

Synthesis Challenge 1 Summary

Our Synthesis Challenge 1 is about gear train design. For the best learning experience, we recommend **watching the videos linked as a Canvas announcement** to get a fun introduction. This document shall act as a reference you are presented with the **key facts in a condensed view**.

A sketch with important dimensions and indicative positions for your gears is shown in Figure 1.

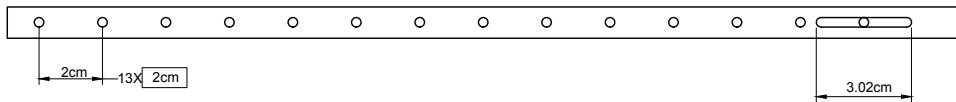


Figure 1: Important Dimensions

Attached to this PDF you will also find a “doodling-template” (drawn to size: A4 landscape) to facilitate your concept design activities.

Functional Requirements

The basic requirements that determine **if your design will be considered to be working or not** are as follows:

- Rotation shall be transmitted from the Input-Shaft to Output-Shaft using gears.
- A **Speed Reduction Ratio** of exactly $\frac{8}{1}$ needs to be achieved *“this means 8 turns of the input shaft shall result in 1 turn of the output shaft”*.
- The direction of rotation shall be maintained. *“if the input shafts rotates counter-clockwise, the output shaft shall also rotate counter-clockwise. Think about how that can be achieved, you might want to re-watch the videos”*.

Other requirements and constraints

The following requirements and constraints (among other) set further boundaries for acceptable solutions.

- Maximum number of shafts that can be used: 8, *“but think about the implications of using many shafts for the Objective Function”*.

- All holes (H1-H13) are fixed in position, only hole H14 can be considered a slot. This allows a maximum movement of 1.51cm to the left and right.

Objectives

Your design shall at the same time minimise the number of shafts used, the size of the gears and the distance of repositioning hole 14. This is summarised by this function:

$$\min : P = x \cdot N + y \cdot \sum_n^N (\Pi \cdot r_n^2) + z \cdot l_r^3$$

Where:

- $x = \frac{\$7}{gear}$, $y = 0.1 \frac{\$}{cm^2}$, $z = 10 \frac{1}{cm}$
- N = overall number of gears
- r = radius of each gear [cm]
- l_r = distance of repositioning the output gear [cm]

Description

One part of the mark you are about to receive for this assignment is determined if your design fulfils the requirements. The other part is determined by how well your particular design performs - in other words: “how well you minimise the Objective Function in comparison to the rest of the class, so: Yes! This is a challenge”.

