



PART DESIGN

Mechanical Engineering CAD

SECONDARY & POST-SECONDARY

Project: Part Design

Time: 3 Hours

Marks: 25

1 Background

For this part of the competition, you will be doing part design for 3D printing. This is intended to reflect a real-world scenario where you're asked to come up with a part to solve a design problem and 3D print that prototype.

2 Task

The task is to finish the design of a handheld coffee grinder. The body is complete, but it's missing a handle and the cup for the finished grounds. More details will be provided in the problem definition, later in the document.

This competition is to take 3 hours, additional time will be given to compensate for computer crashes up to a maximum of 15 minutes.

You are expected to deliver a small drawing package of the newly designed parts, 3D render and the STL files for the finished parts.

3 Problem Definition

You are given:

- This document
- 8 step files for the coffee grinder body assembly
- Drawing package showing how the grinder is assembled and the design requirements

With this, you are expected make an assembly of the coffee grinder using the provided step files, then design a cup and handle assembly to complete the grinder. The design goals in the next section should guide the design process.

3.1 Design Goals

These design goals are to help guide the design. Marks will be associated with them, but it's more important to have a completed design than ensuring each box is checked. Do as many as you can, but don't get hung up on meeting them unless you have extra time.

3.1.1 Overall

- Use as many or as few parts as you see fit for both the cup and the handle
- The volume for all parts should not exceed 150 cubic cm
- They should be aesthetically pleasing
- These parts are going to be 3D printed, a good design should be able to be printed successfully. See Appendix A for design tips in this regard.

3.1.2 Handle Assembly

- One or several parts can be used to accomplish this
- The knob on the handle should fall within the range specified in the design requirements drawing
- The knob should not be larger than a 5cm cube or smaller than a 2cm cube
- A good design will have a knob that rotates, reusing the bearing part is allowed
- The handle should be strong enough for the grinder to work (minimum cross-sectional area of 0.5cm^2)
- A good design will prevent coffee beans from coming out of the top while grinding

3.1.3 Cup

- The cup should thread into the bottom of the body
- The cup should hold be between 70 and 90 cubic cm of coffee grounds
- A good design for the cup will share the same surface pattern as the body

4 Expected Outputs

The expected outputs are:

- Small drawing package
 - Three views with overall dimensions and an isometric view for each part that was designed, as well as for the final assembly
 - Volume for each 3D printed part (in cubic cm) should be present
 - Ensure all key design features are visible
 - Add notes for key design points on the 3D printed parts
- Render
 - Resolution of 640x480
 - Render should be of the complete coffee grinder assembly, including the 3D printed parts
 - Render must complete within competition time
- STL Files
 - Export each newly designed part as a separate stl file
 - This is required for evaluating the design portion of the competition

This project has 25 marks associated with it. The breakdown is as follows:

- 14 marks for the design. This will be evaluated based on the information provided within this document. All the expected outputs may be used to evaluate the design. Missing outputs will reduce our ability to evaluate the design, so make sure you have as much as possible.
- Drawing – 6 points
- Render – 3 points
- STL Files – 2 (+ 14 design points = 16) points*

* The STL files are required for evaluating the design, most of those marks will be lost without the STL file

6 Appendix A – Design for 3D Printing

Note: due to COVID, we will not be printing this year's parts. However, in future years this is what we expect to have available. Despite not printing the parts, you will be evaluated on how printable the parts are as designed.

The printers that this competition uses are fused filament modeling (FFM) type 3D printers. This means that the part is built up of layers of extruded printer filament. Because the context is to design a part that will be built, there are some design guidelines that should be followed for a successful print.

It should be noted that different printers, and even different configurations of the same printer, can result in different design guidelines. For the purposes of this competition, the following guidelines will be what is used for evaluation.

- Minimum wall thickness of 0.8mm.
- Maximum unsupported overhang of 1mm.
- Maximum bridge span of 20mm.
- Support will be required if an overhang angle is greater than 45 degrees or if a bridge is beyond 20mm. Ideally prints should avoid using support material, but it's okay to use it.
- If support material is needed, make sure there is enough space to remove it.

Also, here are some other pieces of information that may be helpful with the design:

- The material used is ABS plastic, it has a strength in tension (pulling) of roughly 4kg of force per square mm.

- The vertical axis of printing will have a layer height between 0.1 and 0.2mm, distances in this axis will become quantized by this layer height.
- 3D printed holes and shafts tend to turn out smaller than designed (connect points on a circle), so if a fastener is meant to fit in a hole, a nominal or loose clearance would work best.
- Outside square corners tend to swell. If one part is meant to fit into another part, chamfering or filleting outer sharp edges will improve the fit.