ME 207 - LABORATORY REPORTING GUIDELINES

Perhaps the greatest obstacle presently confronting the practicing engineer is that of communication. The greatest discovery is valueless if the discoverer is unable to present it to others. All engineers must be able to present their work completely, understandably, and in a form that is recognized and accepted. One absolute requirement for the completion of formal education is the demonstrated ability to write a report. As difficult as it may be to take the long view, the fact is that you will benefit far beyond a good grade from a well-written report. Many professional engineers have had occasion, over the course of their careers, to refer to their old lab reports. Write for your own future utility. What you will want to get from your lab report ten or fifteen years from now is just what any interested reader expects to learn from your report.

Every report must be complete, concise, understandable and useful. The various labs impose specific requirements, but the following general form of a technical report should be used as guideline for all of them.

1. Cover page

The cover page notes the course (ME 207 – Mechanical Engineering Laboratory), the term, the lab (code and name), the dates performed starting with the block number, the group number and the names of the group members. The example below shows the information the cover page should contain.

ME 207 – Mechanical Engineering Laboratory
Spring 2024

MEM 05
DC-Motor Position and Velocity Control

Block X: Date of the plock period

Group #
Name of students in the group

ABSTRACT
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2. Abstract

The abstract is a critical part of any report. Its purpose is to present the problem and a synopsis of the results in a qualitative way. Do not slight the work you have done by carelessly writing an inadequate abstract. Remember that in computer retrieval systems, the abstract is the only information about the work that a prospective reader gets. Write your abstract after finishing all the other sections of the report (you will know by the then its full content). The abstract should be included in the cover page.

3. Introduction

The introduction leads the reader up to the point where he or she can understand in detail your statement of experimental goals. It also explains how those goals are achieved by summarizing the experimental procedure and by qualitatively describing the outcome of the lab. It is a good practice to

include a paragraph, usually the last one in the introduction, describing how the report is organized. Make sure that abstract and introduction are not repetitive.

4. Apparatus and procedure

Briefly describe the equipment and how it works. Include a schematic diagram. Remember that this needs to make sense to you years from now. Describe the instrumentation, ranges of variables, frequencies used, time spans, etc. Remind the reader of all safety issues. Keep in mind that longer descriptions can always be found in the equipment manuals. Summarize your procedure.

5. Modeling

The first step of the lab is modeling. In this section you will need to report on: i- data acquisition for modeling, ii- model development. At this point, the data to be used for modeling is assumed to be complete and correctly obtained. If this is not the case, return to the lab for the missing data. In this section, it is more appropriate to report the acquired data in a graphical way (e.g., plot). The detailed acquired data can be reported in an appendix if necessary. The technique used to develop the model should be clearly explained in this section. More importantly, the outcome of the modeling work should be presented as a transfer function (plant). The proposed model must be compared in the same plot with the acquired experimental data (e.g., step response, bode response).

6. Control Design

The second step of the lab is control design. In this section you will need to report on: i- model-based control design. The transfer function obtained in the modeling step must be used to design a controller that satisfies the given closed-loop specifications. The control design procedure should be clearly explained in this section. The outcome of the control-design work should be presented as a transfer function (controller). Closed-loop simulations results must be presented in this section showing that the developed controller satisfies the given specifications.

7. Experimental Testing

The third step of the lab is experimental testing. In this section you will need to report on: i- experimental tests of designed controller(s). The controller developed in the control-design step must be implemented in the lab and its performance must be tested experimentally. As in the modeling section, it is more appropriate to report here the acquired data in a graphical way (e.g., plot). The detailed acquired data can be reported in an appendix if necessary. This section is the core of your report. It cannot be such a bunch of tables and plots. These are just tools you can use to facilitate the analysis of your experimental results. A comparison between analytical/simulated and experimental results must also be presented in this section. Note that the experimental results may suggest that you need to improve your model or redesign your controller.

8. Conclusions

This section contains a critical assessment of your results. Discuss the validity of the proposed model and perform enough analysis/calculations to be able to propose modifications to the modeling procedure that would produce improvement in the model-plant agreement. Discuss any potential limitation of the employed control-design technique. Summarize your comparisons of simulated and experimental results. Explain potential discrepancies between simulated and experimental closed-loop results. Explain what you would eventually do differently if you had the chance of redoing the lab.

9. Appendix

All data taken in the laboratory should be included here. Any procedures, method descriptions, mathematical developments, or pieces of code that were too long to be included above may be placed in the appendix. Anything that does not add to the presentation of the above sections but that should be recorded somewhere for archival purposes can be put in the appendix.

Additional Comments

Graphics:

It is likely that a reader's judgment of your work will be based more on your graphical presentations than on any other segment of the report. Invest the time and effort needed to make your plots and block diagrams clear and complete. All figures showing either plots or diagrams must have a unique number to refer to and a descriptive caption. Multi-plot and multi-diagrams figures must have appropriate numbering or labeling so that each plot or diagram can be individually described. Plots of different quality are compared in Figure 1. Follow the guidelines below Figure 1. Note how I make reference to a particular figure in the previous sentence. Figures that are not referred to and are not described in the text should not be included in the report.

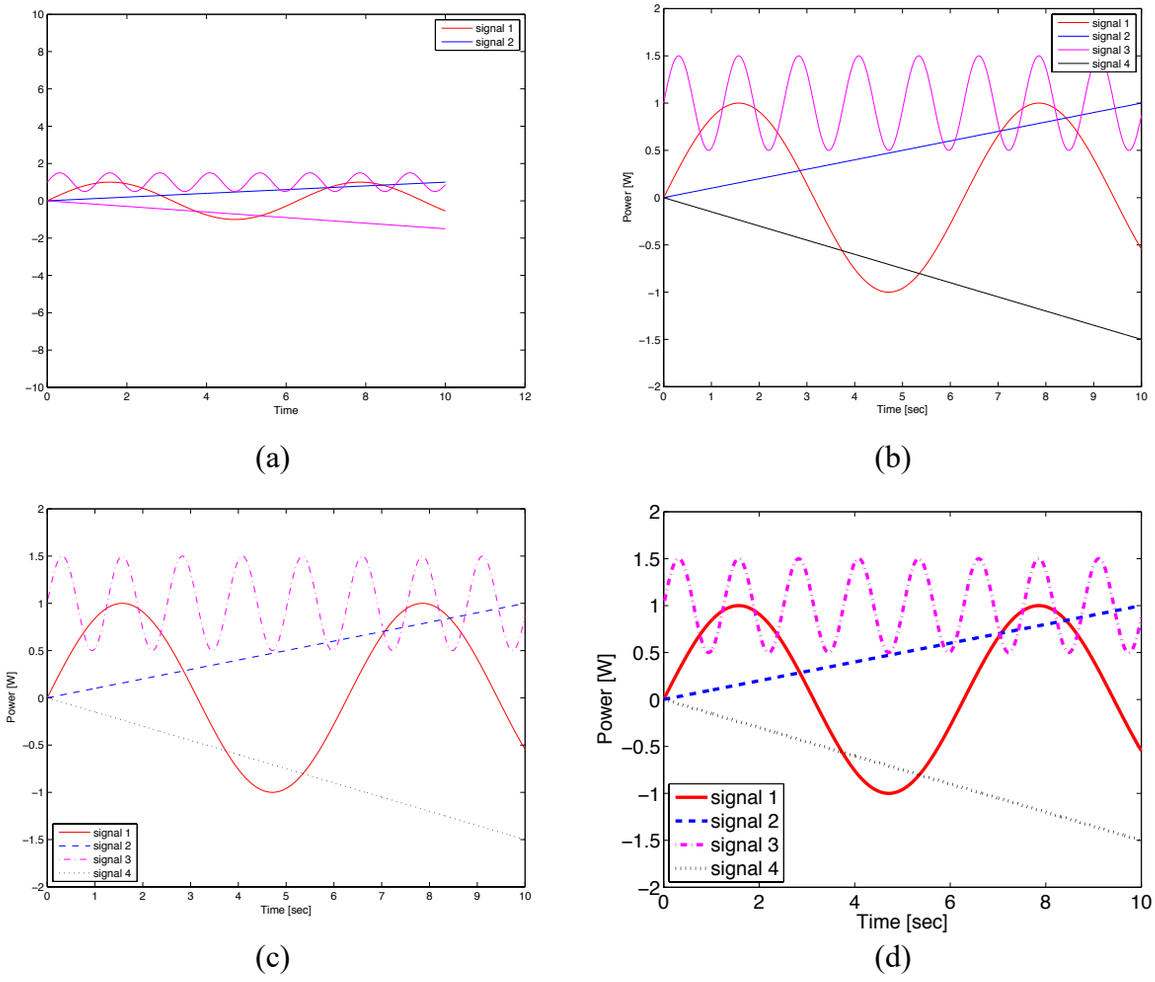

Figure 1: Comparison of plot qualities. (a) Incorrect scale, missing units, missing axis label, missing legend items, repeated line style/color; (b) legend overlap lines, repeated line style; (c) lines too thin, fonts too small; (d) high-quality plot after correcting all problems.

- Plots and diagrams must be large enough to be useful (not uselessly tiny).
- Plots and diagrams must be scaled to focus on relevant data.
- Font sizes in axis labels, axis numbers, and legends must be large enough to be readable.
- Lines must be thick enough to be readable.
- Every plot must have labeled axes with engineering units. Similarly, every block diagram must have labeled lines (signals) with engineering units.
- Multi-line plots must have legends describing all the lines.
- Multi-line plots must use different styles and colors for all the lines.
- The line styles and colors must be chosen so that they remain readable in w/b printout.

Font, Size, Format:

Text should be justified. A font size of 12pt is recommended. Times New Roman and Helvetica are frequently used fonts for technical and scientific publications.

Theory:

The theory content of this report must be brief. It should be written for the expert in the field, not the lay reader. Every lab will require the association of measured phenomena with modeling and control techniques. Usually, modeling and control-design techniques already have been postulated and are available in textbooks, papers or manuals. Do not rewrite already published material. Just make reference to this published material when possible. Handouts are not suitable references.