mass solvents. (ix) understand, derive and apply simple electron transport theory in metals, i.e. Drude theory and Hall effect, (x) understand and use results from combination of Maxwells' and Ohms' laws leading to e.g. skin effect and plasma- and cyclotron- frequency, (xi) understand and calculate simplified electrical effects in insulators, be able to classify materials with respect to polarization mechanism in materials, understand electron resonance and frequency dependence, (xii) elementary magnetism, understand and calculate simple quantities like saturation magnetization, coercivity, understand and apply simple domain theory, origin of magnetic anisotropy.

Course contents

This basic course in the physical sciences of materials covers polymers (focus area in this course), metals and ceramics. The polymer division explains the structure of the polymer molecules (conformation) on the basis of the atomistic and repeating unit structure. The conformational structure is then the basis of the stress-strain behaviour of rubbery materials and the performance of polymer solutions. The metal-ceramic part is focused on: electrical transport in metals like e.g. the Drude model, which, despite its obvious shortcomings, is a simple illustration of the development of an atomistic theory in materials science, hi frequency effects in conductors, electrical effects in insulators (despite the fact it is not a conductor), and an introduction to magnetic materials including some elementary calculations.

Disposition

Labwork

The following three practical exercises are included:

1. Building polymer molecules and studying their conformations using computers.
2. Polymer solutions (polystyrene in cyclohexane)
3. Magnetic measurements

Course literature

‘Polymer physics’, 2nd edition, Ulf W. Gedde and Mikael S. Hedenqvist (to appear, Springer Verlag); pdf’s of chapters for 2008.

‘Electronic properties of engineering materials’, James D. Livingston, Wiley, ISBN 0-471-31627-X, Kårbokhandels, 585 SEK. Ch1-ch5

Examination

- LAB1 - Laboratory Work, 1.5 credits, grading scale: P, F
- TEN1 - Examination, 4.0 credits, grading scale: A, B, C, D, E, FX, F
- ÖVN1 - Exercises, 2.0 credits, grading scale: P, F

Based on recommendation from KTH’s coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

ECTS-grades based on results from examination and from the laboratory course.

Other requirements for final grade

Eexamination (TEN1) 4.0 credits
Excersise (ÖVN1) 2.0 credits
Laboratory course (LAB1) 1.5 credits

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.