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Faculty of Health, Science and Technology

Materials Engineering

**Syllabus**

**Steels: properties and heat treatments**

## **Course Code:** 7MTT101**Course Title:** Steels: properties and heat treatments

##  *Stål: egenskaper och värmebehandlingar*

## **Credits:** 15 ECTS

**Degree Level:** Doctoral

## **Course Approval**

The syllabus was approved by the Faculty of Health, Science and Technology,
24 March 2021 and is valid from the spring semester 2021.

## **Language of instruction**

English

## **Prerequisites**

The course is primarily given to doctoral students, but subject to availability, other types of students (including professionals in the industry) can participate.

The qualification requirements are:

Master’s degree or equivalent with a major in materials engineering, or related fields such as materials science, physics and chemistry. Non-eligible applicants who have acquired equivalent knowledge in some other way may be deemed eligible.

## **Learning Outcomes**

Upon completion of the course, students should be able to:

* analyse the influence of different heat treatments on the microstructure and mechanical properties of steels
* evaluate the phases, including different precipitates and non-metal inclusion, and structures in steel
* assess the kinetics behind solid state phase transformations in steels
* understand basic corrosion mechanisms for different types of steels
* analyse the influence of different surface modifications on the microstructure, mechanical, and tribological properties of steels

## **Course Content**

The teaching is organized in three basic blocks where each block gives 5 ECTS credits (see table 1 below). Each block contains a number of lectures where the students are given a home assignment. The due date of the home assignment is at the next lecture. The student has passed a block by passing all home assignment.

Each teacher grade their corresponding home assignment.

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| Block | Content  |
| 1 | Introduction, perlite, ferrite, cementite  |
| Martensite, bainite, austenite |
| TTT and CCT diagrams and heat treatment to produce ferrite and perlite |
| Tempering of steel and special heat treatment |
| 2 | Surface hardening and modification |
| Stainless steel  |
| Tool steels |
| Cast iron |
| 3 | Tool steel alloy design, principle of heat treatment |
| Heat treatment |
| Low alloyed special purpose tool steel, shock resisting tool steels |
| Cold-work tool steel |
| Hot-work tool steel, high speed steel, and mold steel |

## **Reading List**

Steels: Heat treatment and processing principles, by George Krauss, latest edition.

Tool steels, by George Adam Roberts, Richard Kennedy, and George. Krauss, latest edition.

Reading list with selected articles given at the start of each block.

## **Examination**

Home assignments after each lecture

## **Grades**

Each block gives 5 ECTS and are graded with Fail (U) or Pass (G). For a complete course all three blocks should be ready, and the final grade is Fail (U) or Pass (G).

## **Quality Assurance**

## The course convenor has a duty to encourage a continuous dialogue on learning processes and goal fulfilment. A written evaluation is carried out at the conclusion of the course combined with a joint student-teacher discussion of all aspects commented on. The result of the evaluation is collated and made available in accordance with *The Higher Education* Ordinance, Chapter 1, § 14.

## **Course Certificate**

## Course certificate is issued on request.

## **Goal matrix**

Goals that, after completing the course, are fulfilled for the doctoral or licentiate degree are marked with an X.

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|   | **Doctoral** |  |   |   |   | **Licentiate** |   |
|   | **Knowledge and understanding** |  |   |   |   | **Knowledge and understanding** |   |
| 1a |  - demonstrate broad knowledge and systematic understanding of the research field and | X |   |   | 1a | demonstrate knowledge and understanding in the field of research including |  X |
| 1b | advanced and up-to-date specialised knowledge in a limited area of this field, and |  |   |   | 1b | current specialist knowledge in a limited area of this field as well as |   |
| 1c | familiarity with research methodology in general and the methods of the specific field of research in particular. | X |   |   | 1c | specialised knowledge of research methodology in general and the methods of the specific field of research in particular |  X |
|   | **Competence and skills** |  |   |   |   | **Competence and skills** |   |
| 2a |  - demonstrate capacity for scholarly analysis and synthesis as well as |  |   |   | 2a | demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively and to |   |
| 2b | to review and assess new and complex phenomena, issues and situations autonomously and critically | X |   |   | 2b | plan and use appropriate methods to undertake a limited piece of research and other qualified tasks within predetermined time frames in order to contribute to the formation of knowledge |  X |
| 3a |  - demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively, and to |  |   |   | 2c | as well as to evaluate this work |   |
| 3b | plan and use appropriate methods to undertake research and other qualified tasks within predetermined time frames and to review and evaluate such work |  |   |   | 3a | demonstrate the ability in both national and international contexts to present and discuss research and research findings in speech and writing and in dialogue with the academic community and |   |
| 4 |  - demonstrate through a dissertation the ability to make a significant contribution to the formation of knowledge through his or her own research | X |   |   | 3b | society in general |   |
| 5a |  - demonstrate the ability in both national and international contexts to present and discuss research and research findings authoritatively in speech and writing and in dialogue with the academic community and |  |   |   | 4 | demonstrate the skills required to participate autonomously in research and development work and to work autonomously in some other qualified capacity. |  X |
| 5b | society in general |  |   |   |   |   |   |
| 6 |  - demonstrate the ability to identify the need for further knowledge and |  |  X |   |  |   |   |
| 7 |  - demonstrate the capacity to contribute to social development and support the learning of others both through research and education and in some other qualified professional capacity. |  |   |   |  |   |   |
|   | **Judgement and approach** |  |   |   |  | **Judgement and approach** |   |
| 8a |  - demonstrate intellectual autonomy and disciplinary rectitude as well as |  |   |   | 5 | demonstrate the ability to make assessments of ethical aspects of his or her own research |   |
| 8b | the ability to make assessments of research ethics, and |  |   |   | 6 | demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used |   |
| 9 |  - demonstrate specialised insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used. |  |   |   | 7 | demonstrate the ability to identify the personal need for further knowledge and take responsibility for his or her ongoing learning. |  X |