LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Termodynamik och ytkemi
Thermodynamics and Surface Chemistry

KFKA10, 8 credits, G1 (First Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED B/K
Date of Decision: 2023-04-18

General Information

Main field: Technology.
Compulsory for: W2
Language of instruction: The course will be given in Swedish

Aim

The course aims at providing a solid thermodynamic basis for further studies in chemistry and energy technology by:

- deepening the understanding of the first and second laws of thermodynamics
- clarifying the central concepts and quantities in classical thermodynamics so that they can be correctly applied in various areas
- show how thermodynamics can be used to understand and explain chemical phenomena, both in bulk systems and at surfaces.
- to practice problem solving skills within these areas.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- understand central concepts and quantities in thermodynamics, such as equilibrium, vapor pressure, entropy, entalpy and free energy
- understand basic concepts in surface chemistry, such as surface tension and adsorption.
- know the basic properties of the types of systems presented in the course, such as gases, liquid mixtures and surfactant solutions

Competences and skills

For a passing grade the student must

- be able to perform calculations and qulitative predictions using the models and equations presented in the course.
- be able to analyze a practical problem, make reasonable assumptions, decompose the problem and choose the correct models to solve the problem.
- be able to peform numerical operations, for example integration, equation solving and linear regression, using a pocket calculator and using a computer
- be able to peform chemical laboration in a safe and accurate manner.
- be able to write laborative reports according to given instructions with a correct presentation of data and error estimates.

Judgement and approach
For a passing grade the student must

- be able to to judge the validity of the models presented in the course.
- be able to judge the plausibility of the results found in problem solving.
- be able to discuss advantages and disadvantages of technical applications that rely on thermodynamic and surface chemical principles.

Contents

The course consist of two main parts:

1. Thermodynamics

Basic concepts such as work, heat, entropy, enthalpy, Gibbs energy and chemical potential. Reversible, irreversible, isothermal and adiabatic processes.

Equations of states for fases. Corresponding states. Thermal expansion and compressibility. Quantitative treatment of phase equilibria in one component systems. Clapeyron and Clausius-Clapeyron equations.
The thermodynamics of mixtures. Ideal solutions. Raoult's law. Distillation. Ideal dilute solutions. Henry's law. Colligative properties. Phase diagrams for two component systems. The concept of activity.
Thermodynamic treatment of chemical equilibrium for gases and solutions. Heterogenous chemical equilibria. Pressure- and temperature-dependence of chemical equilibrium.

2. Surface chemistry

Interfaces and surface tension. Wetting. Capillary force. Curved surfaces: Laplace's and Kelvin's equations. Surface active sustances. Gibb's equation. Micelles and critical micelle concentration. Solubilization. Surface films. Foams and aeorosols. Emulsions. DLVO theory. Colloids and their stability.

The lab exercises include work with evacuated systems, distillation equipment, barometer, thermometer, hygrometer, refractometer, etc.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written exam and laboratory exercises. Final grade is based on the written

examination. The examination is constructed so that good understanding and basic problem solving skills on all parts of the course are required for the passing grade. For higher grades, problem solving skills on a more complex level are required. Bonus points to the written exam may be awarded for performed tasks. The bonus points are then valid only for the ordinary exam and the following two re-exams. Students who are awarded bonus points for performed tasks cannot be awarded bonus points for the same tasks once again when re-registered.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts
Code: 0118. **Name:** Written Examination.
Credits: 6,5. **Grading scale:** TH. **Assessment:** Written exam
Code: 0218. **Name:** Laboratory Exercises and Home Assignments.
Credits: 1,5. **Grading scale:** UG. **Assessment:** For passing grade, every task is performed and presented according to the instructions, which may mean either as a written report or orally, in Swedish or English. For passing grade, the written reports should be simple but correct and to the point, have a proper structure and contain a relevant discussion of the results.

Admission

Assumed prior knowledge: FMAA05 Calculus in One Variable, FMAB30/FMA430 Calculus in Several Variables, KASA01 Fundamental Chemistry, FAFA70 Energy and Environmental Physics
The number of participants is limited to: No
The course overlaps following course/s: KFK060, KFK080, KFKA01

Reading list

- Atkins, P., Jones, L. och Laverman, L.: Chemical Principles, The quest for insight, Seventh edition. W. H. Freeman, New York, 2016, ISBN: 978-1-4641-8395-9.
- Robert G. Mortimer: Physical chemistry (2nd edition). Elsevier, 2000, ISBN: 978-0-12-508345-4.
- Complementary material, including supplementary texts, problems and laboratory instructions, produced at the Department.

Contact and other information

Course coordinator: Pär Söderhjelm, Par.Soderhjelm@bpc.lu.se
Course homepage: https://www.cmps.lu.se/education/
Further information: Some teaching might be held in English.