LECTURE FOURTEEN: Technical Writing – Phase II

Remark: This lecture addresses additional instructions that must be considered to write technical documents.

Introduction

Welcome to the uncharted world of creativity! Certainly, not everyone wants to pursue a graduate study or works as a scientist in a research laboratory. We know all that, but you still need to write about your design and you need to document that, in order to finish this course and many other similar assignments in your career as an engineer. As described in Lecture Note Five, your goal should not be to write such that you are understood. That is not enough here. You must write such that you are ***not*** misunderstood. To that end, we need to follow a certain structure. One such structure is described below.

But first, note that any technical document displays two distinct characters. One is the actual technical contribution, which must be described in a certain structured fashion. One is suggested subsequently. The other character is the author(s) of the document, which often can benefit from the publication of a strong technical document, although a technically weak document is an equal opportunity destroyer of careers. Thus, be very careful of what you leave behind bearing your name, and do not sell short your good name. Show restraint and discipline in writing, and do not settle for publishing a document or an article, unless you are absolutely certain of its accuracy and authenticity. A strong technical document must be authoritative and substantially add to the state of its discipline. Of course, you need to practice writing, and a few weak papers are acceptable until you master the art of effective and strong (power) writing. In particular, those of you who will pursue a graduate study will write theses and several technical papers, and will learn this process in due time. However, make a habit of being concise and informative from this very beginning.

Although the style and/or procedure to document and structure a technical contribution is different from one field to another, the following sample is what most IEEE Transactions prescribe, and we suggest that you adopt this structure as your ***writing template***. We review this sample first, then suggest how to use that to write your intermediate reports for this course.

Please pay special attention to the right or left paragraph, center or left-hand side of the page.

Technical Writing – A Template

(***Comment:*** The title must always be direct, short, informative, and without any acronym or any unknown, i.e., you must select similarly.)

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(***Comment:*** Name and affiliation of all authors are given here, in the order of their contributions.)

(***Please note well!*** Unless stated clearly otherwise, the implication of the above name is that, this is the author of the following document in its entirety. If there are several authors, as is the case in the Senior Design Course, then the implication of not spelling out specific name in each of the following sections is that each author has contributed equally into this document. However, in the case of multiple authors, when for instance, a particular section is written solely by one person, that person's name must be given explicitly.)

Abstract – In this section a concise account of technical contributions of this document is presented.
(***Comment:*** Absolutely nothing else is written in this section. Nothing means nothing – no acronym, no quotation, and nothing about the rest of the document. Just the outcome and goal of your problem statement. Also, note that this section has no number and generally starts at the same line as "Abstract" itself. Some journals put this word in the center and some do not use it at all, but still they require having this section without the word Abstract. Some journals use *Summary*, and some use *Synopsis*. In your final report, we call this section *Executive Summary*.)

I. INTRODUCTION

(***Comment:*** Most IEEE Transactions use Roman numbers to label these headings. Some Transactions center that as well as the subsequent headings, but we use the left-hand side as shown here. Also note that these main headings are all in capital letters, which is not so in sub-headings shown below.)

The ***first paragraph*** in this and any subsequent section starts on the left-hand side, i.e., from the beginning of the line as shown here. The next paragraph is indented as follows.

Introduction means just that, i.e., in this section you give some clear background information about your technical problem. As far as this course is concerned, you must state your goals for your design, as well as how the rest of the report is prepared, which, in effect, is described below.

It is a good idea to have this section divided into several sub-sections – identified **A, B, C,** ..., *etc.*. For instance,

A. A Historical Perspective

[Note that we start with "A" historical perspective meaning that we are not covering "Every" historical discussion about the subject – it is safer that way.] Then, we continue by writing that, for instance, since the turn of the century researchers and engineers have worked on this problem [Ref. 64, the style for citation is described in Lecture Note Four, and is placed at the end], but until recently no one knew how to formulate the source of noise in the corresponding circuit, and thus no definitive results were known [Ref. 59].

(***Comment:*** You need to cite references when you speak of other work in the field.)

B. Technical Review

There are many other equally useful methods available to solve this problem such as the recent results published in [Ref. 32] to [Ref. 41], however, our technical approach has many advantages over these methods as described in Section II (referring to your document).
(***Comment:*** Here, you need to make a judicious decision on how much technical review you must present. If your problem has no history, then you have one set of constraints to meet, in order that you convince the

referees that you are doing something worthwhile. On the other hand, if your problem is well known and many people have worked on that, then you really have to show that you have studied those other methods and still are convinced that your approach is better than those other well-known approaches.)

C. Other Pertinent Issues

Depending on the nature of your problem, you may or may not need to have this or any other sub-section here. If you do, then figure out how to label that. It may be a very good idea if you give your problem statement here, but we prefer to keep this section as light as possible, i.e., no equations in this section.

Please note that we are still in Section I (Introduction).

(In the last indented paragraph of this section, starting as shown here, you may write the following, which is sort of a table of contents. In your final report, most of this paragraph is replaced by an actual Table of Contents.) The organization of this document is as follows. In Section II, the technical results are presented. In Section III, the simulation results and the corresponding computational issues are discussed. Experimental results are given in Section IV. (Note that we switch the words around). Section V discusses odds and ends. Section VI to Section before "last" are defined similarly. Conclusions are deferred to Section "last", followed by references, which normally has no section number. If the document has appendices, then the preceding sentence is replaced by the following. Conclusions are deferred to Section "last", followed by several appendices. Appendix A discusses "one issue," while Appendix B discusses "something else," then label the rest of appendices similarly. Finally, you write that, the document ends with the list of references. In your final report, where we use an actual Table of Contents, the above paragraph is not needed in this form, however, you must write something like that in the beginning of each section of that report as a ***"local table of contents,"*** and write that in words.

Please also note that, the entire document must be written in the ***present tense***. Absolutely, no "will be," or "did" is allowed, when referring to a ***location in the body of the document***. When referring to the ***time of occurrence of an event,*** you can say that "we will continue this study next year," or "we did study this problem for several months." But when you are referring to a location in the body of this document, you write, for instance, as described in § I.B, this problem is such and such.

II. TECHNICAL RESULTS (or any heading, depending on the document)

In the first left-hand side paragraph, you give a brief account of the purpose of the document, in perhaps several sub-sections. Followed immediately by the formal problem statement, given in its own sub-section as follows.

A. Problem Statement

This could have been stated informally in the above introduction, but the formal representation must be given here again. Since this is used by senior design students, the above should be followed by a sub-section on ***Design Specification.***

Continue in this section as you deem necessary to explain each subsystem with its schematic diagrams, experimental measurements, or any theoretical argument as you feel is needed. If is justified, then

use a new section to describe simulation and experimental results. ***You need to know, however, where and when to stop!***

III. Next Section and beyond

Here, and in the subsequent sections describe the rest of your technical contributions. Give a clear description of how various subsections are integrated together and what the limitations are. Keep one issue in mind at every step of the way. ***Be always precise and concise and thus avoid jargon.***

The document continues. Throughout this writing when you need to ***label a table,*** it is customary to write its description on the top of the table and center that as follows.

Table 2. The results for experiment five.

Date	Monday	Wednesday.	Thursday.	Friday
Results	False	True	True	False

Similarly, when you need ***to label a figure or chart,*** it is customary to write its description on the bottom and center that as follows.

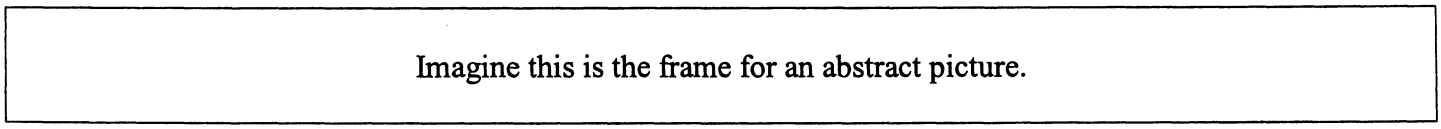

Fig. 3. Description of a figure.

Note that you may number tables and figures sequentially as above, or within its own section. For instance, if you have three figures in Section III, § **A,** then you may also label them as follows. Fig. IIIA-1, o 2, or 3, which as you see this sort of numbering may soon become cumbersome. Unless, we have use numerical system, such as Fig. 3.4-2, which means the second figure in Section 3, sub-section 4.

On the other hand, when we need ***to cite a figure or table,*** we use its corresponding number. For example, "as shown (depicted, presented) in Fig. 2, such and such is true." You may also write this as (cf., Fig. 2), or just ", Fig. 2." That is, to put at the end of a sentence, Fig. 2. Never, ever write "see Fig. 2." Not in this course!

"Last number" CONCLUSIONS

You close your document by writing the following. In this document we have shown that all we have set out in our problem statement are achievable and we have completed our task. We also propose the following suggestions for further study or improvement of this issue or project.

(***Comment:*** Here, you confirm that you have finished the job successfully, i.e., what you had set out in the Abstract and/or your Problem Statement. Also, note that it is perfectly acceptable to use "we," throughout this document, even though the author is only one person as herein.)

References (Note that no number is assigned here, and not all letters are capital.)

The references are described following the above section, unless there are appendices, which are described first. The style to cite references has been already shown in Lecture Note Four. You must include some references that discuss similar issues in any technical document, in particular, your final report. This inclusion is imperative for the success of your document.

ACKNOWLEGEMENT

(***Comment:*** List the names of people or organizations that have supported this project in one form or another.)

The template ends here.

Final Thought

Certainly, you must give as many subsections as you need to describe your entire contributions, within the above style, but you must follow the procedures, which we have described in this course. Namely to write about the ***Elements of Design,*** as well as ***Design Constraints*** as pertain to your project.

Closure

The class ends with the following comments that we expect everyone to understand and use the above template to rewrite intermediate reports in that context in order to proceed further.

A few additional comments, regarding the IEEE standard of writing technical documents.

Avoid opening a sentence with ***any numeral.*** For instance, "19 dollars is an average cost of this circuit," should be written as: "The average cost of this circuit is 19 dollars."

It is also customary that equation number be given in parentheses and the references in bracket. Thus, it is understood that (2) means equation number two, and [2] is the reference number two, and there is no need to write eqn. (2), or Eqn. (2), and similarly Ref. [2].

Finally, the correct way to write numbers, from one to ten is just that, i.e., in English, but from eleven and above is numeric 11, 12, *etc.*.

Essential thoughts in this lecture

Issues.	Applicability to your project, if any.
Each and every piece of these lecture notes forms a tile on the final mosaic of this course. Try to assemble those such that it portrays your contributions to the underlying project as best as possible, and your learning of issues discussed. You really need to think about this template and how to utilize it for your project.	Obvious!
Do you want to add anything else?	Please elaborate.