Aalto University
School of Engineering

MEC-E1003
Machine Design Project

Sept 16, 2022

Prof. Sven Bossuyt

Learning goals for the course

Students...

1. Can relate theory and exercises to practice
2. Can iterate a design from the initial concept to a working prototype
3. Can document their contribution within a team-based effort
4. Are familiar with typical issues in project management and teamwork, and ways to address those issues

Credits: 5 ECTS

Grading: 1 - 5

Duration: 9.09.2022 - 16.12.2022

Teacher in charge: Sven Bossuyt

Access to prototyping facilities is restricted this year, due to ongoing construction, so expectations and assessment criteria for the prototype will be scaled back accordingly.
However, you must still validate your concept and iterate the design with some prototype, and produce design documentation for prototyping and testing

Schedule: Overview and milestones

Week	Deadline	Description
Week 35-36	Sept 9	Group selection and pre-questionnaire
Week 37	Sept 16	Design brief for group project
Week 37-38	Sept 23	Stirling engine starter project (individual work)
Week 40	Oct 7	Initial concept for group project
Week 43	Oct 28	Concept pitch + peer review & 1st evaluation questionnaire
Week 46	Nov 18	Status report & 2nd evaluation questionnaire
Week 47		Status report peer review
Week 49	Dec 7	Information poster
Week 49	Dec 9	Gala: Prototype demonstration & gala reflections
Week 50	Dec 16	Final report & final evaluation questionnaire

Stirling engine starter project

9.09.2022 - 23.09.2022, Friday 12.15 - 16.00

Assemble the Stirling engine kit and Test Performance (individual work)

- Students will be provided with disassembled stirling engine kits, a toolbox with the parts in it, and with a set of hand tools and measurement tools.
- Each student, working alone, will check out a kit for 2 days.
- In those 2 days, they follow provided design documentation to check each part against part drawings, to follow assembly instructions to assemble the engine, and to check the assembly against assembly drawings.
- They operate the engine and confirm performance

Group project

Students, working in teams, will complete a specific mechanical design task, representative of mechanisms used in machines. They will develop an initial concept, build a prototype to demonstrate its working, and carry out more detailed designs of critical components.

For the concept, as a team, reflect on everyday- or industry-related activities and solutions you would like to improve, or to simply try and replicate. In other words, start with an existing object, and design it to be in some way better (perhaps better by some metric that was not important for the original design, sustainability for example).

Project-based learning in this course will be supported by the theory and exercises taught in the courses from the common studies, taught concurrently.

In the end of the course, there will be a final gala where you will be required to demonstrate the prototype of your solution.

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Previous years

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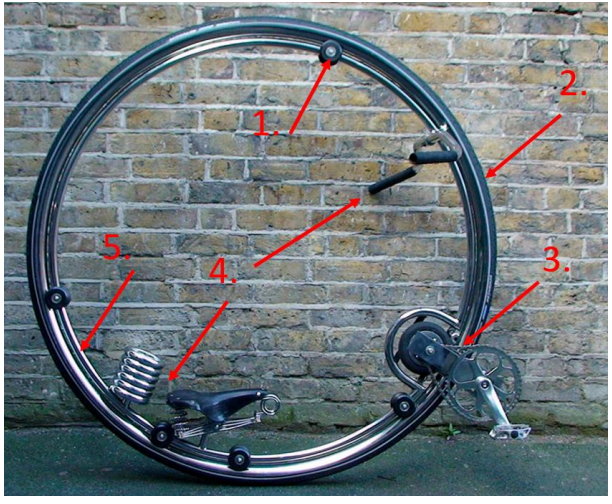

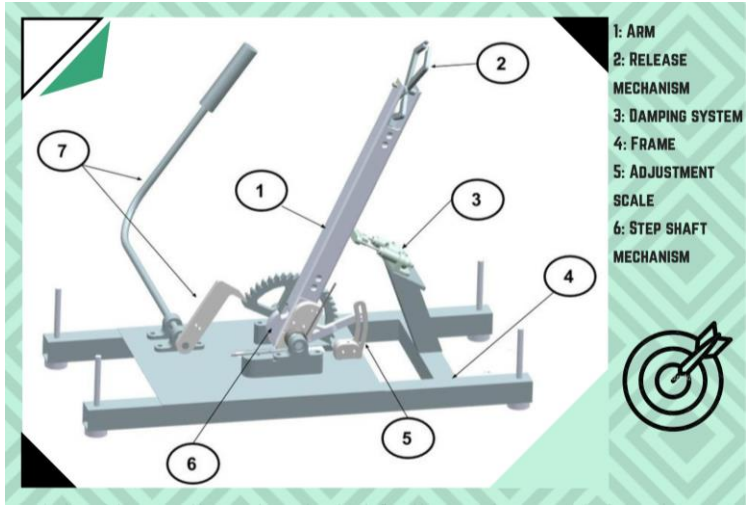

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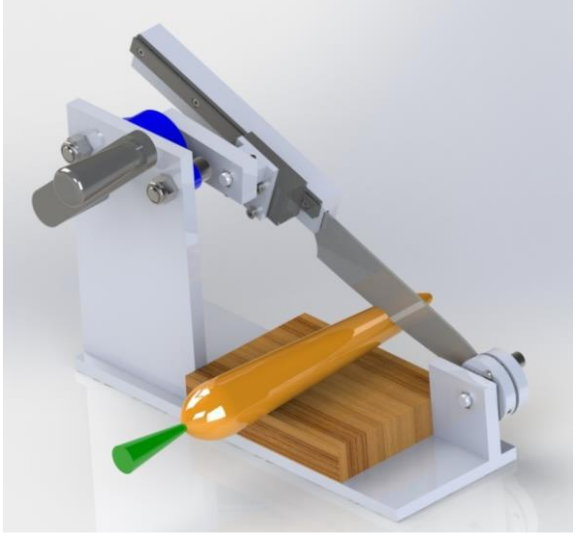

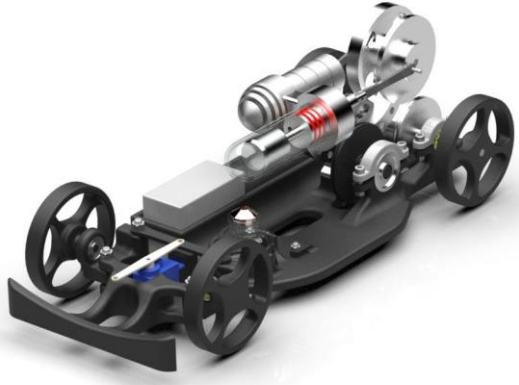

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Design Brief

Requirements & Constraints

There are general requirements & process requirements

Requirements = Set by staff

Constraints = Set because of realities

Must = You have to do this

Recommended = You don’t necessarily have to do this

General requirements

Must have sufficient complexity to showcase mechanical engineering design. Including at least 5 machine design elements (like power screw, spring, bearing, gear, clutch, brake, belt, chain, coupling, linkage, and/or cam) is sufficient.

Must have some functionality.

Must be ready for exhibition and live demonstration on Dec 9

Recommended to focus on mechanical engineering, as the course cannot support you with electronics, programming, and other such features.

+ The course can offer limited budget for the teams

+ The course may be able to accommodate collaboration with external stakeholders who have different constraints and requirements

Process requirements

Must be modeled in 3D CAD with a meaningful structure, dimensions, and tolerances, with regard to its operation.

Must be structurally verified and analyzed with MBS.

~~**Must** be manufactured according to CAD drawings.~~

Must Include at least 1 part, whose shape is optimized with FEM, and material with Granta Edupack.

Must identify at least one part for which to verify key tolerances with appropriate measurement devices.

Recommended to use Siemens NX for concurrent development.

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Some tips

Project management

Frequent team meetings are essential

- Ensure common goals by sharing your expectations
- Focus on good communication

Be clear who does what

- Mutually agree on work allocation
- Decide if you want a project manager in your team

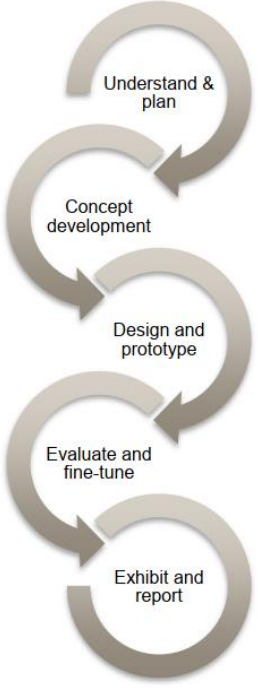
Follow a systematic process

- Maintain a project plan
- Identify, so as to mitigate potential risks
- Iteration is the key!

Document all the steps

- Have a draft report & update as the project progress

Project management



“Fail early to succeed sooner”

Please ask, rather than waiting for us to notice what you need.

Figure adapted from Product Design and Development process by Ulrich & Eppinger

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Questions?

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Collaboration ideas from other courses or research projects