JÖNKÖPING UNIVERSITY
School of Engineering

COURSE SYLLABUS

Thermodynamics and Physical Metallurgy, 7.5 credits

Termodynamik och fysikalisk metallurgi, 7.5 högskolepoäng

Course Code:	T2TOFM	Education Cycle:	Second-cycle level
Confirmed:	Sep 01, 2025	Disciplinary domain:	Technology
Valid From:	Aug 31, 2026	Subject group:	Materials Technology
		Specialised in:	A1N Second cycle, has only first-cycle course/s as entry requirements
		Main field of study:	Product Development

Intended Learning Outcomes (ILO)

On completion of the course the student shall:

Knowledge and understanding

- show a basic understanding of fundamental concepts of chemical and computational thermodynamics and their applications in industrial processes
- identify conditions under which pollutants like CO2 are generated, as well as the chemical reactions and interfacial phenomena that can be utilized to develop environmentally friendly processes
- demonstrate comprehension of the mechanisms of diffusion and the role of crystal interfaces in metallic materials processing, with a focus on casting processes
- explain the principles of solid-state phase transformations, especially ones used in heat treatments and other post-processing methods

Skills and abilities

- demonstrate skills of chemical thermodynamic calculation by commercially available software and evaluate the calculation results
- demonstrate the ability to explain the interfacial phenomena in the materials processes, which involve liquid, solid, and gas phases, from thermodynamic viewpoints

Judgement and approach

- demonstrate the ability to apply the thermodynamic approaches to materials processes
- demonstrate the ability to explain the phenomena in manufacturing processes with the knowledge of chemical thermodynamics
- assess the suitability of a processing method based on the phase transformations involved in the process

Content

The course comprises two main topics, chemical thermodynamics and physical metallurgy. In the first part, the course deals with basic theoretical understanding in chemical thermodynamics, application of chemical thermodynamics, and interfacial physical chemistry. In the second part, the course deals with the implementation of thermodynamics in the context of physical metallurgy, with a focus on diffusion and phase transformations.

Specifically, the course includes:

- Fundamentals of chemical thermodynamics and thermodynamics of interface, and their application in industrial processes

- Chemical thermodynamic calculations for phase equilibria, including evaluation of thermophysical properties.
- Fundamentals of diffusion, crystal interfaces, and phase transformations in materials
- Quantitative methods to predict diffusion phenomena.
- Case study investigations on the application of the discussed topics to industrial problems

Type of instruction

Lectures, laboratory sessions, case study investigations, and exercises.

Language of instruction is English.

Entry requirements

The applicant must hold the minimum of a bachelor's degree (i.e the equivalent of 180 ECTS credits at an accredited university) with at least 90 credits in Materials and Manufacturing, Materials Engineering, Mechanical Engineering, Chemical Engineering, Product Development or Engineering Physics or equivalent. The bachelor's degree should comprise a minimum of 15 credits in Mathematics. Proof of English proficiency is required.

Examination and grades

The course is graded 5, 4, 3 or U.

Registration of examination:

Name of the Test	Value	Grading
Assignment	2 credits	G/U
Laboratory	1.5 credits	G/U
Examination	4 credits	5/4/3/U

Course literature

Please note that changes may be made to the reading list up until eight weeks before the start of the course.

T. Matsushita and K. Mukai, Chemical Thermodynamics in Materials Science – From Basics to Practical Applications –, Springer, 2018.

Porter and Easterling, Phase transformations in metals and alloys, Fourth Edition, CRC Press, 2021