Utbildningsplan för Masterprogram i maskinteknik - strukturmekanik
(120 högskolepoäng)
Master’s Programme in Mechanical Engineering - Structural Mechanics
(120 ECTS credits)

1. Decision

The degree programme was established by Deputy Vice-Chancellor and the Deans on 2018-04-16.

The syllabus was established jointly by the Deputy Vice-Chancellor and the Deans on 2018-10-29.

The document applies for students admitted to the autumn semester of 2018.
Programme code: MTAME

2. Entry requirements

Access to the degree programme requires:
A Degree of Bachelor or a Degree of Bachelor of Science in Mechanical Engineering, preferably with emphasis on structural mechanics. The degree is to include mathematics comprising matrix algebra, multivariable analysis, and transform theory, basic mechanics and programming. English 6.

3. Conditions for participation in programme courses

To participate in programme courses, the student must meet the course entry requirements by the start of the course at the latest. The student’s prior knowledge will be checked before the start of each course. The entry requirements are stated in the respective course syllabi.

To participate in programme courses, the student must be admitted and registered to each course. Admission to compulsory courses within a programme takes place in connection with the start of the semester during which the course will be given, provided that the student meets the entry requirements for the course. Elective courses within a programme must first be selected by the student, on specific occasions, before admission can take place. Course entry requirements also apply to elective courses.

Students have the opportunity to discuss their study situation with the programme director or a study advisor.

4. Degree

The programme leads up to the following second-cycle degree:

Degree of Master of Science (120 credits)
Main field of study: Mechanical Engineering
Specialization: Structural Mechanics
4.1. Specific requirements for BTH

A Degree of Master (120 credits) requires at least 60 second cycle credits in the main field of study, of which the independent project (degree project) is to comprise at least 30 credits (level A2E). A maximum of 30 first cycle credits can be included in the degree.

5. Goals

Upon a completed degree, the comprehensive goal for the student is to master a coordinated method of working at the analysis of decision support in the product development process, comprising the items of virtual and physical modelling, simulation respectively experimental examination and, also, optimization.

In addition to the national goals for the degree, the following goals will also apply to the programme.

5.1. Knowledge and understanding

Upon completion of the programme, the student will be able to:

- demonstrate knowledge and understanding of the field of mechanical engineering, including both broad knowledge of the area of analysis for decision-support in the product development process as well as significant in-depth knowledge of structural mechanical analysis and an advanced insight into current research- and development work.
- demonstrate in-depth methodology knowledge of the main field of mechanical engineering

5.2. Competence and skills

Upon completion of the programme, the student will be able to:

- demonstrate the competence of formulating and validating numerical and analytical models of mechanical systems by means of both advanced software as by strongly simplified relations for important characteristics
- demonstrate the competence of specifying, performing, and interpreting measurements and experimental analysis of vibrations of machines and other mechanical structures
- demonstrate competence to perform simulation of mechanical systems with parameters obtained from numerical models and/or experiments, for example in regard to the impact from applied load and/or simple structural changes
- demonstrate skills of performing optimization of mechanical systems based on results from numerical models, simulations and measurements to meet market needs and benefit from technological progress
- demonstrate skills of coordinating activities and reporting obtained results in an understandable way in accordance with general regulations and practice for scientific writing.

5.3. Judgement and approach

Upon completion of the programme, the student will be able to:

- demonstrate skills of discussing and assessing the value of decision-guiding documents, produced through technical analysis, in consideration of relevant aspects of research- and product development work
- demonstrate skills of relating to a method of working, from a critical examining basis, that involves a systematic coordinated collaborative use of virtual and physical models at the technical analysis for the design of decision support in the product development process

6. Content

The Master’s Programme is designed as a specialized continuation of completed studies equivalent to the Bachelor’s level within the main field of study of Mechanical Engineering.

To ensure a resource-efficient utilization of the resources of nature products need to be optimized for their use. Extensive and advanced calculations are often needed as support for decision at the design of efficient products. Also measurements of real
qualities are needed to be able to verify that the ready product functions in the way estimated.
Working with the courses of the programme will give the student acquisition of knowledge of theories, methods, and means of assistance for planning, performing, and evaluating models, calculations, experiments and simulations of product qualities, as well as developing through applications her/his own skills of predicting and verifying the function of the product.

The content of the programme is adapted for building knowledge and understanding for a coordinated method of working at technical analyses for decision support in the product development process. The method of working may, in brief, be described as follows: Virtual models for descriptions of interesting product qualities and behaviors are developed, verified, and used for simulation of the functionality of the system.

The simulation result is compared to experimental results from examinations of delimited parallelly developed physical models, or to experiences from previous developments, with the aim of validating the virtual models. The coordination means that also the virtual models are used for constructing and designing good physical models and measurement strategies. This process is repeated until sufficient correspondence is reached. Simulation with the virtual model can then be used for optimization. If the optimization indicates a need of changes that affect the relevance for the model in question, the whole process will be repeated. More detailed descriptions are, when need be, added gradually to the model during the ongoing development of the analyzed product. At the development of an entirely new product various reiterations of usually needed. When a new variant of a product is being developed, previous experiences may, to a great extent be reutilized.

6.1. Structure and courses of the degree programme

The courses are studied in the order presented below.

**Semester 1**
- Compulsory: MA1437, Differential Equations with Lie Group Analysis, 7.5 credits, Mathematics, Basic level, G1F
- Compulsory: SL2531, Introduction to Strategic Sustainable Development, 7.5 credits, Strategic Leadership towards Sustainability, Advanced level, A1N
- Compulsory: MT1533, Dynamics of Mechanical Systems, 7.5 credits, Mechanical Engineering, Basic level, G2F
- Compulsory: ET1539, Signal Processing I, 7.5 credits, Electrical Engineering, Basic level, G1F

**Semester 2**
- Compulsory: MT2561, Fracture Mechanics, 7.5 credits, Mechanical Engineering, Advanced level, A1N
- Compulsory: MT2562, Structural Analysis, 7.5 credits, Mechanical Engineering, Advanced level, A1N
- Compulsory: ET2545, Sound and Vibration Analysis, 7.5 credits, Electrical Engineering, Advanced level, A1N
- Compulsory: MT2558, Computational Engineering 1, 7.5 credits, Mechanical Engineering, Advanced level, A1N

**Semester 3**
- Compulsory: ET2544, Experimental Modal Analysis, 7.5 credits, Electrical Engineering, Advanced level, A1F
- Compulsory: MT2560, Computational Engineering 2:1, 7.5 credits, Mechanical Engineering, Advanced level, A1F
- Compulsory: MT2521, Research Methodology with emphasis on Engineering Science, 7.5 credits, Mechanical Engineering, Advanced level, A1F
- Elective: MT2559, Simulation-driven design, 7.5 credits, Mechanical Engineering, Advanced level, A1N
- Elective: MT2553, Physical acoustics, 7.5 credits, Mechanical Engineering, Advanced level, A1F

**Semester 4**
- Compulsory: MT2565, Master’s Thesis in Mechanical Engineering with emphasis on Structural Mechanics, 30 credits, Mechanical Engineering, Advanced level, A2E

6.2. Learning and education

The degree programme is based on a coordinated method of working. The field of virtual modelling and simulation constitute the focus in the courses which treat computational engineering, whereas physical modelling and experimental work are treated,
primarily, in the courses on sound and vibration analysis, and experimental modal analysis. The virtual and physical analysis types meet in the field of simulation. Optimization is treated in a separate course in which knowledge from the previous courses is applied. A coordinated method of working is applied in the concluding degree project.

The programme begins with courses in which the student learns basic tools which are then used in the following main courses. Throughout the programme there will be references to the basic idea of a coordinated method of working at analysis work and current course items are illustrated from this perspective and through strategies for sustainability.

The programme is carried out as an interplay between lectures, supervised exercises, project work, individual supervision and a significant part of independent work. The student is herself/himself the most important part of this process and will also exert a decisive influence on how well the learning objectives will be attained.

The programme is, mainly, constituted by compulsory courses which build on each other in a given order. Only the especially indicated elective courses will be elected depending on the expected specialization of the subsequent degree project. See the respective course syllabi for more detailed descriptions.

The programme is given in English

6.3. Elective courses

One of the elective courses in semester 3 is selected depending on the expected specialization of the following degree project.

7. Quality assurance

The education program is followed up annually regarding content, design, implementation and results. This is done through two follow-up meetings, spring and autumn, where program managers, faculty programme director, deans and deputy vice-chancellor discuss aspects and statistics of the program.

The program is continuously evaluated through the course evaluations of the separate courses conducted after completion of the course, and partly by program evaluation performed every two years. Course evaluations are reported and discussed by course managers and head of department, followed by head of department, deputy vice-chancellor and deans, and feedback gives to the students. Program evaluation is reported and discussed by program manager, faculty programme director, deans and deputy vice-chancellor, and is returned to students. The result of course and program evaluations leads to the development of the program.

The programme is connected to a Programme Board that deals with quality and development issues. The Programme Board and the different committees of the Board, have external members, student representatives and alumni, who discuss the program's development, quality and relevance to the labor market.

8. Student participation

The students are represented in the Board of Education and committees, the Programme Board of the degree programme, and they are also represented in connection with the decisions taken by the departments regarding the course syllabi. There is a programme manager for the programme who is the students’ principal contact person for overall matters regarding the programme.

9. Research base

The education programme rests on scientific grounds and proven experience. The base of the programme builds on basic subjects in mathematics, physics, and mechanics. In addition, specializations are studied which are well anchored in current science and research.

The degree programme is linked primarily/in substance to the research profile of Product Development conducted in the Department of Mechanical Engineering. The Department is active in research within, for example, the following areas:

- Methods for product development and innovation
- Value-driven design (VDD, Value Innovation)
- Structural analysis
- Modelling and simulation in product development
- Water Jet cutting and Rapid Prototyping (3D printing)
10. Third stream activities and labor market links

BTH works actively to make its programmes lead to applicability and employability on the labor market. The courses of the degree programme often include participation from the areas of commerce and industry in the form of: lectures, joint projects, study visits and degree projects/independent projects carried out together with the areas of commerce and industry.

11. Internationalization

In accordance with the BTH internationalization policy, the degree programme aims to contribute to meetings between students of different national backgrounds. The programme is open for recruitment of students from the whole world.

12. Social and gender equality in education

BTH promotes equal opportunities for both women and men to shape society and their own lives.

A good learning environment at BTH means a stimulating, respectful and inclusive environment in which all forms of harassment, discrimination or offensive behaviour are unacceptable. Through our quality enhancement system, we work to improve and develop the learning environment of our study programmes. We have adopted a four-step systematic approach: investigate; analyse; take measures; follow up and evaluate. The work is organised within five different areas: 1) Recruitment and admission, 2) Forms of teaching and programme structure, 3) Examinations and assessments, 4) Study environment and 5) Studies and parenting. The work involves the direct encounters with our students as well as surrounding structures, systems and functions. Our procedures for creating a learning environment free from discrimination, harassment and offensive victimisation cover three aspects: promotion of equal opportunities, prevention of harassment and discrimination, and management of cases that arise.