COURSE SYLLABUS

# Modelling and Simulation of Casting, 6 credits

*Modellering och simulering av gjutning, 6 högskolepoäng*

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| **Course Code:** | TMSS22 | **Education Cycle:** | Second-cycle level |
| **Confirmed by:** | Dean Mar 1, 2022 | **Disciplinary domain:** | Technology |
| **Revised by:** | Director of Education Jan 25, 2023 | **Subject group:** | MA2 |
| **Valid From:** | Aug 1, 2023 | **Specialised in:** | A1F |
| **Version:** | 2 | **Main field of study:** | Product Development |

## Intended Learning Outcomes (ILO)

After a successful course, the student shall:

Knowledge and understanding

• show familiarity with use of casting simulation in the development of new casting processes
• display knowledge of analytical and numerical methods used to calculate phenomena associated with casting.
• demonstrate comprehension of how material properties and boundary conditions affect the calculation results.

Skills and abilities

• demonstrate skills of using analytical formulas and numerical programing of heat transport and solidification phenomena in relation to casting of metallic materials.
• demonstrate the ability to use professional software to optimize mold filling and resulting cast material properties.

Judgement and approach

• demonstrate the ability to chose adequate calculation methods and models for various kinds of cast materials.
• demonstrate an understanding of validation methods to determine if calculation results reflect real phenomena associated with casting.

## Contents

The course covers trends in programing and simulation of solidification phenomena of cast metals. Examples from applications for process and materials development, solutions of technological problems using casting simulation. An analytical part treats the basic heat transport and solidification. A numerical part treats the heat equation by conduction using the Finite Different Method (FDM). Numerical solution of solidification via the Enthalpy method and associated heat transport is solved with the control volume based finite difference method FDM-CV. Numerical solutions based on 1D formulation are solved in MATLAB and compared with simulation in a commercial 3D simulation software.

The course includes:
• Fundamentals of heat flow and solidification
• Programming the heat flow and solidification
• Use of professional casting simulation software
• Validation of the casting simulation

## Type of instruction

Teaching consists of lectures mixed with calculation exercises, laboratory work with programming 1D program codes to calculate heat conduction and solidification, laboratory work with commercial 3D program to test optimization of casting and solidification of cast components.

The teaching is conducted in English.

## Prerequisites

Passed courses at least 90 credits within the major subject Mechanical Engineering, 15 credits Mathematics, and completed course in Component Casting, 6 credits, and Solidification Processing, 3 credits, and proof of English proficiency is required (or the equivalent).

## Examination and grades

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

The final grade for the course is based on a balanced set of assessments. The final grade will only be issued after satisfactory completion of all assessments.

Registration of examination:

| Name of the Test | Value | Grading |
|---|---|---|
| Examination | 3 credits | 5/4/3/U |
| Submission task | 3 credits | 5/4/3/U |

## Other information

Exemption from entry requirement allowed according to the selection groups of the program, where the course is included.

## Course literature

Literature

The literature list for the course will be provided eight weeks before the course starts. Compendium based on "Fundamentals of Numerical Modelling of Casting Processes" by Jesper Hattel. Formula and exercise collection from Attila Diószegi. User's manual for program codes: MATLAB, Magma Soft, NovaFlow & Solid, Flow 3D, ProCast or Fluent.