



Machine Design  
System and Component Design, SKD

## **Course PM: MF2077      2022 (12 hp)**

### **Machine Design, advanced course, part II**

Machine design comprises the design of various types of products, ranging from complex compound machines, to simple products, which we encounter in our everyday lives. To solve problems in an engineering manner by creating new design solutions is a central part of this course. This means that we must solve the right problems, preferably as simple as possible, but also that these have an industrial base where economy, energy and environment need to be considered.

To support the design work we use modern computer programs for geometry modeling and strength analysis but we also emphasize the importance of making rough engineering estimations in some situations.

This course focuses on the detail design phase during product development starting with a selected concept and ending up with a hardware prototype. A large part of the course is project based and a design process model is used to plan and manage the project.

### **Learning goals**

After completed course, the student shall be able to;

LG1: Plan and contribute at development of as well integrated as modular mechanical products.

LG2: Design and detail as well components as subsystems of complex mechanical products, from concept to manufacturing documents and prototype.

- Apply of a systematic model based development process at analysis, simulation and verification of product concepts during the detail design phase. This includes generation of load data on a system level as well as on component level.
- Select material and manufacturing methods, create manufacturing documents for a prototype and finally assemble and test the completed prototype.

LG3: Apply principles for sustainable design and reflect on environmental consequences of e.g. material selection design detailing.

## Contents

- Project work (mainly industrial problems with a focus on detail design)
- Project planning
  - Group evaluation and composition
  - Planning tools
- Design methodology
  - Design process
  - Solution generation and evaluation
- Sustainable development
  - Material and energy resources
- Modeling and simulation analysis
  - Methodology
  - Tools
- Manufacturing
  - Methods for prototype manufacturing
  - Manufacturing documents, drawings etc.
- Installation, testing, redesign, evaluation
  - Sensors
  - Collecting, handling and presentation of measured data
- Presentation and communication - models, oral presentation, technical report

## Activities

### Seminars

**Seminar is a compulsory activity which also is graded.** The seminars are held by the students where they present a topic or focus area that is related to their project and considered interesting for all students take part of to get a common understanding. We usually have 3-4 seminar occasions during this course.

### Project

An important part of the course is the project development work carried out in groups of 4-6 students. The projects share a common purpose to design and develop a product concept at a high technical level in close collaboration with a company.

In this course, the starting point for the project work will be the conceptual solutions developed in course MF2076, Machine Design advanced course, part I.

In this course, MF2077, these solutions will be further developed and detailed ending with manufacturing and assembly of a prototype. The project work is carried out mainly outside of scheduled times, but with weekly scheduled meetings with supervisors. We **require an attendance rate of at least 80-90%** on these project meetings. The assessment of the project work is made both on a group level where all members are equally responsible for the project result

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and on an individual level where a portfolio in combination with individual discussions is used for assessment.

### **Portfolio**

A portfolio is a document that all students should create and update. The document should be a live document showing the students contributions to the project and what the student has learnt. To store and manage portfolios we use the Canvas learning management system. The portfolio in combination with an individual discussion is used as a part of the individual assessment of the project work.

### **Presentation of project results**

The following results documentation and presentation are required:

- **An oral presentation** of the project task and results together with project team
- **A documentation of the final design in a project report (deadline 23/12 – 2022)**
- **A short version of the project report (10 pages) (deadline 23/12 – 2022)**
- **A poster, presenting the project results (deadline 12/12 – 2022)**
- A structured collection of all relevant models and analysis results, including reports, poster and presentation copied on an USB-stick or a cloud storage). **(deadline 23/12 – 2022)**

### **Prerequisites**

Approved on MF2101 Machine Design and MF2076 Machine design advanced course part1.

### **Examination**

To pass this course requires an approved project work, both individually and as a group. In addition, active presence and participation at the seminars are required.

### **Examination of learning goals:**

LG1: Presentations and discussion on the weekly project meetings where we require attendance.

LG2: Presentations and discussion on the weekly project meetings and at course end in the form of project reports, presentations and demonstration of prototypes. In addition, we require an individual reflection report and we will have individual meetings with all students.

LG3: Presented in the project report and in the individual reflection report.

**Grade criteria**

<b>LG</b>	<b>Exami- nation</b>	<b>P/E</b>	<b>C</b>	<b>A</b>
LG1: Plan and contribute at product development.	Project meetings, Portfolio, Seminars	Be able to describe project plan and follow up of the plan for their own project in the course.		
LG2: Design and detail components as well as subsystems.	Project meetings, final report, final presentations, Portfolio.	Be able to describe how a model based process model has been used on an overall level for concept development, analysis, material selection, manufacturing documents for the part of the project that has been the students' responsibility.	In addition be able describe how it has been used for more detailed analysis and studies for the part of the project that has been the students responsibility.	In addition, be able to perform and explain detailed analysis on systems level for the project as a whole including analysis of loads, stresses, behavior manufacturing analysis and manufacturing documents.
LG3: Apply principles for ECO-Design	Project meetings, final report, final presentations, Portfolio.	Be able to describe what trade-offs and principles that have been used for the decisions made in the project.	-	-

The level of fulfillment of learning goal 2 (LG2) is transformed in a score for both an individual part and a group part. Score 10 correspond to an E and 20 to an A with the other grades in between. The course grade is based on the sum of the individual achievement and the project result (group work). This is calculated based on a weighting schema, see Table 1.

<b>Activity</b>	<b>Credits</b>	<b>Weight</b>	<b>Weighted point</b>
Individual achievement	20	1	20
Project results	20	2	40
<b>Total</b>			<b>60 p</b>

Table 1: Tasks in the examination and their credits.

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This gives a total of 60 p with the following grade limits;

Final grade    E  $\geq$  30p  
                  D  $\geq$  36p  
                  C  $\geq$  42p  
                  B  $\geq$  48p  
                  A  $\geq$  52p

### **Reference literature**

Machine Elements in Mechanical Design, Robert L Mott, ISBN 0-13-197644-3

The Mechanical Design Process 4<sup>th</sup> edition, David G. Ullman, McGraw-Hill  
2007.

Engineering Design, A systematic approach 3<sup>rd</sup> edition, G. Pahl, W. Beitz,  
Springer Verlag 2007.

Mechanical and Metal Trades Handbook, Germany 2010

### **Learning management system**

In this course, we use Canvas learning management system for distribution of  
material delivery of home assignments and discussions.

We will also use portfolios for each student to document their contribution and  
learning in the project work.

**Examiner: Kjell Andersson**