# ECE337 Preliminary Project Proposal Guidelines

## Purpose:

In industry or academia, proposals are an unavoidable step in the process of getting money, staff, and space to be able to carry out a design or research project. In the case of ECE337, it is an unavoidable step in passing the course. A proposal is used to describe what you want to do so as to persuade others to provide resources for your project. If people are giving you money and staff to develop a project, then they expect you to already have a good idea of what you want to do, how you want to do it, and what is needed in order to do it. Consequently, some of the research and design work already has to be done before you even present your proposal in order for anyone to believe it.

These sections are also similar to what you might find in industry. Deviations from this format will count against you. Keep in mind also that your final report will also include much of the same information. Therefore, a good job on the proposal will save you time later. **Be warned! You have to make several design decisions in order to write a reasonable proposal. This should become apparent as you read the requirements for this proposal.** In some cases you may feel like you don't know enough to make the necessary design decisions. You might have to guess or make some arbitrary choices. That is ok. Even if you are confident of what you are going to do, you will probably have to make some corrections as you get into the details of the design.

## 0. Title page (1 page)

This should contain the title of your project, the words "Preliminary Proposal Draft", your name, your partners' names, the name of this class (ECE337), your lab day and time, the date the report is due, and your TA's name. At the bottom, all people who prepared the report should place their signatures indicating that they have reviewed the entire report and approve of its contents. Everything should be centered and neatly spaced on a single page.

## 1. Executive Summary (from 1/2 to 1 page)

The executive summary is the first part of your proposal. Company executives or prospective investors will look at this to decide whether or not to bother with the rest of the proposal. **Assume that the reader of the executive summary is an executive or investor.** The reader of the rest of the proposal would probably be someone who can evaluate the technical merits. The executive summary should be short while giving the reader some reason to want to give you resources needed for implementing the project. The summary should answer the following questions:

- What is it you want to design and build?
- Why is it important? (Is there a market for it? Will it save the company time or money?)
- What will be unique about your design that will make it important?
- Why is this design appropriate for an ASIC implementation
- What will it take to do it?
- What is in the rest of the proposal?

# 2. Design Specifications

This section describes the chip you are designing. The description should include (but is not limited to) the following sections.

**The chip you specify here must be consistent with the project idea already approved by your TA or instructor (in writing, or email in the TA or instructor's possession). If the idea you are writing is different from what was approved, be sure to clear the idea first.**

## 2.0. System Usage Diagram

You need to create a super high-level block diagram that illustrates how your intended use of the design and must show what external devices will connect to your design and how they will be connected in terms of interface standards and the types of information that will be sent between them. The purpose of this diagram is to enable system builders and designers to quickly develop a basic understanding of how your design could be used in various systems, so that they can quickly decide if the design has the potential to fulfill a needed role in a their system or not.

## 2.1. Operational Characteristics (between 2 and 6 pages for most projects)

You need to describe the functions that are to be performed by your chip. This section should provide the most detail into your chip's operation. First, identify all external input and output pins of the chip. For this purpose, include a table listing all inputs and outputs of your chip including clock, reset, power, ground, and all data signals unique to your design. Organize the table as shown below. For the design review, you will be required to refine the input/output descriptions to specify data formats, active high/low, and timing requirements.

| Signal Name | Type In/Out/Bidir. | Number of bits | Description |
|---|---|---|---|
| RST | IN | 1 | Asynchronous reset for all memory elements in the design. |

Inputs and outputs need to be specified in a way that will be compatible with the external devices to which your chip will be connected. For example, if your chip needs to interface with a keypad, it is NOT reasonable to have a separate input pin for each button. Find a commercially available keypad datasheet online and see how the inputs and outputs work.

Identify the general type of commercial part to which your final chip would be connected, and any relevant industry standards for data interfaces. For the design review to come later you will need to provide a copy of relevant data sheets and/or standards documents. Note: because of the limited time for this project, you may find it necessary to use simplified versions of some industry standard or commercial interfaces.

Describe the intended operation of the chip using at least two of the following approaches depending on what is appropriate for the type of design you are creating.

- A timeline depicting the sequence of operation of the chip
- A flowchart depicting the high level sequence of operations of the chip
- A list of features or functional blocks with an explanation of each.

Where possible, use tables, charts, state transition diagrams, or timing diagrams accompanied by some explanatory text to describe functions of your chip. If your chip requires a particular format for input data, memory contents, or output data, indicate that a detailed data format will need to be defined.

Try to imagine yourself in the position of a designer who has to use your chip with only your documentation to work from. You need a concise and complete specification of the chip.

## 2.2. Requirements (1/2 to 1 page)

Include a discussion of how the intended application affects special requirements for your chip. For example, a hand held game probably requires low power dissipation and a small pin count. An automotive application might require tolerance of wide temperature variations and rugged packaging. Consider what the most critical design parameters are for your chip (speed, low power, area, high I/O bandwidth, etc.). Think about the environment in which the chip has to operate and how it is to be packaged.

Indicate whether your primary optimization objective is going to be speed or minimum area. If the speed requirements for your design are not very tight, then you will be required to optimize for minimum area. Minimizing area reduces the chances of manufacturing defects and will often also reduce power. Be advised that just telling the synthesis program to optimize for area will not be enough. Find ways to structure your design to minimize the size of the design. If speed requirements are tight, you should still try to minimize area when possible, but only as a second priority. Again, just telling the synthesis program to optimize speed is not enough. Think about ways of structuring your design that will make it fast. In the upcoming design review, you will need to explain the steps you are taking to optimize your design.

Not only do you need to choose general optimization objectives, in this section you must specify targets for area, pin count, and speed or throughput. **At this early stage you have very little information upon which to base an area target, so to get started you are given an initial allocation of 1.5mm x 1.5mm. Your area allocation can be much larger than this, you just need to provide strong justification for the additional area. As you refine your design, you will get a much better idea of the area requirement. Your last chance to justify a larger area allocation will be at the time of your design review.** It will be your job to make the case for a larger allocation based on preliminary synthesis results and estimates based on detailed block diagrams for your design. Pin count, on the other hand, is something for which you should be able to make a good estimate in this proposal, but you will be able to request an update to your pin count at the time of the design review.

Throughput will depend on the application. For example, if you are sending 16 bit uncompressed CD quality audio, your throughput in one direction will need to be on the order of 44100 samples/sec x 2 bytes per channel /sample x 2 channels = 176,400 bytes per second. Usually, clock rate will need to be significantly higher than the throughput unless your design is heavily pipelined (pipelining is something most of you will learn in depth in ECE437 and is not expected in this course, although some prior projects have made use of pipelining).

For the technology used in this course, a clock rate of 100MHz to 200MHz is usually very easily achieved. 400MHz to 500MHz can be reached, but usually requires a lot of attention to the organization of your design and how it affects critical paths. In extreme cases, 1GHz can be reached, but generally only for sequential circuits with little or no combinational logic such as a shift register.

## 3. Design Architecture (1 page)

You a required to have an architectural block diagram of your chip completed with the preliminary project proposal draft. The level of detail of the architectural block diagram should be such that it consists of high-level functional blocks, i.e. a DVI interface, SD Card Interface, Master Control Module, Memory Arbiter, etc. Draw arrows with labels to identify any essential data that has to flow from one block to another. External inputs and outputs should be consistent with the descriptions in the operational characteristics section.

## 4. Comments and advice (not a section of the report)

It is recommended that you use the proposal grade sheet as a guide to the amount of work put forth in each section. Keep in mind that your TA will use the grade sheet when scoring your document.

## 5. Format, and method of submission

Format: single spaced, 12 point fonts for text, 14 point for section labels. Margins no more than 1 inch on each side.

There will be a blackboard assignment for submitting your preliminary project proposal draft. Submissions must be a single PDF