EECS 401 – Design Report Guide

The Design Report

This report is basically a working document that you will continuously develop throughout the year. In the end, it will evolve into the Final Project Report of your senior design. You can choose whatever tool your team will use. I recommend using something designed for online collaboration, such as Overleaf / Latex or Microsoft Office 360. As a matter of course, your evolving report should contain the most up-to-date table of contents, list of figures, list of tables, project management information, budget, and references.

Title Page

The title page shall include student names, project name, report title ("Design Report" or "Final Project Report"), the name of the course (COSC or ECE 401 for the Design Report, or COSC or ECE 402 for the Final Project Report), the date submitted, and the names of the team mentors/sponsors, if any.

Executive Summary

Provide a summary of the contents in this evolving report. At its longest, when submitted as a part of the Final Project Report, Executive Summary will be no longer than a page. It is used to help the reader decide if the report contains information that is of interest. The Executive Summary should be on its own page and precede the table of contents as shown in the template.

Table of Contents/List of Figures/List of Tables

It is recommended that your report include a Table of Contents followed by a List of Figures and a List of Tables. These come after the executive summary and are not generally paginated except with lower-case Roman numerals.

Problem Definition & Background

Page numbering should start with this section. This section should begin with the problem statement – the one you were provided at the start of the project. It then should provide the background and context for the project. Here are the sorts of questions that this section should answer:

1. What is the problem? Why is the current situation unsatisfactory?
2. Who is having this problem? Who are the would-be customers for a solution?
3. What basic functions must the design perform?
4. How will the design be used by the customer(s)? Under what circumstances and in what environment? Don't limit your considerations only to those of the end user!
5. What is the underlying theory or background that needs to be understood to address this problem?
6. What prior work has been done on this problem?
7. What products, currently available, were not designed or intended for this application but could be used to perform a similar function?

Provide evidence that you have used multiple sources of information applicable to your project,

including technical papers, product literature, and patent literature.

There may be some engineering modeling/calculation required to answer some of these questions. For example, if one of the project requirements is to design a power system for a forward operating base, you should estimate what the energy needs are likely to be for that base. This sort of information is *solution-neutral* which is to say it doesn't matter what your final design looks like, this is information that must be known to provide a solution – any solution.

Also, regardless of the design, there are most likely associated codes and standards that may place constraints on the design. Please ensure these are referenced and the pertinent portions included in the discussion.

The Requirement Specification

In this section, you will document your project objectives (aka "customer requirements") ordered by priority. Explain the reasons behind each requirement. Document how you developed the requirements, with whom you spoke to confirm them, and how did you prioritize. Please include images wherever useful in communicating the necessary details. Use quantitative metrics whenever possible; for each metric you list, provide a target value, and explain why you have chosen such target. Please note, this section should evolve as you work through the project, because you will make discoveries when iterating through prototypes and getting feedback.

For projects that involve any CpE and EE majors, your requirements section must consider and document the use of specific standards and your justification of adopting each standard. Related to the standards you decide to adopt, you must also clearly identify multiple constraints that your project design must address due to the standards.

Technical Approach

You should begin this section with an overview of your project space. Even though it is likely that your project is already somewhat defined, you should aim to keep your design space as open as possible without being artificial. For example, if you plan to focus on the development of an optical communications link it would be artificial to feign to consider alternative communication strategies such as smoke signals, but it would be reasonable to not yet specify a particular light wavelength, receiver type or communication protocol.

Next, you should describe the functional decomposition of your system. This involves breaking down the overall performance of the system into individual functional units. Use a block diagram or flow chart to illustrate the functional decomposition. This is where you should really start to go deep on the different parts of the design. The decomposed parts of your project shouldn't be general like previous parts of the document, they should start to become more specific.

Finally, you should identify the major design decisions within your project. This means you should talk about the topics or parts of your project you will need to make design decisions on – you will not talk about the actual solutions to these decisions in this section. Your project should have many design decisions to be made. If your project contains no design decisions, then it cannot be used to fulfill the capstone design requirement and you will need to complete a

separate capstone project! Fortunately, most engineering projects involve design decisions. If you are struggling with identifying meaningful design decisions within your project, please discuss this with your mentor and/or the capstone coordinator for the department. As you identify these design choices, you should also identify the requirements that will be affected by each choice. You will use those requirements to choose between different alternative concepts for each design decision.

Design Concepts, Evaluation & Selection

For any project aiming to create a product for human users, provide sketches of the user interfaces, describe the intended user flows/workflows, document the target use scenarios, and provide evidence that you have confirmed that the designs meet user's requirements. Develop an overall Evaluation Plan for your designed user experience.

For internal parts of your product, each major design decision would require the following:

- Develop at least two alternatives. The concept should be developed to the extent that you can reasonably estimate the performance versus the requirements that would result from that choice. You should also include all design concepts that your "customer" might reasonably expect to be considered. For example, if the design choice you are considering is what you should use for a portable power source, you would be expected to at least consider batteries and solar arrays as possible options.

- Predict how each of the alternative would affect your requirements. Be as quantitative as possible. If there are modeling tools available that are applicable to your problem, then you should make use of them. For example, if you are considering different material choices for a transmission line, you should model the structure in Sonnet, making reasonable approximations for material parameters, to calculate how your material choices would affect requirements such as insertion loss.

- Select the best alternative for each design decision. Develop an Evaluation Plan, i.e., test cases, teat method, and metrics you will use to compare alternative concepts for each design decision. Do not rely on your gut. Do not base all decisions singularly upon individual aspects such as performance characteristics, nor cost, not development time. Your decision must balance multiple needs and meet multiple explicit as well as implicit constraints. Please think through, experiment, discuss, and document the team's work process to understand the tradeoffs as well as the discussions to make the decisions.

Deliverables

Together with your team, and mentor/sponsors if applicable, develop a list of what you will deliver at the conclusion of the project. Think of it in terms of answering the question, "What are we going to create and let people use in the end?"

Project Management

Understanding many of the specifics will not have been determined yet, this section should contain a proposed timeline for your project. Following a brief introduction, include a table of project-specific milestones (in addition to those listed on the syllabus). These dates may seem very vague at this stage, but it is useful to think through your project schedule even in the initial

stages. You will refine the schedule as you work through the year.

Budget

Likewise, it may seem a bit premature to propose a budget for a project for which the details have yet to be determined. However, projects are almost never proposed without preliminary budget estimates. This section should include an accounting of the anticipated expenditures for the project, provided in table format. Please note, engineering time is one of the biggest expenditures. Do your best to document estimated human-hours for the whole project and for each milestone. You will also record actual human-hours as you work through the year.

References

Technical documentation should always be written such that without direct contact with any of the group members someone could follow the design process and continue or revise the design without reconstructing the project themselves. Thus, documenting references is crucial. In this course the *IEEE style* format is recommended for the List of References. You may use endnotes, so long as they appear prior to the appendices as described in the Design Report Template.

Appendices should be lettered A – Z and appear in the order they are referenced in the text. Appendices are composed of any information that does not complement the narrative flow of the in-text discussion but must be included for the sake of completeness.

Appendix – Project Quad Chart

This is a single PowerPoint slide that describes your project. It will be discussed in lecture. You will update this slide throughout the year as your project evolves. It will become part of the project portfolio which the capstone coordinator uses to solicit support for the capstone program.