Appendix C
Laboratory Report Guidelines

Every instructor has a different definition of the perfect lab report. We use the set of guidelines given below in our signals and systems courses; these are not meant as the definitive guide to writing lab reports, but should merely serve as a template if you do not already have guidelines in place. We suspect that instructors may wish to provide their own guidelines, particularly regarding laboratory performance evaluation.

Motivation

While many engineering students are adept at mathematics, problem-solving, and programming, fewer are as skilled at writing reports. The ability to accurately, concisely, and clearly maintain a record of your experimental activities and report on your results will be critical to your success as an engineering professional. You are more likely to be promoted if your employer is aware of the importance and extent of your activities; your work is more likely to be implemented in products if you can convince others of the value of your work and communicate its relevance; you are more likely to ultimately be promoted to a leadership position where you help define company technology directions, and thus work on projects which interest and excite you, if you are organized so that others can pick up on projects where you left off.

You are asked to provide reports for each laboratory assignment using the guidelines provided below. The objective is for you to become comfortable at both working in the laboratory environment and reporting your results. Each report should not be viewed as a major project, like a term paper, but as a progress report. Our goal is for your ability to evolve over the course of the semester so that you become more adept and efficient at maintaining an accurate record and reporting your results.

Report Goals

Following are some objectives of lab reports, which you should recall when writing and organizing your results as well as when proofing and evaluating your report. In general, a lab report has four dual purposes:

1. To maintain a complete record of what you understood and accomplished. Use figures, sketches, and plots, in addition to verbal and mathematical descriptions, to illustrate key ideas critical to your understanding. Documenting your work from as many different representations as possible aids in enhancing your understanding and clarifying your accomplishments for a wider audience. Identify design parameters selected and design procedures and equipment settings used. Indicate any difficulties encountered and your solutions to them. Given your report, you should be able to - at some later date - use your own report as a reference to help you do related work. In evaluating your report, can you do this?

2. To provide for colleagues or new employees on the project a guide to what has been done, how it was accomplished, and the tools available. Consider whether someone knowledgeable of the overall goals of a project could pick up your report, understand how and what you accomplished, and be able to determine the tools and information needed to replicate your results. Think of this objective in tenns of a fellow student who takes this course in a later semester: if assigned a similar experiment, could this student use your report to help her/him gain some understanding and get started? You do not want to rewrite the lab assignment, since it can be referenced for details. However, your report should be self-contained, and understanding it should not require simultaneous access to the assignment.

3. To highlight key results and bottlenecks for your manager including a critical evaluation of the results, recommendations for future work, and examples (either simple analytical or experimental results with figures) illustrating key points. Using your report, could a manager make informed decisions regarding what is the most reasonable direction for the project to take at this point? Would your manager think that you had done a thorough and thoughtful job? Would your manager believe that you had creative potential and good ideas?

4. To demonstrate your understanding for your manager, or - for this course - to demonstrate that you completed and understood the laboratory assignment. Essentially, if you are able to write a report using your own words such that it meets the first three goals, then you will have demonstrated the required understanding.

General Format Guidelines

In completing your final report, make certain to adhere to the following guidelines:

- It should not be lengthy, but should contain enough information to meet the goals stated above. We have found that 5-10 pages of text, excluding figures and other attachments, is generally sufficient for the purposes of these assignments.

- Figures, plots, and tables should be clearly identified. Be sure to label all axes and highlight points of special interest, including critical component parts and interconnections. We encourage you to use visual explanations when possible, but caution you that such visual aids are not self-explanatory and still need to be discussed in the text. Also, do not simply attach plots of all the results that you generated. Be selective: include only those figures that best illustrate your main points.

- As part of your text, include answers to the questions posed in the assigned laboratory problems. Be sure that the correspondence between the assigned tasks and questions and your answers is clearly evident from the text.

- You may include printouts of the MATLAB function files you created for the assignment if they are referred to in the text of your report, but it is not required.

In fact, we discourage you from attaching MATLAB files unless including them enhances your discussion.

- Attach your final, corrected solutions to assigned lab prep problems. In explaining your results, you may wish to reference these solutions rather than rewriting explanations.

Suggested Report Organization

Below is a suggested outline for your report. You are welcome to use a different organization if you feel that it would result in a clearer presentation of the material. If you do use a different organization, be sure that you include all the information requested in the outline below.

1. Title Page should include

- Laboratory title and assignment number
- Group member names
- Course and section numbers
- Date

2. Introduction

- Approximately 1/2 page
- 'Express the goals and assigned tasks for the laboratory in the application context using your own words. What are you given? What are you to find?
- What are the applicable analytical representations, concepts, operations, and tools you have learned from the text and lectures?
- 'What did you learn from this assignment?

3. Mathematical Analysis

- Approximately 1 page of text, with references to attached Laboratory Prep Problem solutions
- Define each given and desired quantity as a variable.
- Present analytical (mathematical) formulations of the problems you are to solve and tasks you are to perform.
- 'Provide mathematical, intuitive, and physical explanations for what you expect to see in the assignment. You may want to use a simplified example that illustrates your expectations. For example, explore the analytical impact on a simple sinusoid of the operations that you will perform on speech in lab.
- 'Present any preliminary analytical preparation needed to execute the laboratory assignment and identify key design parameters or variables that you will have to choose

- Often the two tasks above are facilitated by referencing your Lab Prep Problem solutions. How do these solutions relate to the laboratory goals, tasks, and expected results?

4. Experimental Parameters and Method

- Approximately 1 page of text, with references to diagrams as necessary
- Identify the hardware systems or components that you will be using. Be specific; e.g., what specific functionality of the sound card will you be using? Indicate how the hardware will be interconnected to perform the assigned tasks, and identify hardware settings that must be selected as part of the data measurement or acquisition process. Which components, settings and operations will be most critical? Most sensitive?
- Which MATLAB functions and commands will you be using? What function do they perform? Identify how the variables that you defined in the Analysis section correspond to parameters and signals that will be passed to and returned from these MATLAB functions.
- Often a diagram is helpful for specifying the interrelationships among the hardware, software, variables, parameters, and settings.

5. Results

- Approximately 1-2 pages of text, with references to plots as necessary
- How did you complete the assigned tasks? Indicate signals and systems representations, concepts and operations used, equipment settings selected, and parameters computed. What procedure did you use for selecting successful settings for the equipment and parameters for MATLAB functions?
- What did you observe? Document your observations in as much detail as possible. You should comment on the interplay between the mathematical analysis and observed physical properties. Use the questions in the laboratory as guidelines in your discussion, but do not limit yourself to asking only these questions.

6. Evaluation and Conclusions

- How good were your experimental results? In what ways did they match with your expectations? Explain your answers. Suggest ways to improve your results.
- What difficulties did you encounter, if any? Be sure to document how you overcame these. Even difficulties that seem to have trivial solutions, e.g., MATLAB syntax errors, should be documented so that you do not continue to repeat them in future labs.
- 'Which tasks were easiest to analyze, understand, and execute? Most difficult? Why? If some major difficulty occurred that did not allow you to complete the assigned task in the allotted time, analyze what went wrong and indicate how you expect to avoid similar difficulties in future labs.
- What extensions come to mind? What else might you like to try, given the time and resources?

Grading

Your laboratory reports will be graded based on

- Content: You should have completed all of the assigned tasks and should demonstrate a clear mathematical and physical understanding of your observations.
- Presentation: Your report should be as clear and concise as possible. All discussions should be in your own words and reflect your observations, experiences, and understanding
- Use of Visual Aids: Since you are an engineering student, you should use figures, plots, diagrams, and tables to represent information in a clear and concise form. However, do not simply attach all figures generated in the course of your experiment; be selective. All attached visual aids must be referenced in the text discussion and be included only if they enhance the clarity of the report.
- Observations: You need to demonstrate that you were careful in your observations. Provide quantitative detail. Previous observations should be used to help define questions to be answered and which experimental parameters to change.
- Conclusions: You should demonstrate that you thought carefully about how your mathematical analysis, experimental observations, and physical intuition match for the given problem. What discrepancies do you notice? How can you explain these?