MG2022 Advanced CAD & FFF
Course Memo & Grading Criteria

General course information

Course code & name: MG2022 Advanced CAD Modelling and Rapid Prototyping, Project Course
Course instructors: Lasse Wingård (lw@kth.se, 790 9077) & Per Johansson (pj@kth.se, 790 6372)
Classrooms: M221 & M226, Brinellvägen 68, ground floor, on the left hand past the table tennis table.
Course material: Exercises and assignments distributed to registered course participants through Canvas.

The overall goal of this course is to make you familiar with most of the functions for part modelling in one state-of-the-art CAD system for mechanical design. As a result, you will become an advanced user of the system that we are using, Solid Edge from Siemens PLM Software, but that is an effect, rather than a goal. The skills you acquire during this course could be applied in any modern CAD system from the major vendors, as the functionality and modelling methodology is, if not identical, at least very similar between these systems[1].

Besides the advanced CAD part, there is also a small module in the course on design and preparation for additive manufacturing (alias 3D printing/rapid prototyping/freeform fabrication, …). This module includes an exercise and a small project task, where you are given the opportunity to design and manufacture a model of your own choice, using our additive manufacturing equipment.

The intended learning outcomes are that:

After passing the course, you will be able to:

- *use a structured approach, to utilize the full range of functions available in a modern CAD system to create robust CAD models of parts and products with complex shapes and structures*
- *adapt and prepare CAD models to make them suitable for manufacturing in an Additive Manufacturing machine*

Subjects trained during the course are:

- *Advanced solid modelling operations*
- *Modelling of parts with complex shapes and freeform surfaces*
- *Diverse and unconventional methodologies for CAD work*
- *Modelling operations for sheet metal parts*
- *Adaptation and preparation for additive manufacturing*

The classes in this course are given during two periods/quarters each year.

During the first of these periods, there will be classes twice every week. We will give you a number of gradually more advanced part modelling exercises[2] to work with. You will be given a reasonable time to (try to) complete each of these exercises, varying from one hour of one class to several weeks of classes. When this time has elapsed for one exercise, we will make a demonstration of our approach to the modelling of this exercise, before distributing the next one. We request you to show the result of your modelling efforts after each exercise, and when you have done this, we will record the approval of this exercise in Canvas. You can check in Canvas what have been recorded for you, under *Grades* (*Omdömen*).

During the second period, there will be classes once a week, and there will be no prepared exercises. The classes will be for supervision and help on the project task of creating CAD models of a number of different drawings of your own choice, chosen from the drawings provided electronically through Canvas. Depending on which grade you aim at, you have to complete different numbers of models from drawings, as specified below.

Attendance at classes is not compulsory, but highly recommended, in order to get assistance with the exercises and the project tasks. The completion of all exercises during the first period and of the

[1] The dominant systems for mechanical CAD are: **CATIA** and **Solid Works** from Dassault Systèmes; **NX** and **Solid Edge** from Siemens PLM Software; **Creo** from PTC; **Inventor** from Autodesk Inc.
[2] Anchor block; Feed bracket; Coupler; Surface modelling exercises #1 & #2 (or Gearbox side cover, for those who have already done the surface modelling exercises); Injection Pump Shelf; Front spring seat; Sheet metal modelling exercise; Exercise in preparation for additive manufacturing

project tasks during the second period are however compulsory, in order to pass the course. Below, you find all details on the examination and grading in the course, including deadlines.

Requirements and Grading Criteria

All the exercises of the first period, see footnote above, should be documented in a short written report (typically 5-10 pages), including your approach and a reflection on what you experienced and learnt for each of the exercises. We do not want a complete description of the modelling process for all the models, but you should describe the highlights and the most interesting aspects of each model, in text and figures. When all compulsory exercises have been completed and the report on these have been uploaded to an assignment in Canvas, we will comment on your report and suggest improvements. If we judge your report to be good enough, you will get the first 3 credits of this course reported in Ladok, with a **P**(**ass**) grade. If it is judged to be of insufficient quality, we will ask for a revised version before you get the grade reported. This grading of this will not influence your final grade in the course, but the comments made to your report will help you in improving the quality of your final report, which will be graded.

For a passing grade (E or D, depending on our judgement of the quality of your models and report), you should:

- document your work (i.e. all exercises and assignments you have carried out throughout the course), in a written report (including the revised version of the report on the exercises of the first period) and present it together with the corresponding models in an individual grading discussion with Lasse or Per.
- complete all the tasks (including documentation) and book a time for a presentation & grading discussion, no later than April 1st, 2020. If your report is submitted later than April 1st, 2020, but no later than May 1st 2020, your grade will be reduced by one step. After May 1st 2020, only grades D or E will be awarded. Presentations/grading discussions may be held after April 1st and May 1st respectively.
- complete all the exercises in ***solid modelling*** (*Anchor Block, Feed Bracket, Coupler/Kopplingsklo, Injection Pump Shelf)*, in ***surface modelling*** (*Surface modelling exercises #1 & #2, Front spring seat/Framfjäderfäste*), in s***heet metal modelling*** (*ordered sheet metal modelling*) and in ***additive manufacturing preparation***.
- create part models of at least two different drawings, where at least one should be of red difficulty level. **These two models do not count in the collection of points for higher grades.**
- create a mailbox CAD model utilizing the sheet metal modelling functionality of Solid Edge, see separate document distributed during period 3/spring semester.

For a higher grade (D, C, B or A, depending on the drawings you have modelled and our judgement of the quality of models and report). In addition to the above you should complete the following tasks:

- from the original drawing and the corresponding part model made by fellow student, make an analysis of that student's modelling work (on a yellow or red level drawing), write comments about the quality of the model and if possible and necessary suggest improvements of the modelling process and the result.
- perform a self-critical reflection on the work you have done during the course and the results you achieved and present these reflections in writing before, and orally during the individual grading discussion.
- collect points by creating additional part models from drawings according to the following (explanation of the drawing categories on the following page):
  Models of red drawings give 2 points; models of yellow drawings give 1 point.
  N.B. The two compulsory models do not count in the collection of points for higher grades

- **For grade D/C** – Collect 3 points by creating part models from at least two drawings, where the models are of different type.
- **For grade C/B** – Collect 5 points by creating part models from the drawings where at least one is of category red
- **For grade B/A** – Collect 8 points by creating part models from the drawings where at least two are of category red

Drawing categories: (green drawings are used for individual training only)
Yellow – complex modelling, complex forms, surface modelling - help is necessary
Red – very complex modelling, a lot of dimensions, complex forms, no guarantee that everything can be modelled according to the drawing - expert help is required

Offer (non-compulsory task):

carry out an additive manufacturing preparation process for a part model of your own choice - prepare the part model for additive manufacturing in a scale which limits the total material consumption (model and support material) to a maximum of 125 cm^3, create an STL file and do preprocessing in Insight, for manufacturing of your part in our **Fortus 400mc small** FDM machine, specifying the model material to be ABS-M30. Upload your *.cmb* file in Canvas. We will collect a number of models and build them in one or more batches.