1. Laboratory/Experiment Reports

The primary function of a technical report is to communicate information which may ultimately be used to duplicate/document a procedure, corroborate results, or simply understand a phenomenon. To be successful at documenting this information, effective communication skills are required. Technical reports are effective insofar as they are clear, concise, complete, accurate, organized and neat.

There are many forms of reports, and usually each company has an approved format which must be followed. To provide training for the student, the following format will be used. The report, in general, contains:

- *Transmittal Letter/Memo*
- *Introductory Materials*
- *Body of Report*
- *Supplementary Materials*

The transmittal letter/memo should be included as a cover letter *indicating the general content of the report, the members of the experimental team and their contributions. The transmittal letter should be from the team leader to the person requesting the report.*

1.1 Introductory Materials

Introductory materials include the following:

- *Title Page - The info on the title page should include a title of the experiment, date of the experiment, date of the report, and the group indication. For the purpose of this class, assume that your group is a small testing/consulting company with the name "Group X Company".*
- *Summary or Abstract (1-2 paragraphs, maximum 1 page)*
    - *What was done?*
    - *What are the results?*
    - *What are the conclusions?*
- *Table of Contents*

- *List of figures and list of tables (not required for this course)*
- *Pages should be numbered*

1.2 Body of Report

The body of the report consists of the following:

- *Introduction*
- *Experiment*
- *Results*
- *Discussion*
- *Conclusions*

1.2.1 Introduction:

The report should begin with a section or sections that explain any theory and/or prior literature which bear on the work. This portion of the report might consist of a variety of arrangements: INTRODUCTION or BACKGROUND (or both) followed by sections on THEORY or ANALYSIS, etc., depending on the particular experiment. In any event, all background necessary to familiarize someone with your engineering background, with the test and the methods of analyzing results should be included here. This background can be a summary of the theoretical issues, including the pertinent equations. Often, a short summary is used with adequate references cited to give the reader the necessary background. ***References should be numbered at the end of the report and cited in the text of the report using the following format*** ***[1,2,3,5-8]*** ***.***

The objective of the experiment must be stated clearly in the introduction. *The objective must match the ensuing report and it must be fulfilled in the conclusions. A good statement of purpose will convey the single overall objective of the work and include some elaborations of this aim. The objectives of the Structures/Motion Lab course should not be included. For example, you might want to determine a turbine's efficiency as a function of brake horsepower and speed. But the objective of familiarizing yourself with water turbines is not an objective that would interest the reader of the report.*

An understanding of your objective is of immense importance. When you state an objective, you make your contract with the reader. Every word in the subsequent report should lead toward the stated objective.

1.2.2 Experiment:

This portion of the report might contain a single section entitled: EXPERIMENT, or it might consist of two sections entitled APPARATUS and PROCEDURE. In either case, this portion should give a full description of the apparatus and instrumentation with the help of an appropriate schematic diagram(s). The importance of a good diagram can not be underestimated. This section should provide a full explanation of what was done in the experiment. The PROCEDURE section should give a step-by-step procedure that could be used to replicate the experiment. This is best presented in a bullet or numbered list. The PROCEDURE should be complete enough for someone else to replicate the experiment.

1.2.3 Results:

This section presents the reduced and/or calculated results of the experiment. The original data sheets will be included as an appendix item.

This section should describe the results fully and indicate how any data reduction was handled. The reduced or end results will be presented in graphical form wherever appropriate and/or in tabular form. Sample calculations will be presented as an appendix item where appropriate. Tables and graphs should be included to give a clear description of the data or its important characteristics. Tables and graphs should only be included when referred to in the associated text. Tables should be numbered and legends provided. Each graph should have a separate figure number and caption. MATLAB, or equivalent, should be used in this course for the presentation of all graphical data.

1.2.4 Discussion:

This is the most important single item in the report. In this section the student should show how the results bear out the conclusions and fulfill the objective. He/she should also compare his/her results with theoretical predictions and with the results of other comparable experiments, where possible, in order to verify them. Anomalies and discrepancies should be explored and explained in physical and mathematical terms. The explanations should be keyed to the results section by referring to the Figures and Tables by number. Most often this is the section in which error analysis should be quoted. If a formal error analysis is done, this documentation should probably be an appendix item.

1.2.5 Conclusions:

This section contains the direct answers to the experiment objective and these are usually given as numbered, specific items or bullets. The justification for these calculations has already been given by the Results and Discussion.

1.3 Supplementary Material

Supplementary materials include the following:

- *References (Immediately following the conclusions, before the appendices)*
- *Appendices - Label each Appendix separately (A,B,C,D)*
  - *Appendix A: Equipment List*
  - *Appendix B: Sample Calculations*
  - *Appendix C: Additional Figures/Tables*
  - *Appendix D: Data Sheets/Matlab Scripts*
  - *Appendix E: Error Analysis (If Required)*

1.3.1 References

The references should be included after the conclusions of the report and entitled REFERENCES. References that are not actually used should not be included, and all references should be keyed to the text in the following way [1,2,3,5-8] using a numbered reference list.

Nothing should be copied verbatim from a reference unless there is some special reason to do so and then only if it is set off in quotations or otherwise noted as a verbatim quote.

1.3.2 Sample Calculations

This appendix should contain one example calculation for each major calculation made in the technical report. The sample calculation should include numbers and units, making clear any units conversions, etc. Even if the actual calculations are performed in Excel or Matlab, this sample calulation(s) must be included.

1.4 Additional Comments

- *Margin should be 1.5 inches on the left side of each sheet and 1 inch at the top, right side and bottom.*
- *Font size should be 12.*
- *Size of paper should be 8.5 x 11 inches.*
- *Report folder will be optional. Use of a metal binder clip is normally sufficient.*
- *Report should be typewritten or in ink.*
- *Graphs should be titled as Figures. Unless otherwise directed, take the dependent variable as the ordinate (y-axis). Always state the units in the legends of the abscissa and ordinate. Plot the curve to a reasonable scale, indicating the observed or calculated points by means of small circles (3/32 inch diameter) or small triangles, squares, etc. if there is more than one curve on the graph. Do not use colors to differentiate many curves on a graph. Colors cannot in general be copied. Instead, use dashed, dotted, or dot-dashed lines in conjunction with the small circles, squares, or triangles. Don't forget the legend to identify different curves. MATLAB plotting gives you all of these features. Plotting with MATLAB is strongly encouraged.*
- *A concise description with diagrams and sketches will make clear the general arrangement or set-up of the equipment for the test. Diagrams can be rough sketches in this course (The use of a drawing program is not required.). Diagrams should be titled, components lettered and referenced by letter in a description. All diagrams in technical laboratory reports should be in ink (pencil is acceptable for this course).*
- *Note all instruments and auxiliary apparatus used, with laboratory identification numbers and concise descriptions.*
- *Use one side of sheet only.*
- *Spelling, punctuation, paragraphing, and other mechanical details of correctly written English are of utmost importance. Do not use personal pronouns in an Engineering report. Avoid run-on sentences.*
- *A formal statistical error analysis is not required for this class. However, make a careful analysis of the possible errors in the experiment and state in the discussion (if short) or in the appendix (if long) what precautions would be taken to minimize such errors should the experiment be repeated.*

1.4.1 Data Presentation

Please be complete in your presentation of data. For example, frequency domain data often has magnitude and phase (real and imaginary) information. In some situations, the phase information is not important but in other situations, the phase is an important part of the answer.

Data format is also an important issue particularly as it pertains to linear and/or logarithmic magnitude displays. Linear and/or logarithmic magnitude display formats are used to intentionally show comparisons between very small and very large numbers in a favorable light, depending upon the desired result. Pay attention to this issue in your data as well as in data that you review that is generated by others.

1.4.2 Data Plagiarism

In an experimental setting, the quality and originality of the data is a primary issue. Everyone involved must subscribe to the doctrine that the data is original and, to the best of everyone's ability, valid as described by the experimental report. The use of data from another source, without permission and reference, is not permitted. If a group presents data from another source as their own, the grade for that report will be zero. Remember, data is very distinctive. While a data plot looks very similar to another data plot, real data rarely if ever will be exactly the same.