



## Programme syllabus

Faculty of Technology

Maskinteknik, masterprogram, 120 högskolepoäng

Mechanical Engineering, master programme, 120 credits

### Level

Second cycle

### Date of Ratification

Approved 2024-06-14.

The programme syllabus is valid from autumn semester 2025.

### Prerequisites

General entry requirements for secondcycle studies and specific entry requirements:  
Bachelor of Science in Mechanical Engineering or Industrial Engineering and Management

7.5 credits Solid Mechanics or Structural Mechanics or equivalent

22.5 credits Mathematics including Algebra and Calculus or equivalent

English 6 or equivalent.

## Description of Programme

The program aims to educate engineers in mechanical engineering with a focus on technical calculations, product development, and manufacturing. These skills are in demand by both industry and universities for development and research. By taking the courses offered in the program and completing an advanced-level thesis in the subject area, students will be well-prepared to acquire the knowledge that is sought after, as mentioned above. The program thus prepares students for both qualified professional work in the industry and for doctoral studies.

## Objectives

### Central degree objectives in accordance with the Higher Education Ordinance

#### *Knowledge and understanding*

For a Degree of Master (120 credits) the student shall

- demonstrate knowledge and understanding in the main field of study, including

both broad knowledge of the field and a considerable degree of specialised knowledge in certain areas of the field as well as insight into current research and development work, and

- demonstrate specialised methodological knowledge in the main field of study.

#### *Competence and skills*

For a Degree of Master (120 credits) the student shall

- demonstrate the ability to critically and systematically integrate knowledge and analyse, assess and deal with complex phenomena, issues and situations even with limited information,
- demonstrate the ability to identify and formulate issues critically, autonomously and creatively as well as to plan and, using appropriate methods, undertake advanced tasks within predetermined time frames and so contribute to the formation of knowledge as well as the ability to evaluate this work,
- demonstrate the ability in speech and writing both nationally and internationally to clearly report and discuss his or her conclusions and the knowledge and arguments on which they are based in dialogue with different audiences, and
- demonstrate the skills required for participation in research and development work or autonomous employment in some other qualified capacity.

#### *Judgement and approach*

For a Degree of Master (120 credits) the student shall

- demonstrate the ability to make assessments in the main field of study informed by relevant disciplinary, social and ethical issues and also to demonstrate awareness of ethical aspects of research and development work,
- demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used, and
- demonstrate the ability to identify the personal need for further knowledge and take responsibility for his or her ongoing learning.

## Content

### *Programme Overview*

During the first semester, students are introduced to computational mechanics, structural dynamics, and lightweight construction materials such as composites. The second semester provides a foundation in experimental methods and the evaluation of measurement data. Students gain a deeper understanding of physical systems, their properties, and the uncertainties in experimental results. Additionally, the second semester focuses on the product life cycle with a clear emphasis on sustainability. Another part of the semester is dedicated to machine design. Students are also given the opportunity to choose a course from the available options during the second semester. In the third semester, students deepen their understanding of control engineering, manufacturing technology, and automation. A part of the semester is also devoted to scientific methodology. The acquired knowledge is applied in a larger independent project that runs during the fourth semester.

Course changes within the program can be made in consultation with the program coordinator. The prerequisites for courses and the local regulations for degrees at Linnaeus University must always be met. This means that at least 90 credits of the master's degree must consist of advanced-level courses.

The program includes the following courses:

### **Year 1**

*Multivariable Calculus and Vector Calculus* (7.5 credits, G1F): The course covers mathematical concepts and methods for analyzing problems in multiple variables. Furthermore, students are introduced to Matlab.

*Engineering Materials, advanced course* (7.5 credits, A1N)\*: The course focuses on advanced engineering materials, covering material properties, processing techniques, and the relationship between microstructures and macroscopic behavior. It also includes the application of constitutive models to create computational models at various length scales for material characterization, analysis, and design.

*The Finite Element Method* (7.5 credits, A1N)\*: The course provides an introduction to the finite element method. It covers strong and weak formulations in one and multiple dimensions for heat conduction and elasticity problems, discretization and shape functions, constitutive relations, isoparametric element formulation, numerical integration of the weak form, and convergence criteria.

*Structural dynamics* (7.5 credits, A1N)\*: Structural dynamics is a subject with a wide range of applications, from aerospace, automotive, and machinery to buildings. The course studies the dynamic behavior of structures, including performance, comfort, lifespan, and vibrations when subjected to time-varying loads from people, maneuvers, wind, earthquakes, etc. As structures become increasingly lighter, the need for knowledge in structural dynamics grows to ensure designs can withstand dynamic loads and maintain functionality. Finite element models are often used in structural dynamic calculations to determine structural responses.

*Experimental Mechanics* (7.5 credits, A1F)\*: The course focuses on the fundamental components of experimental vibration analysis required to obtain detailed information about vibration characteristics and to develop and model real physical systems. These components are also useful for controller design and condition monitoring. Sensors, measurement techniques, data acquisition, and applied signal processing for the measurement and analysis of mechanical vibrations, as well as experimental modal analysis of structures and machinery, etc., are thoroughly covered. Robust signal processing methods for monitoring the health status of rotating machinery, such as bearings and gears, are also highlighted.

*Machine design, advanced course \*\** (7.5 credits, A1N)\*: The course covers the dimensioning and design of hydrodynamically lubricated gears, dynamic seals, and gearboxes, utilizing mechanical failure prevention and reliability theories.

*Product Development, Advanced Course* (7.5 credits, A1N)\*: Lectures present current research and various theories within the scientific field of product design and development. Seminars provide more detailed and practical information about the steps in the product development process.

A project is based on the critical evaluation and application of the theories presented in

the seminars.

Elective Course \*\*\* (7.5 credits)

\*\* Students who do not meet the prerequisites for the course Machine Design, Advanced Course, will instead take *Machine Design A*, which is offered within the Bachelor of Science in Mechanical Engineering program.

**Year 2:**

*Advanced Manufacturing and Automation, Advanced Course* (7.5 credits, A1N)\*: Study of conventional and advanced forming and machining processes to assess their suitability, efficiency, and costs in specific manufacturing contexts, particularly for the use of unique materials. Introduction to modern concepts in automation, such as Industry 4.0, industrial robotics, and digital twins. Additionally, the course covers the integration of fundamental sustainable production principles with product development and manufacturing systems, including recycling and remanufacturing.

*Automatic Control* (7.5 credits, G2F): The course covers fundamental principles of control engineering. Systems and controllers are modeled, and the controlled systems are analyzed.

*Scientific Theory and Method* (7.5 credits, A1N): The course covers the structure and writing of scientific articles according to international standards for scientific publishing, as well as the presentation and discussion of relevant scientific issues within the field of engineering. The course prepares students for independent work with a focus on problem formulation, planning, and designing a research project, including the ability to explain and select methods, objectives, and limitations.

Elective Course \*\*\* (7.5 credits)

Degree Project (30 credits, A2E)\*:

The course concludes the program and provides students with the opportunity to practice their skills in independently conducting a project. The student must demonstrate the ability to apply the knowledge acquired during the program, define a problem, carry out an investigation, analyze, and present the results.

\* = course in the main field of study

The placement of courses in the academic year and study period may change. Courses are offered in English. A detailed description of the courses in the program is provided in separate course syllabi.

\*\*\* A variety of elective courses are offered by different departments and faculties, depending on demand and availability. Elective courses may also be taken at our partner universities. Courses must be chosen in consultation with the program coordinator to ensure they form a coherent body of knowledge within the overall field of Mechanical Engineering (a total of 15 credits are elective within the program).

*Societal Relevance*

The program offers students the opportunity for industry and research contacts through instructors and lecturers who are or have been active in industry or research, through study visits, and through the completion of a qualified, often industry-related, thesis project.

### *Internationalization*

Parts of the program can, after consultation with the program coordinator, be completed at foreign universities. The program coordinator determines whether the courses taken abroad are relevant to the program's focus and may approve them to replace certain courses within the program. International studies are best undertaken during the third semester of the program. The program is taught in English, and students from many different countries and cultures come together in the program. Some of the teaching staff have international backgrounds, which also contributes to the program's internationalization.

### Sustainable Societal Development

Gender equality and diversity perspectives within the program and for the professional roles the program prepares students for are discussed in program councils. All students are treated equally in the program in terms of teaching, supervision, etc., in accordance with the current regulations and guidelines at LNU.

Sustainable development permeates the program. Economic, environmental, and social sustainability are specifically highlighted in the courses on Structural Materials, Product Development, and Manufacturing Technology and Automation. In other courses, this perspective is included as a reflective or evaluative element, especially in the Thesis Project course.

Ethics should, where possible, be integrated into all courses within the program but is specifically highlighted in the course on Scientific Theory and Method.

The program includes reflection on the role of technology in society and how it can contribute to a more sustainable way of living. Furthermore, an entrepreneurial approach is emphasized by placing product development in the context of global opportunities and local conditions. This helps students identify various possibilities, such as local entrepreneurship, as well as connections to global opportunities. Finally, economic sustainability is an integrated part of several courses within the program. These aspects contribute to an entrepreneurial mindset.

### Quality Development

A program council has been established for the program. The program council consists of teachers, students, and representatives from the professional field. The council meets regularly to discuss the program's structure, content, and relevance to the profession.

Course evaluations are conducted by students after each course through surveys and survey summaries. The course coordinator is responsible for carrying out the course evaluations. At the end of each semester, program evaluations are also conducted by student representatives and the program coordinator. Course and program evaluations are followed up to enhance the quality of the education.

The program is reviewed and compared with equivalent programs at other universities. Some review and quality assurance are also conducted through industry contacts, primarily as many students carry out their thesis projects in collaboration with various companies.

### Degree

After having completed their studies in accordance with the requirements stated in the

Qualification Ordinance of the Higher Education Ordinance and in Linnaeus University's local qualification ordinance, the student may apply for the award of a qualification. Students who have completed the programme Mechanical Engineering may obtain the following qualification:

Teknologie masterexamen  
Huvudområde: Maskinteknik

Degree of Master of Science (120 credits)  
Main Field of Study: Mechanical Engineering

The degree certificate is issued in two languages (Swedish and English) and is accompanied by a diploma supplement in English.

### **Other Information**

The program may include study visits, excursions, study trips, and similar mandatory activities that may incur costs for students. Furthermore, students are expected to have the necessary digital equipment to participate in the program.

In the event of any discrepancies between the Swedish and the English version of this programme syllabus, the Swedish version shall prevail.