Term Design Project – Details ME170

Key Requirements:

- Design a new mechanical or electro-mechanical consumer product
- The product should have moving parts (i.e. a mechanism).
- The product should have stemmed from the Human Centered Design activity utilized in Labs 1-3. For this semester, the class will be considering Food on Campus and identifying unmet needs related to this topic. To do this, your team will interview people around campus who may experience this topic in a variety of ways. By talking to them about their experiences, you will identify unmet needs, then work iteratively to refine your understanding of how best to address these. Once a clear problem has been identified and you have a good understanding of how best to address it, you will develop a solution in the form of a physical, mechanical or electro-mechanical product. This product may be part of the larger conceptual solution, though your team must design a physical product which should be able to be manufactured at a large production scale.
- Design for annual sales worldwide of at least 1 million per year with a product life of at least 5 years.
- The product should be designed predominantly utilizing sheet metal stampings and plastic molded parts; and thus should have investments in hard tooling utilizing injection molds and progressive dies. Other off-the-shelf components such as fasteners, springs, and motors, and other processes such as stock machining or bar & tube may be incorporated as necessary.
- The product should be your own design and should have something new or different about it; innovation will be a portion of the grade. Your product does not have to define a new problem; it may provide a novel and/or economic solution to an existing problem.

Project Deliverables:

You will be graded on the following key deliverables:

1. Human Centered Design approach – Ideation process
2. Product Description
3. Concept Sketches – initial and finalized
4. Concept Selection Process (Pugh Matrix)
5. Product Design Specification (PDS)
6. CAD Models – Part and Assembly Models
7. **Assembly** Drawing with Cross-Sections
8. Exploded **Assembly** Drawing with Bill of Material (BOM)
9. Detailed Engineering **Part** Drawings fully dimensioned with tolerances
10. Tolerance Analysis
11. Materials and Manufacturability, including aPriori cost analysis

Forms of Submission:

1.	**Human Centered Design Presentation**	Lab#3 grade (~5%)

	• 5 slides documenting the human centered design process. Presented in Lab section (Lab#5) and assessed by peer evaluation.
	• Must include:
	  o Initial interviews - Who? Why? Key findings?
	  o Follow up interview(s) - Who? Why? Key findings?
	  o Point of view Statement
	  o ”How might we…” questions
	5 different concept sketches - Explain how these concepts address the unmet need.	

2.	**Preliminary Presentation**	~5% of final grade
	• Relatively informal meeting with TA and grader on a computer in the 1009 MEL EWS lab to demonstrate that your group is on track. • There is no formal grading rubric for the preliminary presentation. Your group should demonstrate to the TA and grader that you have made sufficient progress on the project. We will expect you to have a good chunk of the part CAD modeling done (6. above) and please have one detailed engineering part drawing (9. Above) complete (fully dimensioned and toleranced) so that the TA&grader can critique and, as necessary get you on the right path.	
3	**Design Presentation**	~10% of final grade
	• A ten minute presentation to your lab section colleagues, instructor, TA and Grader in your lab sections during the last full week of semester. • You will present using Creo, NOT Powerpoint, connected to a large screen projector in a presentation/conference room. See the class website for the room schedule. • Please bring all Creo files (part, assembly, and drawing) on a flash drive (reliable internet connection not available) or your own laptop provided your laptop has a VGA output.	
4.	**Final Written Report**	~20% of final grade
	• Create, pdf (i.e. printable) report containing each of the deliverables listed above • Due by 11pm Friday of ‘last week of classes’ (i.e. May 3rd) submitted to your Team’s grading TA via MechSE server under the “Term Design Project” link	

Project Deliverables in More Detail:

1. Human Centered Design Approach – Ideation Process

Presentation during Lab #5: Brief presentation, 5 slides summarizing the human centered design process. This should be a narrative explaining how the initial concept space was selected, who was interviewed and why, what was learned and how this informed the design concepts developed.

Must include:

- Initial interviews - Who? Why? Key findings?
- Follow up interview(s) - Who? Why? Key findings?
- Point of view Statement

- "How might we…" questions from Lab 3. Highlight the most useful one or two.
- 5 different concept sketches - Explain how these concepts address the unmet need.

Final Presentation: Brief overview of Human Centered Design approach employed, as presented in Lab 5.

Report: One-page narrative summarizing the human centered design process and how your final product design was informed by it. Describe the context of your product space, including the problems in this space, who experiences them, and how your product fits in this context. Explain how the insights gained from your interviews influenced your final design. Discuss the unmet need that your product aims to address, and how it was identified – including a discussion of your interviews and key findings. What features or elements of the design are intended to address the unmet needs identified? What is the intended impact of your design? How will it improve the experience of your target user(s)?

2. Product Description

Presentation: One member of the team should briefly describe the unmet need your design aims to address, then describe your product while another operates the computer with the Creo assembly model on the screen zooming in and rotating as needed. Also explode assembly model and include a brief animation to help clarify how it works. Be sure to mention how your product addresses the unmet need and highlight important aspects of functionality and novelty.

Report: This section should include about one page of narrative describing the product. Be sure to mention important aspects of functionality and novelty, and perhaps answer some of the questions: Why should I buy it? What is better about this product than other similar products in the marketplace? How does it address the needs of your target user? How does it fit into the larger context? This section may refer to the other deliverables (images, drawings, and tables) as needed.

3. Concept Sketches – Initial and Finalized

Presentation: Not required

Report: The sketches should be any initial product ideas plus finalized concept sketches that you used for the Pugh's concept selection matrix. Include a brief narrative explaining and reviewing these ideas along with an overview of how you navigated the ideation process.

4. Concept Selection Process (Pugh Matrix)

Presentation: Not required

Report: Include the Pugh Matrix you submitted during labs along with your brief narrative explaining the concept you chose and your justification for choosing it. Feel free to revise and update the original to better reflect your findings during the detail design phase.

5. Product Design Specification (PDS)

Presentation: Not required

Report: Include your PDS as submitted during labs but updated as necessary to reflect the evolution of the product during the detail design phase.

6. CAD Models – Part and Assembly Models

Presentation: Present your assembly model while you describe your product.

Report: A clean, colored assembly model can provide incredible benefit to both the engineering and marketing teams. The coloring scheme helps engineers distinguish between parts and does not need to be a photo-realistic rendering. Include both exploded and unexploded views (you do not need to include individual part model screenshots).You will be graded for your use of color and thoughtful selection of views. You will not submit any computer files or digital content with the final report. The final report is entirely a paper document.

7. Assembly Drawing with Cross-Sections

Presentation: Present your assembly drawing in Creo (not a pdf) with cross-sections through the assembly's main components and any motion axes.

Report: Your assembly drawing should include the three main orthographic views and cross-sections through the assembly's main axes and any motion axes. The three main orthographic views should all appear on the first sheet with cutting planes identifying the various section views, and the section views populating additional sheets. Section views should be scaled as large as possible so that it is easy to see how parts mate together (i.e. fill each page with each section)

All assembly drawings should be printed in black and white (not color). Hidden lines are optional and generally not shown in assembly drawings.

8. Exploded Assembly Drawing with Bill of Material (BOM)

Presentation: Present your exploded assembly drawing with BOM in Creo (not a pdf). It should fill the page and include balloons with parts separated out cleanly and clearly.

Report: Include a printed black and white exploded assembly drawing with bill of material and balloons to identify parts on the drawing. Your bill of material, exploded view, and balloons should appear on the same drawing sheet.

9. Detailed Engineering Drawings

Presentation: Present one detailed engineering drawing fully dimensioned and appropriately toleranced.

Report: A detailed engineering drawing should be completed for each manufactured part. Drawings are not required (and should NOT be included) for off-the-shelf parts. However, catalog and part number information should be included in the manufacturing BOM in section 10.

Your drawings will be graded based on the following criteria:

- Hidden lines shown in all views EXCEPT 3D isometric view
- Center lines on all circular features on all views
- Proper views included for all parts
    - Orthographic views for all parts
    - 8Cross-sections and detail views as necessary
- Specific tolerances included where necessary
    - ISO limits and fits included at motion connections
    - Tolerance scheme and units match title block information
- Overall clarity, scaling, and layout
- Text positioned outside views, no overlapping text, no lowercase text, etc.
- Arrowheads flipped correctly and cleanly, no overlapping arrowheads
- Proper dimensioning of features
    - No dimensioning to hidden lines
    - No zero-dimensions
    - All features are fully dimensioned; features are not over-dimensioned
- Proper use of the title block

You must complete the CAD *models* of all of your parts for the design presentation. However, you are only required to present one complete, fully-dimensioned *drawing*. In other words, you do not have to have all of your drawings completed for the presentation.

A detailed drawing of each manufactured part must be printed in black and white and included in the final written report.

10. Tolerance Analysis

Presentation: Not Required

Report: Demonstrate that you have selected appropriate tolerances, including ISO limits and fits, for one cross-section in your design that has a moving component. This should be a linear or rotary bearing arrangement. You should cover both:

- Radial or Diametral Clearance and Allowance, and
- Axial Clearance and Allowance

Please include in your report an image of the dimensioned drawing view or cross-section with the relevant parts labeled (i.e. "hole" and "shaft"). Please refer to the Drawing Tips document from Lab 8 for instructions on how to create an ISO dimension in Creo.

<u>For Radial or Diametral Clearance and Allowance:</u>
Identify the type of ISO fit that you propose (e.g. close running fit), the nominal and bilateral tolerances of the mating parts, and compute the worst case clearance and allowance.

<u>For Axial Clearance and Allowance:</u>
Identify the parts that make up the “hole” and the parts that make up the “shaft,” then compute worst case clearance and allowance, and comment on your choice of fit.

11. Materials, Manufacturability & Cost Analysis

Complete a manufacturing Bill of Materials (BOM) in Excel, using the "Manufacutring_BOM_Template.xls" as a template. Include a method of manufacture and cost

estimate for all parts. For manufactured parts, use aPriori to develop material, manufacturing, and tooling cost estimates. For off-the-shelf parts, include a part number, catalog name, and the price of the part as listed in the catalog. A short list of suppliers can be found below. You are by no means limited to this list.

Additionally, discuss in narrative form how you have considered materials, manufacturing methods, cost and selling price as an integral part of your design. What is the total investment in tooling required? Is the target retail/selling price realistic? Will the product be successful? What is the risk? (Low, medium, or high?)

Presentation: Present at least a preliminary version of your manufacturing BOM in Excel. Materials and manufacturing processes should be chosen based on a part's design and function. A part's design should also reflect and accommodate its material and manufacturing process. A good presentation might include one or two specific examples of this

Report: Complete the manufacturing Bill of Materials (BOM) in Excel and include the narrative above.