



## KURSPLAN

# Tillämpningar i beräkningsströmningsdynamik och värmeöverföring, 7,5 högskolepoäng

*Applications of Computational Fluid Dynamics and Heat Transfer, 7.5 credits*

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<b>Kurskod:</b>	TTBS22	<b>Utbildningsnivå:</b>	Avancerad nivå
<b>Fastställd av:</b>	VD 2022-03-01	<b>Utbildningsområde:</b>	Tekniska området
<b>Gäller fr.o.m.:</b>	2022-08-01	<b>Ämnesgrupp:</b>	MA2
<b>Version:</b>	1	<b>Fördjupning:</b>	A1F
		<b>Huvudområde:</b>	Produktutveckling

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### Lärandemål

After a successful course, the student shall:

#### Kunskap och förståelse

- 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 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.

#### Färdighet och förmåga

- 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 the ability to create, analyze and critically evaluate different engineering solutions as well as motivate the choice of materials, based on CFD simulation results and analytic estimations.
- demonstrate skills to produce written calculations with mathematical models of different physical phenomena involved in the scope of selected engineering applications.
- demonstrate ability to systematically integrate knowledge and create and solve static and dynamic models by applying commercial CFD simulation tools.

#### Värderingsförmåga och förhållningssätt

- demonstrate ability to independently and critically suggest solution methods and tools for a scope of engineering problems all involving heat transfer and fluid dynamics.
- demonstrate understanding of trade-off nature of the multidisciplinary engineering problems involving fluid dynamics and heat transfer, taking into account reliable component performance,

manufacturing process, human needs and various sustainability aspects.

### Innehåll

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, Flotherm) with experimental support, e.g. for 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.

### Undervisningsformer

Lecture, exercises and laboratory sessions.

Undervisningen bedrivs på engelska.

### Förkunskapskrav

Passed courses at least 90 credits within the major subject Mechanical Engineering, 15 credits Mathematics included multivariable calculus, Thermodynamics and completed course in Numerical Analysis, 7,5 credits and Polymer and Composite Technology, 7,5 credits, proof of English proficiency is required (or the equivalent).

### Examination och betyg

Kursen bedöms med betygen 5, 4, 3 eller Underkänd.

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 exam.

Poängregistrering av examinationen för kursen sker enligt följande system:

Examinationsmoment	Omfattning	Betyg
Skriftlig examination <sup>†</sup>	4 hp	5/4/3/U

Laborationer och inlämningsuppgifter	3,5 hp	U/G
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<sup>1</sup> Bestämmer kursens slutbetyg vilket utfärdas först när samtliga moment godkänts.

### **Kurslitteratur**

The literature list for the course will be provided eight weeks before the course starts.

Course compendium distributed during the course.