Thermodynamics and Statistical Mechanics (iMOS)

Module	Credits	Workload	Term	Frequency	Duration
2 EC	5 CP	150 h	1. Sem.	Each WiS	1 Semester
Courses			**Contact hours**	**Self-Study**	**Group size**
a) Lectures b) Exercises			a) 2 SWS b) 1 SWS	105 h	30 Students

Prerequisites

Admission to M.Sc. iMOS

Learning outcomes

Students remember the basic laws of thermodynamics, thermodynamic potentials and concepts such as phase coexistence, phase transitions and phase diagrams. They combine this knowledge with the variation principle to construct simple models of the temporal and spatial evolution of thermodynamic properties of solids, e.g., alloys and magnetic materials. Moreover, the students apply fundamental concepts of statistical mechanics to put such basic models on a microscopic footing. They discuss approximations involved in these models and systematically propose improvements for the individual steps.

Content

- Basic principles of thermodynamics, phase coexistence, Gibbs phase rule and phase diagrams
- Equation of state of ideal gases and extension towards the van-der-Waals theory
- Landau theory and vibrational principle (Ginzburg-Landau)
- Statistical theory of ideal gases, lattice gases and the regular solution theory for themodynamic properties of gases and solid alloys.
- Statistical mechanics of stress tensor: The Virial formula
- Statistics of quantum harmonic oscillator and specific heat of solids
- Spin statistics: Para and ferromagnetism, mean field approximation for ferro-magnetism

Teaching methods

Lecture and group work in exercises.

Mode of assessment

Written examination (1.5 hours), bonus points can be gained by providing solutions to the problem sheet in class.

Requirement for the award of credit points

Passing the examination

Module applicability

M.Sc. iMOS

Weight of the mark for the final score

According to CP

Module coordinator and lecturer(s)

Prof. Dr. Fathollah Varnik
lecturer from the *Interdisciplinary Centre for Advanced Materials Simulation (ICAMS)*

Further information

These course components are also in the RUB M.Sc. Module Handbook Material Science and Simulation as Required Course Module 2.

Literature: McQuarrie: Statistical Mechanics, C. Garrod: Statistical mechanics and thermodynamics, D.R. Gaskell; Introduction to the thermodynamics of materials, D.A. Porter & K.E. Easterling; Phase transformation in metals and alloys.