2021-01-15

Maskinkonstruktion, KTH

Course PM: MF2076 - VT 2021 (9 hp)

Machine Design, advanced course, part I

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 the solutions 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 early phases of product development from initial product idea to a selected concept and manufacturing of a prototype. A large part of the course is project based and a design process model is used to plan and manage the project. In this course we will introduce and apply; model based product development, manufacturing technology, Eco design, and rapid prototyping, in the scope of the project task.

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: Apply a systematic model based development process for the early conceptual design phases with a specific focus on:

- Development of a requirement specification.
- Application of methods for concept generation and evaluation of concepts using matrix based methods.
- Analyses and verification of concepts properties against the formulated requirements in the requirement specification.
- Creating simplified physical or digital models for evaluation of concept properties.

LG3: Apply principles for sustainable design and reflect on environmental consequences of e.g. concept selection or material selection during conceptual design.

Contents

- Project work (mainly industrial problems with a focus on detail design)
- Project planning
    - Group evaluation and composition
    - Planning tools
- Design methodology
    - Design process
    - Information retrieval, benchmarking, requirement specification
    - 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

First of all, this course round in spring 2021 is due to the covid-19 epidemic planned a bit differently than normal. We will start the semester with the plan to have all course activities in P3 online supported by Canvas system for course management and the Projectplace system for project management.

Home assignments
Home assignments are given as individual tasks to solve and to practice some basic engineering skills needed for a design engineer. In this course we have 3 home assignments, two graded and one not graded.

Project
An important part of the course is the project development work carried out in groups of 4-5 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 only the conceptual phase is covered, this means that the projects cover the tasks of project planning, requirements specification, concept generation, evaluation and selection of a concept solution. This concept solution will be the starting point in MF2077, Machine Design advanced course, part 2. In MF2077 the concept will be further developed and detailed, ending with manufacturing, assembly and testing of a prototype. The project work is carried out mainly outside of scheduled times, but with weekly scheduled meetings with supervisors. The assessment of the project work is made both on a group level where all members are equally

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

Project meetings
All project groups will have scheduled weekly meetings with the supervisors. These meetings are **compulsory to attend** for all students. We also require that each meeting has an agenda with a prepared presentation and is documented in a meeting protocol. 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 and on an individual level where a portfolio in combination with individual discussions is used for assessment.

Compulsory activities

In addition to what is mentioned about the project meeting we also the following as compulsory activities to attend;

- Guest lectures
- Laborations (1 planned in p4)
- Part time presentation
- Final presentation

Project management system
We will use the system Projectplace (www.projectplace.se) for project planning, management and file storage. We will also use the Canvas system for distribution of course material during the course.

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.
This portfolio should also contain a reflection about the course activities and what you have learnt during the course. A template for the portfolio will be placed on Canvas.

Prerequisites

The course requires that the compulsory modules of the curriculum for the master track in industrial product development have been approved.

Examination

To pass this course requires approved home assignments, approved written exam and approved project. In addition we require compulsory attendance at project meetings.

Examination of learning goals:

LG1: Presentations and discussion on the weekly project meetings where we require attendance. Also examined at the written exam and with one home assignment.

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. Also examined at the written exam and with home assignments.

LG3: Presented in the project report and in the individual reflection report. Also examined at the written exam.

Grade criteria

LG	**Exami-nation**	***P/E***	***C***	**A**
LG1: Plan and contribute at product develop-ment.	Project meetings, Portfolio, HA	Be able to describe project plan and follow up of the plan for their own project in the course.		
LG2: Apply a systematic design process approach.	Project meetings, final report, final pre-sentations, Portfolio. HA	Be able to describe how a model based process model has been used on an overall level for concept development, analysis, material selection, etc. documents for the part of the project that has been the students' responsibility.	In addition be able give a detailed description of how it has been used for requirement specification, concept generation etc. for the part of the project that has been the students responsibility.	In addition, be able to apply the used model based process approach on a new prospective project task which is be presented for the student.
LG3: Apply principles for ECO-Design	Project meetings, final report, final pre-sentations, 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 assessed as based on the following components; project work with both an individual part and a group part, home assignments, and written exam. We use a score between 0-20 to assess project work and home assignments where the score of 10 correspond to an E and 20 to an A with the other grades in between. Please note that assignments handed in after the given deadline can only obtain 10p as a maximum score. The course grade is given by the weighted sum of project work, home assignments and written exam, see Table1.

Activity	**Score**	**Weight**	**Weighted point**
2 home assignment	20	1,5	60
1 written exam	40	1,5	60
1 project individual	20	1	20
1 project results	20	2	40
Total			**180 p**

Table 1: Tasks in the examination and their score.

This gives a total of 180 p with the following grade limits;

Final grade E >= 90p
D >= 108p
C >= 126p
B >= 144p
A >= 162p

Course literature

The Practical guide to project management, Christine Petersen, PMP, free available at bookboon.com

Reference literature

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

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

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

Mechanical and Metal Trades Handbook, Germany 2010

Learning management system

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

Written exam: Monday June 7, 2021 kl 8-13

Examiner: Kjell Andersson