Critical Design Review

MISCE project

Mechatronics for Improving and Standardizing Competences in Engineering

Competence: CAD Software

Experimental exercise for mechatronics systems: Designing with CAD software

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This document is the Critical Design Review of the technical competence ‘CAD Software’. It details the complete design for mechatronics systems with CAD software

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1 Introduction

1.1 Scope

This document presents the detailed design of the CAD modelling exercise developed in the framework of the MISCE project. The main objective is to improve the acquisition of technical competence:

C16. CAD Software

which related skills are (see Table I):

Table I. Skills of CAD Software

S1.1.	To properly select the CAD software according to their main features and the project requirements
S1.2.	To be able to interprete technical drawings
S1.3.	To have the basic knowledge necessary to recreate the geometry of machine elements and its modification
S1.4.	To know how to efficiently use the CAD program to create parametric 2D and 3D technical drawings
S1.5.	To know how to use CAD systems to design a simple device or mechatronic system according to the given specification

1.2 Preliminary definition

The CAD Software exercise is an effective educational tool for engineering students to acquire fundamental skills in 2D and 3D modeling, interpretation of technical drawings, and creation of documentation using professional CAD systems. This activity supports practical learning, increases software flexibility and awareness, and provides a foundation for more advanced mechatronic system design tasks in the future.

This exercise introduces students to professional CAD software environments. Students are asked to complete a 3D modeling task based on given reference drawings and technical requirements. The task is software-agnostic and may be completed using different CAD tools. Example programs were chosen. The ability to use different programs will make it easier for students to make choices in the future. The student as a future employee will have a wider range of company choices. The selected systems: SolidWorks, Catia, Siemens NX, and Inventor are presented below (Fig. 1). Examples of performing specific tasks are presented in exercise instructions for students. Students can choose any program and should perform similar exercises.

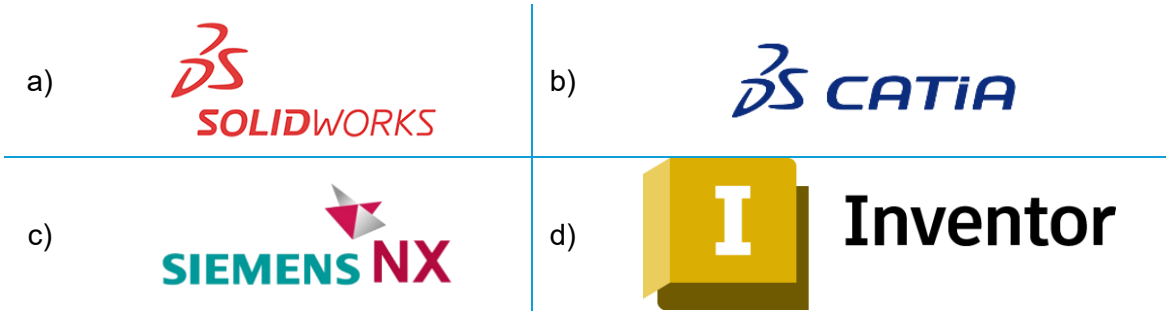

Fig. 1. Selected systems: a) SolidWorks, b) Catia, c) Siemens NX, d) Inventor

The student should create an CAD model and engineering drawing using solid modeling tools. An example of the shape of the part is shown in Figure 2.

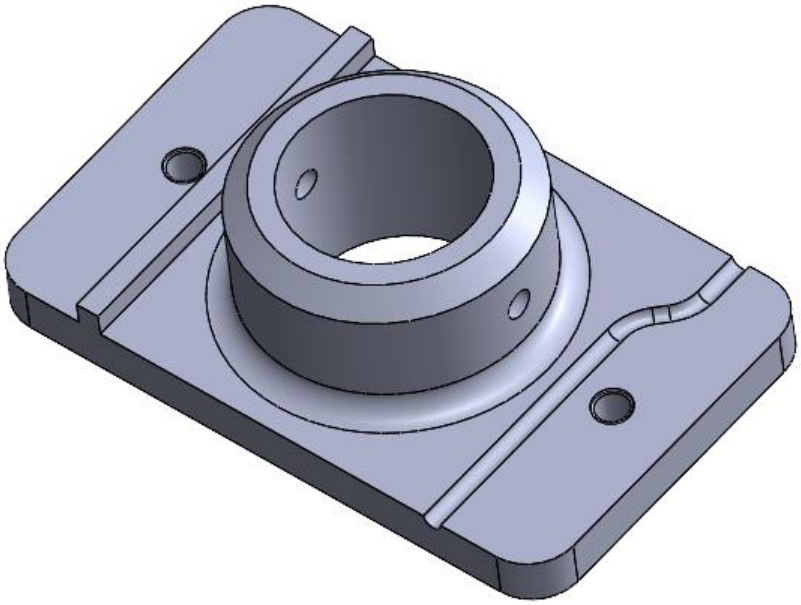

Fig. 2. Example model to be made in exercise 1

The method of making the model and the functions used are presented in the exercise instructions for students. The student model does not have to be exactly as shown in the example, but the features of the proposed program should be used.

The second exercise introduces the student to making assemblies and parametric modeling issues. The exercise shows a plate simulating a valve system.

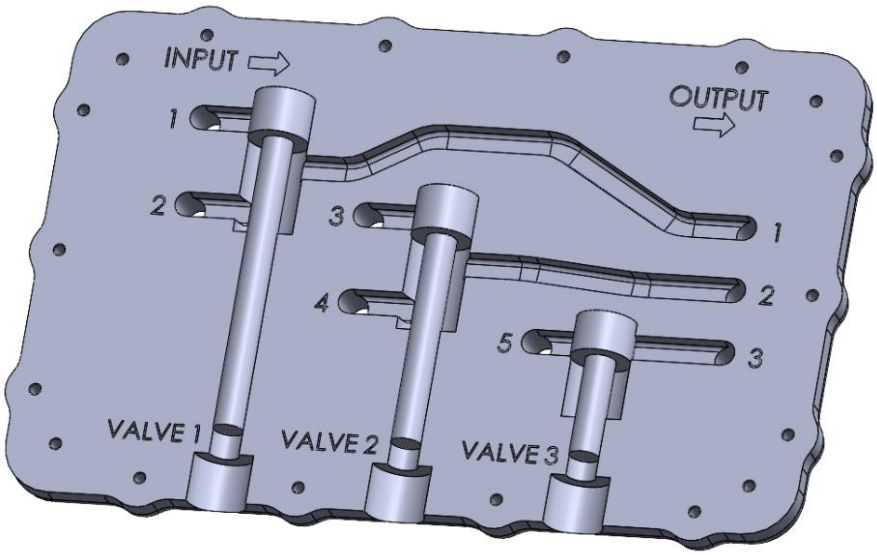

Fig. 3. Example model to be made in exercise 2

A student, knowing the basic tools of solid modeling, should create his own model of parts and assembly or use an example. In the "exercise instructions for students" ways of parametric modeling were presented.

1.3 Technical requirements

The technical requirements to efficiently contribute to the achievement of skills of Table I are:

R1. Environment must support 2D sketching and 3D modeling. Example CAD software: Catia, Autodesk Inventor, SolidWorks, Siemens NX.

R2. The system must allow generation of 2D drawings from 3D models. Example CAD software: Catia, Autodesk Inventor, SolidWorks, Siemens NX.

R3. Exercise materials must be provided in editable and printable formats.

R4. Students must be able to save and export their results in standard formats CAD files and documents, e.g. pdf, docx.

2 Hardware design

2.1 Functional parts

No physical hardware is needed for this educational exercise. Students work exclusively on PCs with installed CAD software. Recommended components include:

- Windows 10 64-bit or Windows 11 64-bit
- Licensed CAD software (SolidWorks, Inventor, CATIA, NX, additional software - Microsoft Office Excel and Word)
- Hardware:
  - Intel 64 or AMD64 clocked at 3,3 GHz or higher,
  - 32 GB RAM,
  - hard drive: 512 GB or larger, SSD recommended,
  - graphics cards: NVIDIA Quadro and AMD Radeon Pro at 4 GB or higher
- Optional: 3D mouse and second monitor

2.2 Mechanical design

Students are to construct a 3D model from orthographic projections. The model includes basic and advanced features like extrusion, cuts, rounds, and patterning. Designs are created with consideration for future manufacturability.

3 Software design

Students open their chosen CAD tool, start a new part file, and begin a 2D sketch on a default plane. The base shape is then turned into a solid model using appropriate CAD features.

The selected CAD application should support:

- Parametric solid modelling
- Drawing generation
- Exporting to standard file formats
- Dimensioning, tolerancing, and section views
- Feature history and model hierarchy

The result should include the native CAD file, exported 3D model (.STL or .STEP), and a 2D technical drawing in PDF. Models will be reviewed based on dimensional accuracy, drawing clarity, and conformity to task requirements.