Final Report

This section provides some information on what should be included in each part of the team's report, along with some hints or examples that might be helpful in preparing that part of the report. Each part of the report is covered in a separate subsection. Do not copy and paste text from your lab memos into the report, but use them as reference for information.

Cover Page
Include
• Project title
• Team name and number
• Names of team members
• Course name and number
• DATE!!!

Hints
• Use a design or team letter on the cover page.

Table of Contents
Include
• Number of each part or section
• Part or section titles
• Page on which each section begins

Hints
• The page number for the Table of Contents is "i".
• If a section is several pages long, in the Table of Contents, give only the number of the first page of the section.
• Look in some published reports or books for examples.
• From the Microsoft Word menu, use “Insert”, “Reference”, “Index and tables…”, then click on the “Table of Contents” tab. This is the easiest and neatest way to create this section. You can also use it to update page numbers and heading names in the Table of Contents on command as you make changes to the body of your report.

List of Figures (Drawings)
Include
• Figure number
• Figure title (as it appears in the caption on the figure)
• Page on which the figure is found

Hints
• Assuming that the Table of Contents is only one page long, the List of Figures is on page "ii".
• Look in published reports or books for examples.
• From the Microsoft Word menu, use “Insert”, “Reference”, “Index and tables…”, then click on the “Table of Figures” tab. This is the easiest and neatest way to create this section. You can also use it to update page numbers and heading names in the Table of Contents on command as you make changes to the body of your report.
Executive Summary
This portion of the report is a very concise rehash of the entire report from the Introduction to the Conclusion. It can be used by a manager in a hurry to get a high-level understanding of the report without having to wade through many pages of detail. It is very brief, yet comprehensive in that it covers the following:

- Problem Statement
- Discussion of the design process
- Final design descriptions
- Final design performances
- Potential improvements.

Introduction
This part of the report has three main purposes.

- Problem Statement: First, it tells the reader exactly what problem is being solved or what piece (or pieces) of equipment will be designed.
- Significance of the project: Next, it explains to the reader why this work is important.
- Organization of the report: Finally, the last paragraph of the introduction gives the reader a "road map" to the report by describing the organization of the report, stating the sections that follow and a brief statement regarding each section's content. For example, the last paragraph might contain sentences such as, "Section 2 contains the requirements and constraints the design must meet." or "Description of the preliminary paper design is presented in Section 3.", if section numbers are used. Otherwise, this last paragraph would, in a similar fashion, only list the section titles in place of the section numbers, along with a brief statement about the contents.

NOTE: Very few people read a report from cover to cover. They scan the introduction to see whether the project being described is of interest to them. If it is of interest, they might check the "Organization of the Report" to see which section will provide the information they are seeking.

Requirements, Constraints, and Information Needs
How does the sponsor, i.e., the person who paid for the project, decide whether the design is acceptable? He or she makes that decision by determining whether the product meets all of the requirements and can be produced within the constraints. This section describes the requirements and constraints that will be used to judge the design. In it, team members also identify any additional information they will need to gather in order to design an acceptable product. Examples of a requirement, a constraint, and information need follow. Your report will need to include the following:

- **Requirements**: specific features that the design must have (e.g., performance specifications)
- **Constraints**: factors that limit design options (e.g., size, budget, material, etc.)
- **Information needs**: data that must be collected to evaluate proposed designs (e.g., test or calibration data)
Example:
Suppose a team is to design a child's car seat that converts into a stroller. A requirement might be that the seat be light enough for one person to lift easily. However, a constraint, at least here in Ohio, is the law that any child weighing 45 pounds or less must be in a car seat while traveling in an automobile. The car seat must, therefore, be strong enough to support a 45-pound child, and that certainly could affect the weight of the car seat. As a result, two information needs might be the density and strength of a variety of materials that could be used in a car seat.

1st Chip Design Concepts and Analysis
The reader will turn to this part of the report to learn about the team's 1st chip design. Some readers will learn more by reading a written description, some will prefer an illustration, and still others will use both. Thus the team must provide both, a clear written description and illustration of the concept and a stated link between the text and the illustration.

The team reports on the 1st chip design and the actual design progression, in light of the requirements and constraints, and on its 2nd chip design decision. The reader should be able to follow the team's reasoning as it accepts or rejects all or parts of each concept and selects a final design. In addition, the team will describe any refinements to the design (include all relevant revisions to illustrations) and the reasons for them. All calculations (including MATLAB, Excel and paper-based calculations) should be presented. You will include the following:

• Introduction to the section
• Discussion of 1st chip design and its detailed mathematical justifications
• Discuss how the feedback was incorporated
• Changes made to the 1st chip design concepts and their revisions in light of the requirements and constraints
• Selection of the 2nd chip design
• Justification of the selection based on requirements and constraints

Hints
• Think of the written description of as what a team member might say in a telephone conversation with a potential customer who has asked for a description of the design. The goal is to paint a "mental picture" of the concept.
• The concept should be described in detail.
• Stick to the facts. This is not an advertisement. It is a formal, professional report.
• Include illustrations of the concept as and when needed.
• Refer to the illustration in the text so that the reader knows the illustration is available. Here are some examples of references to an illustration: "The three-wheeled stroller, shown in Figure 3.5, is..." or "One unique feature of this concept is the detachable canopy. (See Figure 3.7.)"
• Illustrations should follow the paragraph in which they are first mentioned, if the illustrations occupy less than a full page. If an illustration requires a full page, it should be on the page following the one in which it is first mentioned.
• Each illustration (figure) should have a number and a title. For example, “Figure 3.5. Three-Wheeled Stroller/Car Seat Combination in Stroller Mode.”

2nd Chip Design
If the reader turns to this section first, he or she should find a written description of the 2nd chip design that provides a clear "mental picture" of the design. That description should be followed by a complete Solidworks drawing of the design. At the end of the description, be sure to tell the reader that the working drawings follow. Include the following:
• Introduction to the section
• Description and comparison of the designs
• Accompanied CAD/other drawing Summarize the paper and actual design progressions
  i) Show design calculations for at least one feature.
  ii) Briefly summarize the other features in one of your designs with respect to volumes, flow rates, flow lengths, assumed maximum sealing pressure, etc., from your 2nd Chip Design documentation

Circuit Analysis
In this section, teams should include a schematic of the circuit employed and the rationale behind why that circuit is used. Teams should discuss the advantages and disadvantages afforded by the particular circuit and other possible variations as well as discuss proposed improvements to the circuit. Include the following:
• Circuit Schematic
• Brief working of the circuit
• Suggestions for using alternative circuits (general)
• Proposed improvements to the circuit (general)

Performance Analysis
This section is for the reader who simply wants to know the "bottom line" - what happened in the project, why it happened, and what the team learned from the design project experience.
• Introduce the section
• Tell the reader how your team’s system performed (sometimes a table of data with a discussion of the most important information in the table is effective).
• Discuss the reasons for the performance of your team’s design
• Identify the tasks your system performed as expected and mention any problems encountered.
• Discuss why the problems occurred and what could be done to solve them.
• Compare the performance of the two designs, and if one works better than the other, discuss why.
• Hint: Include and use your collected excel/testing data to analyze your chips’ performance.
Fabrication Issues
This section considers current fabrication process issues and the future of the manufacturing of the device if it was “ramped up” for production or scaled down to the nano. Include the following:

- Introductory paragraph
- Discussion on how prototype was fabricated and type of fabrications methods employed
- Discussion on how fabrication process affected chip performance and possible improvements to this process
- Discussion on necessary design changes to make chip truly portable, including fully interfaced detection system
- Discussion on issues likely to be encountered when scaling the device to the nanoscale. Discuss issues with respect to manufacture, sensing, fluidics and functionality.

Summary & Conclusion
Finally, in a paragraph or two summarize what the team learned from the design project. The "lessons learned" could be related to technical components of the system, communication skills, teamwork, or any other aspect of the course. Include things you will want to remember to do in the future as well as things you want to avoid. You may include the following:

- Summary of report contents
- Suggestions on improvements on the design process and the project as a whole
- What the team learned from this design project; things team members want to remember to do in the future, and things they want to do differently.

Grading Guidelines
The grading guidelines sheet (below) should be attached to your final report.

More Tips
Some tips on report preparation could apply to more than one part of the report:

- The report is a formal, professional document. It is not advertising copy. Use formal language. Choose words carefully. Be accurate. Do not exaggerate.
- The audience for this report is a group of engineers and their managers who must first decide (on the basis of the written report) whether your design is the best one for their needs. Then, if it is the best, they must be able to build your design using only the information provided from your report.
- Don't use first person (I, me, my, we, our) or second person (you, your). Refer to the writers of the report as "the team", "team members", etc. Sometimes, it may be necessary to use passive voice to avoid using first person.
- Provide as much detail as is necessary to describe the project but be as concise as possible. Be considerate of the reader. Don't waste his or her time. If a word does not provide new or important information, leave it out.
- Use 1 1/2 or double line spacing.
• Number the pages. The Title of Contents is on page "i", the List of Figures is on page "ii", and the first section "Introduction" begins on page 1.
  o The sections before the Introduction section of the report should be numbered with roman numerals (i.e. i, ii, iii, iv…)
  o The body of the report is numbered 1-xx, with the introduction being page 1
  o The appendices should be labeled A, B, C, … etc. Each appendix has its own title page, then the appendix pages are numbered according to the appendix label (A2, A3, B2, B3, etc.)
  o Use multi-level lists to generate the table of contents in Microsoft word. This will automatically update all of the page numbers and keep things in good order.

• Use headings and subheadings to help the reader follow the organization of the report or find the section of interest. Section titles should be the same as those in the Table of Contents. If a numbering system is used for headings and subheadings, it should be the same as the one in the Table of Contents.
  o It is helpful to number your section headings appropriately. You can number them numerically, or use roman numbers (I, II, III, etc) or capital letters.
  o Use subsections! The main sections of your report (brainstorming, analysis and testing, etc) have a lot of information in them. Make your report easy for the reader to read. If someone picks up your report looking for specific information (how did they come up with the button pushing mechanism?!?), they should be able to easily find it.

  o It is helpful to number your subsections appropriately. The subsections can be numbered based on the section heading they are in (3.1, 3.2, 3.2.1, 3.2.2) or they can have their own style (a, b, c, etc).

**Tips on Figures and Appendices**

Few students have experience putting figures in reports. But in technical reports, figures are often very important. The reader must be able to locate the figure and quickly understand how it is related to the text. Here are some tips on figures. Place figures *in your text*. The appendices should be a reference section, not an extension of the section of your report. If there is a figure that is integral to the understanding of your report (i.e. a sketch of a design you are describing, the picture of your mock-up, etc) *it should be included in the body of your report*. This will make it easier for your reader to understand what is going on.

• A figure should have a number and a descriptive title (also called a *caption*). Some examples follow.
  o Figure 1. Multiview drawing of the three-wheeled stroller concept.
  o Figure 7. Graph showing densities of various stroller construction materials.

• The figure number and title in the List of Figures should be the same as the number and title in the body of the report. Use figure and table referencing for all of your figures and tables. This will allow you to automatically generate a list of figures and a list of tables with the page numbers included.
Each figure should be described and referenced in the text so that the reader knows to look for the illustration.

A figure should follow the paragraph in which it is first mentioned, if the figure is small, or follow the page on which it is first mentioned, if the figure requires an entire page.

Horizontal figures should be put in the report so that the top of the drawing is on the left and the bottom is on the right. Be careful that the margins are wide enough that the entire figure, including its title, is visible when the report is bound.

Figures and tables that go in the appendix are either
  - Too large to fit into the body of the report (take up more than half a page)
  - Are a member of multiple figures for a section (i.e. the working drawing set)
  - Are important for a full understanding of your project, but are not directly related to your discussion in your report
  - If you are unsure, ask one of the TAs!

Title your appendices appropriately. Your final report has a lot more content than your lab reports from last semester. Because of this, you should create appendices that are more related to the content of your report to help the reader find what they are looking for. Thus, appendix titles such as “Figures” or “Tables” are not descriptive enough, and thus should not be used. Something like “Brainstorming Sketches”, “First Chip Design”, is much more descriptive and appropriate.

Include things that you have already created! The assignments that we have laid out for you previously are to help you develop your final report. Thus, you should be using components from each assignment that you have already completed. If you have any questions on how to do any of this, ask one of the TAs. You can even email us outside of class!
## GRADING GUIDELINES

**DOCUMENT GRADED:**

**TEAM DESIGNATION:**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>POSSIBLE POINTS</th>
<th>POINTS EARNED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TABLE OF CONTENTS</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>LIST OF FIGURES &amp; TABLES</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>EXECUTIVE SUMMARY</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>MAIN BODY: CONTENT</td>
<td>70</td>
<td></td>
</tr>
</tbody>
</table>

The following non-gray cells represent the breakdown of the 70 points allotted for MAIN BODY: CONTENT. Bolded lines are sections of your report. Non-bolded lines are requirements within that section.

| Requirements, Constraints & Information Needs | 5 |
| 1st Chip Design Concepts and Analysis         | 10 |
| 2nd Chip Design: Description                  | 10 |
| CAD/other Drawings: 2nd Chip Design           | 5  |
| 2nd Chip Design Analysis: 1. Show design calculations for at least one feature; 2. Summary of other features; 3. Justification of 2nd Chip Design | 15 |
| Circuit Analysis: Description & Circuit Schematic | 5 |
| Performance Analysis                         | 10 |
| Fabrication Issues                           | 10 |
| SUMMARY & CONCLUSIONS                        | 5  |
| OVERALL EFFORT & EFFECTIVENESS               | 5  |
| **TOTAL POINTS**                             | **100**        |