

Thermodynamics and Statistical Mechanics

Programme course

6 credits

Termodynamik och statistisk mekanik

TFYA12

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

Autumn semester 2025

Replaced by

TFYB14

Main field of study

Applied Physics, Physics

Course level

First cycle

Advancement level

G2F

Course offered for

- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Physics, Bachelor's Programme

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

Intended learning outcomes

The general aim of the statistical mechanics part of the course is that the student equipped with a quantum mechanical description of physical systems on a microscopic level and guided by the principle of entropy maximization - can derive equilibrium features of macroscopic systems that apply to thermodynamics, medicine, metallurgy, chemistry and semiconductor physics. This means that the student should be able to:

- construct idealized models for microscopic systems and calculate equilibrium features under different circumstance, i.e. given temperature, chemical potential or energy
- give an account of the reasoning and/or derivations in statistical mechanics and describe the connection between the basic concepts of the theory
- use the statistical mechanics results for problem solving in thermodynamics, medicine, metallurgy, chemistry and semiconductor physics.

Course content

The statistical definitions of entropy, temperature, pressure and chemical potential constitutes the starting point. Other concepts that are presented is: multiplicity, ensemble average, specific heat, Boltzmann factor, partition function, thermodynamic identity, Helmholtz free energy, classical ideal gas, quantum concentration, Sackur-Tetrodes equation, Planck radiation law, Stefan-Boltzmanns law, emissivity, photon gas, greenhouse effect, heat shields, internal and external chemical potential, Gibbs factor, Gibbs sum (grand partition function), absolute activity, Langmuir adsorption isotherm, orbital, Pauli exclusion principle, Fermi-Dirac distribution, Bose-Einstein distribution, internal partition function, reversibility, free electron model, density of states, chemical potential as a normalizing constant, heat, work, heat engine, refrigerator, heat pump, Carnot process, adiabatic process, isothermal process, Gibbs free energy, law of mass action, phase transformation, Clausius-Clapeyron equation, van der Waals equation.

Teaching and working methods

The course is presented in lectures and problem solving lessons.

Examination

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|------|---------------------|-----------|------------|
| TEN1 | Written examination | 6 credits | U, 3, 4, 5 |
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Grades

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

Department

Institutionen för fysik, kemi och biologi

Director of Studies or equivalent

Magnus Johansson

Examiner

Peter Münger

Course website and other links

Education components

Preliminary scheduled hours: 52 h

Recommended self-study hours: 108 h

Course literature

Additional literature

Books

David Goodstein, (2015) *Thermal physics Energy and Entropy 1* Cambridge University Press
ISBN: 978-1-107-46549-7

Compendia

E. Peter Münger, Läs- och räkneråd för kursen termodynamik och statistisk mekanik

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://stydokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.