



ITM/MSE

## Casting Processing, MH2252, 6hp H20

### Aim

The course gives an overview over both component casting and processes such as ingot casting, continuous casting and direct casting and describe and explain the problems that can arise during metal casting, solidification and cooling.

### Intended learning outcomes

After passing the course the student should be able to:

- Give example of and justify for the use of common casting processes for manufacturing of components, as well as blanks
- Apply and calculate fluid dynamic processes for metal flow at tapping and filling of a casting system for manufacturing of components, as well as blanks
- Explain principles and justify adopted models for heat transport at the moulding and solidification of metals
- Explain and justify for structure and structure formation in casted materials and the appearance of micro and macro segregations during solidification
- Explain the origin of casting defects such as shrinkage, gas porosity, slags, secondary phases and cracks and methods and processes to control and minimise these
- Dimension and simulate a casting system with the purpose of minimising casting defects and maximising yield, and present this in a scientific context.
- Describe and give examples of the complexity of a real industrial process chain for casting of components or blanks and present this during a seminar

### Specific prerequisites

- Good knowledge of the production process for casting of metals corresponding to the course MH1024 Fundamentals of Materials Science - Metallic Materials, or the equivalent
- Good knowledge in fluid dynamics of melts corresponding to the course MH1018 Transport Phenomena, or the equivalent.

### Literature

Materials Processing during Casting. Hasse Fredriksson, Ulla Åkerlind, Wiley, March 2006, ISBN: 0-470-01514-4. Freely available by Wiley Online Library accessed by KTH Library.

### Examination

PRA1 - Practical training, 1.5 credits, Grading scale: P, F

STU1 - Study visit, 0.5 credits, Grading scale: P, F

TEN2 - Written exam, 4.0 credits, Grading scale: A, B, C, D, E, FX, F

### Examiner:

Anders Eliasson

08-790 7255

[anderse@kth.se](mailto:anderse@kth.se)

## Lectures and exercises

The aim of the lectures in the course is to highlight the vital parts of the course. The major part of the material is to be studied individually.

Lecturer: Anders Eliasson, [anderse@kth.se](mailto:anderse@kth.se)

The exercises will give opportunity to discuss application of theory and to solve problems.

Problem solving will be done both by the students and by the assistant.

Assistant: Lu Yu-Chiao (Ishana), [yclu@kth.se](mailto:yclu@kth.se)

## Computer assignment (PRA1: 1,5 credits)

A computer assignment should be solved by help of the numerical simulation program MagmaSoft.

Assistant: Nils Andersson [nilsande@kth.se](mailto:nilsande@kth.se)

## Study visit (Lab1: 0,5 credits)

A mandatory study visit is planned to a foundry. For H20 it might be cancelled and replaced due to Covid-19. The students are requested to in groups prepare questions, write a visit report and present it at a seminar.

Responsible: Anders Eliasson, [anderse@kth.se](mailto:anderse@kth.se)

Isak Hollinger, [isak.hollinger@scania.com](mailto:isak.hollinger@scania.com), Jessica Elfsberg, [jessica.elfsberg@scania.com](mailto:jessica.elfsberg@scania.com)

## Examination (Ten2: 4,0 credits)

The examination is in two parts. The first part is answered without any aid, while during the second part the use of handed out course material (Summary pages) is allowed. Note, this means that only the Summary pages/course material is allowed, no personal notes. Exams registration is done through your “KTH menu”.

Responsible: Anders Eliasson, [anderse@kth.se](mailto:anderse@kth.se)

## Course schedule H20

Date	Time	Place	#	Topic	Chapter
25/8	10-12	Blå	L1-2	Information and introduction. Component casting. Cast house processes. Chapter 1-2	1.1-1.2 2.1-2.6
27/8	10-12	Blå	L3	Casting hydrodynamics. Chapter 3.	3.1-3.7
31/8	08-10	Digital	E1	Component casting. Cast house processes. Casting hydrodynamics.	Chapter 1-3
3/9	10-12	B21	L4a+b	Heat transport at Sand mould casting - good contact Chapter 4-5	4.1-4.4 5.1-5.7
7/9	08-10	Digital	E2	Heat transport at component casting.	Chapter 4-5
8/9	10-12	Blå	L4c	Heat transport at component casting - poor contact. Chapter 4-5	4.1-4.4 5.1-5.7
9/9	13-16	Digital	CL1	Computer lab – Introduction to MagmaSoft	
14/9	08-10	Digital	E3	Heat transport at component casting - poor contact.	Chapter 4-5
15/9	10-12	Blå	L5+6	Structure and structure formation in cast materials. Micro-segregation and solidification processes in alloys. Macro-segregations. Chapter 6, 7, 11.	6.1-6.11 7.1-7.9 11.1-11.9
18/9	13-16	Digital	CL2	Computer lab – Introduction to Assignment	
21/9	08-10	Digital	E4	Structure and structure formation in cast materials. Microsegregation and solidification processes.	Chapter 6-7, 11
23/9	13-16	Digital	CL3	Computer lab – Work with Assignment	
24/9	10-12	M38	L7a+b	Precipitation of pores and slag inclusions at casting processes. Chapter 9.	9.1-9.9
28/9	08-10	Digital	E5	Reaction kinetics and precipitation of gas pores and non-metallic phases during solidification.	Chapter 9
29/9	10-12	M38	L8a+b	Solidification and cooling shrinkage of metals. Chapter 10 Information about the study visit.	10.1-10.7
30/9	13-16	Digital	CL4	Computer lab – Final work with Assignment	
5/10	08-10	Digital	E6	Solidification and cooling shrinkage.	Chapter 10
6/10	10-12	B24	L9	Repetition: Casting and solidification. Information about the exam.	
6/10	13-17	Scania	Field trip	Study Visit at Scania AB, Södertälje. Note, Preliminar!	
7/10	13-15	Blå	Sem	Seminar – Presentations of Study visit groups	
8/10	10-12	Digital	E7	Repetition	
16/10	08-13	Blå	TEN2	Examination.	
16/12	08-13	Blå	TEN2	Re-examination	

## Literature: Materials Processing during Casting by Hasse Fredriksson and Ulla Åkerlind

<u>Chapter</u>	<u>Chapter</u>	<u>Activity</u>	<u>Exercises</u>	
1. Component Casting	Whole chapter	Carefully	-	-
2. Cast House Processes	2.1 – 2.4	Carefully	-	-
	2.5 – 2.6	Browse		
3. Casting Hydrodynamics	3.1 - 3.3.2	Carefully	3-1	3-6
	3.3.3 - 3.3.4	Browse	3-2	<b>3-7</b>
	3.4	Carefully	<b>3-3</b>	3-8
	3.5	Browse	<b>3-4</b>	3-9
	3.6 - 3.7	Carefully	3-5	3-10
4. Heat Transport during Component Casting	Whole chapter	Carefully	4-1	<b>4-7</b>
			4-2	4-8
			<b>4-3</b>	<b>4-9</b>
			4-4	<b>4-10</b>
			<b>4-5</b>	4-11
			<b>4-6</b>	
5. Heat Transport in Cast House Processes	5.1 - 5.3	Carefully	5-1	5-7
	5.4	Browse	5-2	5-8
	5.5	Carefully	5-3	<b>5-9</b>
	5.6	Browse	5-4	<b>5-10</b>
	5.7	Carefully	<b>5-5</b>	<b>5-11</b>
	5.8	Browse	<b>5-6</b>	5-12
6. Structure and Structure Formation in Cast Materials	6.1 - 6.4	Carefully	6-1	6-6
	6.5 - 6.6	Browse	<b>6-2</b>	<b>6-7</b>
	6.7 - 6.9	Carefully	<b>6-3</b>	6-8
	6.10 - 6.11	Browse	6-4	6-9
			6-5	6-10
7. Microsegregation in Alloys – Peritectic Reactions and Transformations	7.1-7.3	Carefully	<b>7-1</b>	<b>7-6</b>
	7.4	Browse	<b>7-2</b>	7-7
	7.5	Carefully	<b>7-3</b>	7-8
	7.6-7.9	Browse	7-4	7-9
			<b>7-5</b>	
8. Heat Treatment and Plastic Forming	8.1 – 8.4	Browse	8-1	8-6
	8.5	Carefully	8-2	8-7
	8.6	Browse	8-3	8-8
			<b>8-4</b>	8-9
			8-5	8-10
9. Precipitation of Pores and Slag Inclusions during Casting Processes	9.1-9.7.5	Carefully	<b>9-1</b>	<b>9-6</b>
	9.7.6-9.7	Browse	9-2	9-7
	9.8	Carefully	<b>9-3</b>	9-8
	9.9	Browse	9-4	9-9
			<b>9-5</b>	9-10
10. Solidification and Cooling Shrinkage of Metals and Alloys	10.1-10.5.1	Carefully	<b>10-1</b>	<b>10-6</b>
	10.5.2-10.6	Some Browse	<b>10-2</b>	10-7
	10.7	Browse	10-3	<b>10-8</b>
			-	10-4
				<b>10-5</b>
Macrosegregation in Alloys	11.1 – 11.5	Browse	11-1	<b>11-6</b>
	11.6 – 11.9	Carefully	11-2	<b>11-7</b>
			11-3	11-8
			<b>11-4</b>	<b>11-9</b>
			11-5	

**Bold: recommended exercises.**