JÖNKÖPING UNIVERSITY
School of Engineering

COURSE SYLLABUS

Applications of Computational Fluid Dynamics and Heat Transfer, 7.5 credits

Tillämpningar i beräkningsströmningsdynamik och värmeöverföring, 7.5 högskolepoäng

Course Code:	TTBS22	Education Cycle:	Second-cycle level
Confirmed:	Feb 01, 2025	Disciplinary domain:	Technology
Valid From:	Sep 01, 2025	Subject group:	Materials Technology
		Specialised in:	A1F Second cycle, has second-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 the product/component and contribute to the component reliability, being integrated into the component design process

Skills and abilities

- demonstrate ability to critically and independently formulate problems in the scope of studied engineering applications involving heat transfer and fluid dynamics as well as ability to contribute to knowledge creation
- demonstrate skills to produce written calculations with mathematical models of different physical phenomena involved in the scope of selected engineering applications
- demonstrate ability to create and solve static and dynamic models by applying commercial CFD simulation tools

Judgment 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, 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 and component 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 (e.g. COMSOL Multiphysics, Flotherm) and laboratory measurements serving e.g. for the purposes of model validation/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
- Fluid flow in porous media, including local thermal non-equilibrium conditions, and applications.
- Flow and heat transfer simulation in the context of the methods, materials, and components for thermal management of automotive and telecom assemblies
- Heat transfer models for heat treatment process design (e.g. annealing) of large metallic components
- Simplified phase transformation models and their application to manufacturing processes, e.g. laser cladding
- Applications of fluid flow and heat transfer models for polymer component manufacturing

Type of instruction

Lecture, exercises and laboratory sessions.

Language of instruction is in English.

Entry requirements

Passed courses of at least 210 credits in the program Industrial Product Realisation, or passed courses of at least 90 credits in Materials and Manufacturing, Materials Engineering, Mechanical Engineering, Chemical Engineering, Product Development, Engineering Physics or the equivalent. The bachelor's degree should comprise a minimum of 15 credits in Mathematics. Taken courses Polymer and Composite Technology, 7,5 credits, and Metallic Materials: From Phase Transformation to Characterization, 7,5 credits, or the equivalent. 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 both the written home 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 [1]	3.5 credits	5/4/3/U
Laboratory	2.5 credits	G/U
Assignment	1.5 credits	G/U

[1] Determines the final grade of the course, which is issued only when all course units have been passed.

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 distributed during the course