



Aalto University  
School of Engineering

# MEC-E7005

## Advanced casting technology, 5 cr

*Spring 2021*

# Course staff

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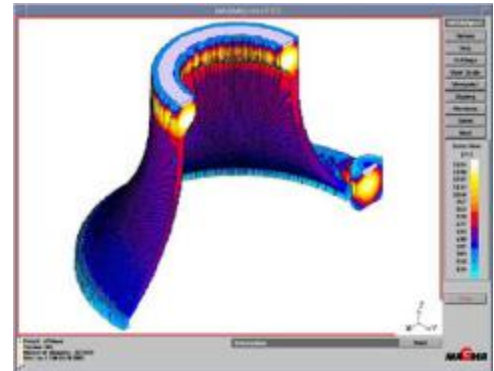
# Casting technology in AM2 group

Prof. Juhani Orkas

Casting technology in Aalto covers related production technology, component design and metallurgy.

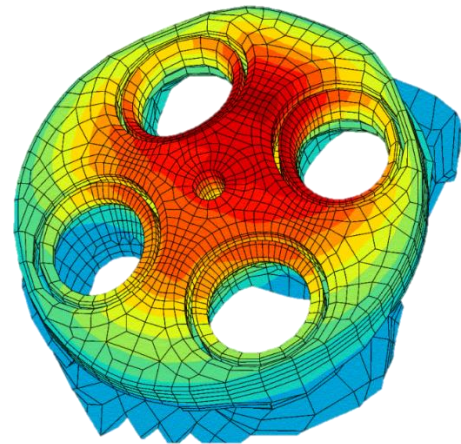
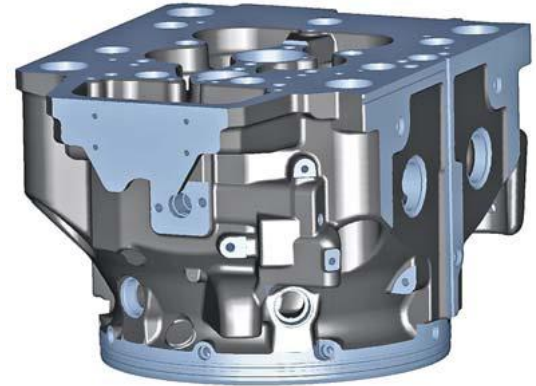
Research topics:

- New casting materials, particularly cast irons and aluminium alloys
- Circular economy
- Future foundry, smart foundry (Internet of Things, 3D-printing etc.)

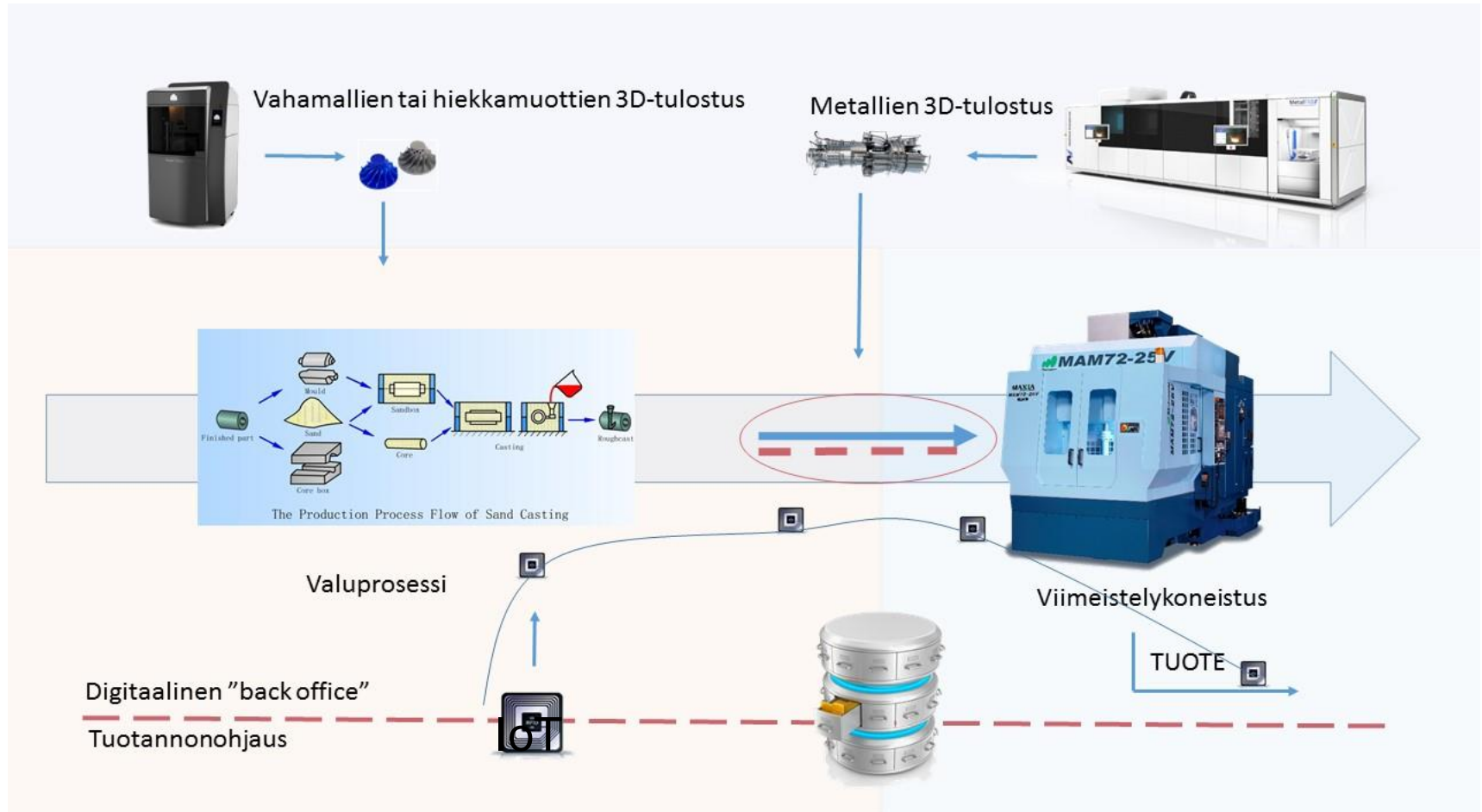


# Novel ductile cast irons

- Cast irons are widely used, but still strongly developing materials
  - Breakthrough of High silicon / Solution Strengthened Ferritic ductile irons with improved mechanical properties
  - GJS-500-7 → GJS-500-14
  - GJS-600-3 → GJS-600-10
- Research scope:
  - Solution Strengthened Ductile Irons
    - Fundamentals, characterization and material properties
    - Austemperability, new generation high strength ADI grades
  - Novel Ductile Iron concepts
    - Beyond standard grades, new additives and treatments
    - High thermal conductivity low alloy ductile iron for elevated temperature use



# Finnish Industry New age – Fin3DPrint research project



# Your background, answer in chat

**Nationality and previous foundry experience**

# Course content

- **Principles of casting technology**
  - Casting methods and materials
- **Relations between design and manufacturing processes of casting**
  - Casting design principles, casting simulation
- **Casting quality and purchasing**
- **Advanced topics in foundry engineering**
  - Digitalization and circular economy in foundries
  - 3D printing/proto castings business in foundries by CEO Ville Moilanen, Hetitec Oy

# Learning targets

**Students are able to explain basic principles of casting**

**They will also learn to use the relations between design and manufacturing processes**

- castings
- cast materials
- casting design principles
- computational methods in casting design, e.g. simulation

**How the process steps interact to determine properties and requirements of high quality cast components**



# Completion of course

- **Lectures & individual assignments**
  - Attendance recommended
  - For every lecture one assignment
  - Choice between basic quiz or advanced written report
- **Pair exercise**
- **Laboratory demo (not in person this time, but a video presentation is in the works)**

# Evaluation of course

**Your grade will be mostly based on pair exercise (75%).**

**You have to complete one individual assignment per lecture (25% of grade). Report will have higher max points than quiz.**

**Guest lecture on April 7th will give attendance points, so be there!**

# Lecture assignments

- **An assignment per lecture is compulsory for passing the course**
- **Choice between simpler quiz and more advanced written report work**
  - If you are busy or unmotivated that's totally fine, the quizzes take around 15 minutes to complete and you can still get a good grade if you succeed well in the pair exercise
  - If you are motivated to learn and have the time and resources to put more effort into this course, the written assignments are for you, and getting good points from those will make it possible to get grade 5. Be prepared to put at minimum an hour for each lecture assignment

# Timetable

DATE	WEEK	DAY	TIME	CLASSROOM	TOPIC
3 Mar 21	9	Wed	12:15-14:00	Zoom	Introduction to course, casting principles
10 Mar 21	10	Wed	12:15-14:00	Zoom	Cast Materials and Methods
17 Mar 21	11	Wed	12:15-14:00	Zoom	Quality of castings, purchasing of castings
24 Mar 21	12	Wed	12:15-14:00	Zoom	Principles of casting design, simulation
31 Mar 21	13	Wed	12:15-14:00	Zoom	Advanced and Current Topics (Digitalization and CE)
7 Apr 21	14	Wed	12:15-14:00	Zoom	Guest lecturer from Hetitec Oy, CEO Ville Moilanen
19 Apr 21	16	Mon	23:55		Latest deadline of exercise report

# Course exercise

- **Course exercise will be pairwork**

- **Orient to:**

Analyze demands of cast product

Choose casting method and material for cast product

Design cast products

Purchase cast products

->You have to think in parallel between all those tasks!

# Course exercise: Report

- **No indicative number of pages**
  - **Font size 12 pt; Line spacing 1,5 lines**
  - **Make use of the features of the word processing software**
    - Style
    - Table of contents
    - Reference
- **Try to make a clear and coherent report**

# Course exercise: Report

## - study subjects to be discussed

### 1. Operating Environment

- Overview of the part against the requirements of
  - *Loadings,*
  - *Operating temperature,*
  - *Pressure,*
  - *Corrosion resistant*
  - *etc.*
- Other requirements such as
  - *Wear, machinability, etc.*

**→ Operating environment and other requirements specified by the terms will limit available choices**

# Course exercise: Report

## - study subjects to be discussed

### 2. Choice of cast material and casting method

- Constraints and freedoms in step 1 forms the basis of realistic method of casting / cast material combinations
- This part should cover suitability of possible method/material combinations for the manufacture of product and end up in a ***justified choice***



# Course exercise: Report

## - study subjects to be discussed

### 3. Casting design and the casting drawing

- Product is designed as casting (molding point of view)
- You will get a drawing of a quite simplified part, in need of changes
- In practice, these changes mean for example, that in product you have to make the necessary drafts and roundings, and you must choose the position of a parting line
- Design changes are possible
  - *Course staff will act as the customer, so if you want to make bigger changes, ask for opinions!*
- CAD modeling is part of the course
- After modeling, new drawings are needed

# Course exercise: Report

## - study subjects to be discussed

### 3. Casting design and the casting drawing

- What should I do?
  - *Print given casting drawing*
  - *Sketch in blueprint*
    - Parting line, Drafts, Roundings
    - etc.
  - *Choose correct CT- tolerance and machining RMA*
  - *Model your part*
  - *First is drawing for a cast part (not machined)*
  - *Second is drawing of a machined part (which features are cast vs. machined?)*
  - *Justify your choices in report*
  - *Add drawings to tender in report*

# Course exercise: Report

## - study subjects to be discussed

### 4. Tender

- Prepare a (fictional, do not send it) Tender.
- Recipient: Finnish foundry
- Carried out according to standard *1559-1, Valut: Yleiset toimitusehdot*
- Remember to ensure that the foundry can cast your chosen material with your chosen method.
- A list of Finnish foundries is given in MyCourses

# Course exercise: Report

## - study subjects to be discussed

### 4. Tender

- However, because the tender is made only as a practice, do not call or send any queries regarding this to foundries.
- Tender shall contain selected material, casting method and the degree of tolerance in addition to the quality criteria / quality. Casting, such as no other manufacturing techniques, will never achieve absolutely perfect products, and therefore the required quality level of sound definition ("a sufficient, but not over tight") is an important part of a successful order-delivery process

# Course exercise: Deadline

**Exercise report (inc. tender) should be returned to MyCourses at the latest on Monday 19<sup>th</sup> of April at 23:55**

**Detailed instructions will be added to MyCourses**

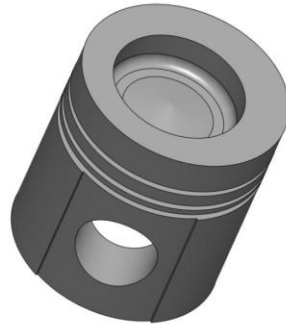
# Course exercise: Evaluation

- **Grade Scale 0-5**
- **Obligatory part of course**
- **Scoring based on report:**
  1. **Structure** 3 p
  2. **Choice of material** 3 p
  3. **Choice of casting method** 3 p
  4. **CAD models and Blueprints** 3 p
  5. **Tender** 3 p

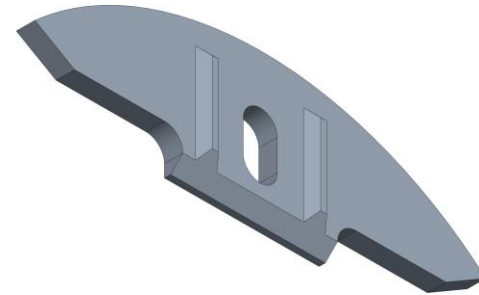
**in total** 15 p
- **Rating Limits depend on the quality level of returned reports**
- **Lecture assignments can give max. 5 points so course total is 20 points**

# Course exercise: Components

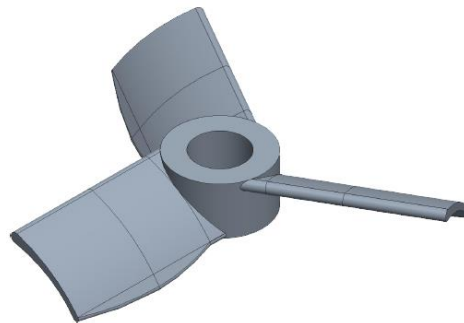
1. Automotive piston



2. Mixer blade



3. Slurry impeller



# Metal Casting 101 Course, 3 cr

**In co-operation with Aalto ARTS**

**Hands-on course where your task is to design and cast a technically sound casting**

**Course in Spring and Autumn**



# Webinaari ajankohtaisista valimoalan asioista 25.3.2021 klo 09:00-11:30

## Aiheina mm.:

- Miten valimoteollisuus selvisi koronavuodesta 2020?
- Valukomponentin hiilijalanjäljen laskenta
- Uusi valimoalan oppimiskeskus on avattu Tampereelle
- Katsaus valimoalan tutkimukseen
- Tohtorikoulutusprojektin läpivienti