JÖNKÖPING UNIVERSITY
School of Engineering

COURSE SYLLABUS

Computational Fluid Dynamics for Manufacturing Processes, 7.5 credits

Beräkningsströmningsdynamik för tillverkningsprocesser, 7.5 högskolepoäng

Course Code:	T2BFTQ	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 familiarity with general Navier-Stokes equations and solution methods employed in computational fluid dynamics, including heat transfer phenomena
- demonstrate comprehension of heat transfer mechanisms and fluid flow regimes and types in the scope of components, materials and manufacturing processes studied in the course, and the insight into current research and development in the area
- display knowledge of how computational fluid dynamics (CFD) simulations address technical requirements to a product/component, being a part of component and manufacturing process design

Skills and abilities

- show familiarity with general Navier-Stokes equations and solution methods employed in computational fluid dynamics, including heat transfer phenomena
- demonstrate comprehension of heat transfer mechanisms and fluid flow regimes and types in the scope of components, materials and manufacturing processes studied in the course, and the insight into current research and development in the area
- display knowledge of how computational fluid dynamics (CFD) simulations address technical requirements to a product/component, being a part of component and manufacturing process design

Judgement and approach

- demonstrate ability to independently suggest and critically evaluate solution methods and tools for a scope of engineering problems all involving heat transfer and fluid dynamics, as well as motivate the choice of materials and manufacturing process parameters, based on simulation results and analytic estimations
- demonstrate understanding of trade-off nature of the multidisciplinary engineering problems involving fluid dynamics and heat transfer, accounting for the reliable component performance, manufacturing process, human needs and various sustainability aspects

Content

The course treats fundamentals of CFD and heat transfer, and methodologies for solving a broad range of multi-disciplinary engineering problems in the context of manufacturing process design, via application of CFD and thermal simulation tools in design analysis. The effects of different fluid flow regimes and thermo-physical properties of materials are studied. The course includes simulation laboratory sessions formed as case studies (e.g. COMSOL Multiphysics, Flotherm, MAGMASOFT) and laboratory measurements serving e.g. for the purposes of CFD model calibration/input parameter generation.

The course includes the following elements:

- Steady state and transient heat transfer, heat transfer modes and thermal resistance network applications.
- Overview of Navier-Stokes equations, and numerical solution methods.
- CFD model validation and virtual prototyping methodology.
- Flow and heat transfer simulation of mold filling and solidification in gravity casting.
- Fluid flow in porous media, including local thermal non-equilibrium conditions, and application to component casting.
- Simulation models for heat treatment process design (e.g. annealing) of metallic components.
- Simplified phase transformation models and their application to manufacturing process simulation, e.g. laser cladding.
- Application of fluid flow and heat transfer models for polymer component manufacturing.

Type of instruction

Lectures, exercises and laboratory sessions.

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.

For grade 3 it is required to get passed on both the written assignments and the labs. For a grade higher than 3, it is required additionally to pass a written examination.

Registration of examination:

Name of the Test	Value	Grading
Examination	3.5 credits	5/4/3/U
Laboratory	2.5 credits	G/U
Assignment	1.5 credits	G/U

Course literature

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

Course compendium is distributed during the course as well as references to relevant research publications.