

1. Introduction

Engineers who are unable to communicate effectively with their superiors or colleagues will never receive due credit for their work. In the engineering profession, information has to be transferred to enable decisions to be made, money allocated or work started. The most usual method of technical communication is via the written report. An engineering graduate must therefore be highly competent at presenting technical information using the medium of the written report, to the extent that this is one of the specific outcomes listed by the Engineering Council of South Africa (ECSA) as a requirement for accreditation of a Bachelors Degree programme in engineering.

Before starting a report, certain points should be considered in order to make the report effective:

- **Why** is the report being written? Have the contents been planned such that the reader will understand what is being said?
- **Who** will read it? This decides the level of technical information that is to be included.
- The writer must be absolutely clear as to exactly **what** information is to be conveyed. The reader studies a report for what can be gained from it.

Once the answers to these three questions have been determined, the correct **structure** of the report and its contents can be decided upon, and the actual writing of the report can then commence. Some suggestions are given below to improve and simplify the presentation of reports.

• Choose a short, meaningful title.

• Include as many sketches and diagrams as you think are appropriate. Remember that a single sketch will often clarify what might otherwise be a very confused paragraph.

• Describe what you are about to discuss in general terms before giving the details. Nothing is more confusing or frustrating than reading a very detailed description of some small piece of equipment when the reason for its use is not yet known.

• Clearly separate facts from opinions. Opinions certainly have their place as they frequently give a report its interest, but do not attempt to raise them to the status of facts.

• Use a simple, clear style of writing. Long and involved sentences are a hindrance to easy understanding and frequently contain grammatical errors.

• Be precise. For example - a fuzzy statement referring to a "large tank" immediately raises the question - how much does it hold?

2. Arrangement of Material

In many instances (both at university and later in professional life) an engineering report will have to be written to conform with a particular format. As a student in the School, the first formal report you will write will be the *First Semester Laboratory Report* in your second year of study. For this type of report the School has a particular format that is required, as outlined in the following pages. In later years of your degree programme, you will be required to submit many other written assignments such as design and self-study reports; for these assignments the format can be adapted from that described in this guide in order to suit the nature of the report. However, for the laboratory report assignment students are required to adhere strictly to the format outlined below.

The material in the report should be arranged in the sequence shown in Table 1

Table 1: Arrangement of material in a report.

Heading	Page Number	Comments
Title	i	Title use bold. Use Roman numerals up to but not including Section 1. Do not show i on this first title page.
Abstract	ii	Heading bold
Table of Contents	iii	Heading bold
List of Symbols	iv	Heading bold
1. Introduction	1	Main heading bold Number each page sequentially from 1
2. Theory	2	Main heading bold
3. Experimental Method and results	3	Main heading bold
3.1 Experiment 2	4	Subheading not bold
3.2 Experiment 2	5	Subheading not bold
4. Discussion of Results	6	Main heading bold
5. Conclusion	7	Main heading bold
References	8	Main heading bold Note that the Reference heading is not numbered.
Appendix 1	A1	Main heading bold Number each page sequentially from A1

2.1 Title

This should indicate the subject of the report as clearly and briefly as possible, the author's name(s) and the date of the report.

2.2 Abstract

This should give a clear and concise summary of the purpose and contents of the report, and the most significant results and conclusions.

2.3 Table of Contents

This should list the main and sub-paragraph headings and the page numbers on which they appear.

2.4 List of symbols

Internationally standardised or recognised symbols should be used and, if not in general use, a list of their meanings given.

2.5 Introduction

The principal object of the introduction is to acquaint the reader with the problem and to point out the purpose and significance of the report. The introduction should be logically developed to explain the nature of the problem and to provide any background information that is needed by the reader. The introduction should outline the work that forms the subject material of the report and, depending on the nature of the report, should include a survey of the relevant literature, or give the objectives of the engineering design, or give the aim of the laboratory experiment as the case may be.

2.6 Theory

This is an important section that marks the beginning of the main body of the report; it should contain all the relevant theory and any other detailed technical information needed by the reader to understand the rest of the report. Any theoretical predictions would normally be included in this section, although this may vary depending on the nature of the report. The subject matter of the theory section should be logically developed, in carefully thought-out steps, under appropriate subheadings. Where diagrams and equations are used to assist in the development of the theory, these should be properly introduced in the text: you should never leave your reader having to guess why a diagram or equation has been put in a report.

2.7 Experimental Method and Results

This section should contain a full description of the experimental method used to carry out the practical, including the setting up of the experiments, and it should show the results of the experiments. As it is likely that the project or laboratory experiment will involve several different experiments, appropriate subheadings should be used. For example, the first experiment might involve a dc circuit where voltages and currents are measured, while the second experiment might involve an ac circuit. The first subsection (3.1) should describe the dc experiment and the experimental procedure followed by the results. The second subsection (3.2) should describe the ac experiment and the experimental procedure followed by the results. Do not take shortcuts when writing this section: you must provide enough detail to allow the reader of the report to be able to reproduce your entire experiment using only this description of the experimental method as a guide.

2.8 Discussion

This section should analyse the results, comparing the theoretical predictions with the measured experimental results. Sources of possible errors should be explained. It is important that you actually **discuss** and **assess** your results, and do not simply present a re-hashed version of earlier theoretical predictions. Please see the additional pointers on this issue provided later in this guide.

2.9 Conclusion

The conclusion should state concisely what is shown by the work and significance of the findings. Avoid silly exaggeration and remain focussed on what can genuinely be concluded from your results. Please see the additional pointers on this issue provided later in this guide.

2.10 References

Referencing is a particularly important aspect of technical report writing, and there are some very serious implications if it is not carried out correctly. Referencing serves two different but important functions: (i) to point the reader to sources of further information; (ii) to acknowledge all other sources of information used by the author in compiling his or her own report. Every single source of information that you make use of in the process of writing a report (lecture notes, practical sheets, text books, internet web sites etc.) must appear in a numbered list under the heading "References". At each place in the text of your report where you refer to material or ideas taken from one of these sources, you are required to acknowledge this using a numbered reference. One widely-accepted method of doing this is the use of numbers in square brackets in the written text, e.g. Bruce[1], and Draper[2] or Kirchhoff's Voltage Law[3]. In each case the number in brackets in the text should correspond to the number of the particular source of information as it appears in your list of references.

Each entry in the list of references should contain name(s) of author(s), title of paper, title of publication, volume, page and date. For books, the name of the publisher should replace the title of the publication. For web pages, the web address, title and date should be given. Each source of information appears only once in the list of references, even if it is referred to several times in the text of the report.

1. Bruce R, Royal H and Price J B: "Factors influencing the design of large high voltage power transformers", *Trans. SAIEE*, Vol.6, p.43, January 1968.
2. Draper A: *Electrical circuits*, 2nd Ed., p.63, Longman, New York, 1972.
3. <http://www.howthingswork.com/mp3-player.htm>, "How MP3 Players Work", 16 October 2000

In addition to the above, if you wish to include in your report direct extracts of text from another source (i.e. word-for-word reproductions of sentences or paragraphs) then these must always appear in quotation marks **and** be followed by a numbered reference acknowledging their source.

Please note carefully that for all future assignments (whether at university, or later in professional life) all of the following are serious breaches of the accepted rules and ethics regarding written submissions: failure to acknowledge the sources of information used in compiling your own reports; direct reproduction of text from other sources without quotation marks and referencing; inclusion of diagrams and / or results from other sources without proper acknowledgment of their origin; copying the work of other people and presenting it as your own.

Students should be aware that the use of another's material without acknowledgement is referred to as plagiarism; this is the case irrespective of the source of the material (be it lecture notes and textbooks or even another student's work) and irrespective of the nature of the material (i.e. whether the material was obtained from a written source or another person's ideas exchanged in conversation). Plagiarism is not just an academic issue, it is a criminal offence in terms of breach of copyright.

Students are requested to familiarise themselves with the particular section of the student rule book that deals with this issue [rule 9(1)(e)(i)(ff)] and are to understand clearly that any breaches of these rules in any written assignment in the School of Electrical, Electronic & Computer Engineering will result in disciplinary action being taken against those involved. Such disciplinary action for plagiarism is a serious matter, and the consequences can be as severe as exclusion from the university.

Each student submitting a report for marking in the School of Electrical, Electronic & Computer Engineering is required to complete and sign the declaration that is attached to the end of this guide. This signed declaration must appear inside the cover of the report as the first page or the report will not be considered for marking.

2.11 Appendices

The appendices contain material that is needed for completeness of the report, but which is not appropriate for inclusion in the main body of the report. It should be possible to read and understand the main body of the report without having to refer to the appendices. Therefore circuit diagrams and graphs of results **must** appear in the main body of the report as close as possible to the text where they are discussed, while appendices may contain:

- large tables of data;
- sample calculations;
- physical constants used;
- equipment list - type, make, model and serial number of each instrument used;
- complicated derivations and proofs of material appearing in the theory section of the report.

3. Editorial and General

3.1 Report

Reports should preferably be prepared on a word processor but handwritten reports, that are neat and legible may be acceptable. Confirm these requirements with your lecturer/supervisor. The text of the report should be printed on one side of the page only. Each major section should start on a new page. For laboratory reports the pages should be bound together on the left-hand side in a pre-printed Engineering Faculty cover.

The preferred format settings are shown in Table 2.

Table 2: Preferred format settings for a report.

Margins	25mm left, right, top and bottom
Font	New Times Roman

Font sizes	
All material except	11-point regular
Title author etc	12 or 14-point bold.
main headings	11 or 12-point bold
subheadings	11-point regular
Line spacing	Single (or one and a half spacing if desired)
Page numbering	Centre at the bottom of each page
Printing	Single sided
Spelling and grammar	English(UK) or English(South Africa)

3.2 Units and quantities

Metric (SI) units should be used.

3.3 Paragraphs

A decimal system of numbering paragraphs (as used in this document) should be used where the report is long and there is a need for reference to other parts of the report.

3.4 Diagrams, tables and graphs

Diagrammatic material should be presented in a format that permits it to be read either with the report the usual way up, or with the report turned *clockwise* through 90°.

All figures should be numbered with the **text below the figure** e.g. "Figure 1. Armature voltage as a function of field current".

Tables should be numbered with the **text above the table** e.g. "Table 1. Armature voltage as a function of field current".

3.5 Equations

All equations must be numbered sequentially as shown below in **round brackets**:

"The output voltage of the amplifier is given by

$$(1) V_o = A_v(V_1 + V_2)$$

where A_v = the voltage gain

V_1 = input voltage 1

V_2 = input voltage 2."

In an appendix such as Appendix 1 it is normal to number the first equation (A1.1).

When referring to a particular equation the following convention must be used.

"In Equation (1) above A_v is limited to ..." or more simply

"In (1) above A_v is limited to ..."

The use of an equation editor (e.g. in Microsoft Word) will assist in setting out equations correctly. When using an equation editor, please pay particular attention to ensuring that the font size of the variables in your equations is consistent with the font size of the main text in your report.

4. Hints on writing laboratory reports

While observing all the foregoing general recommendations, the student should also take note of the following specific hints on the formulation of laboratory reports.

4.1 Equipment and procedures

Because of their critical importance in laboratory work, these two items need to be given due attention. The date and place of the work and the experimental method employed should all be clearly stated and all equipment identified unambiguously.

4.2 Tables and graphs

Tables and graphs are the normal method of presenting data gathered in, or deduced from, the experiment. Be sure that they are clearly titled and numbered, uncluttered and simple to follow.

4.3 Plotting the graphs

Each axis must be labelled with the name of the variable and its units. E.g. Time (s) and Output (V_{RMS}). The scales of the axes should be appropriate for a well-proportioned graph filling a reasonable portion of a page. Axes should be marked in intervals corresponding to 1, 2, 5 or 10 units (or these times powers of 10). Other interval sizes make it extremely difficult to read between divisions on decimal graph paper.

The graph must be drawn as a reasonable and smooth "best fit" to the experimental points and should not "join" points in a stepwise fashion. If several curves are drawn on one set of axes, take care to identify clearly each curve and its set of measured points.

The use of a graph plotting software package such as MatLab is encouraged.

4.4 Sample calculations

A sample set of step-by-step calculations should be included, giving the formulas used, the particular readings taken and the final numerical result including units. Reference must be made to the graph or table containing the complete set of data.

4.5 Units

Always refer to measured quantities in terms of their SI units and accepted multiples or submultiples thereof. This applies throughout the report - i.e. to text, tables, graphs and calculations. The omission of physical units in an engineering report is unacceptable.

4.6 Grammatical style

It is normal to write reports in the third person, passive voice. Use of the first person (I, we, me, us etc.) may be acceptable, but usually only in exceptional cases. You should use the past tense whenever you are reporting on things that were done, or decisions that were made during an assignment, design project or practical. You should use the present tense when describing theory and any other issues that are always true in the present. These style requirements are best illustrated by two examples.

"The speed of the dc motor was held constant, and measurements of armature voltage were taken for a range of different values of field current. The graphical results obtained are shown in Figure 1, while the actual measurement readings are shown in Table 1 in Appendix 1. While carrying out the measurements, it was noted that a linear relationship existed between the voltage and current readings."

"According to Kirchhoff's Voltage Law [3], the instantaneous sum of the voltages around a closed loop in an electric circuit is zero."

If the report is typed, it is an idea to use the most technical style of the word-processor's grammar checker. Please note that a very matter-of-fact style of language is generally used in technical report writing; you should avoid using flowery prose unless it is absolutely necessary.

4.7 Discussion of results

In formulating your discussion, remember that it is your task, as author of the report, to convince your instructors that you have understood the purpose of the practical and that you have applied a logical reasoning process to the analysis of your results. You must clearly set out your interpretation of the results to show how they confirm (or fail to confirm) the aims of the practical; e.g. try to explain why a curve appears as it does. Do not merely say 'it is linear', but 'it is linear because...'. Whenever possible, be ingenious in your approach: you may be able to enhance your discussion by providing more than just the graphs and calculations that have been specifically requested. Use other graphs or analytical approaches to see whether a theory of yours is valid. For example, extrapolate graphs to zero and make inferences from the result, or if an instrument is suspect, calculate the effect on the result. If a theory of yours turns out to be invalid, do not leave it out; explain that the effect is NOT due to this or that, and prove it to your reader as you have to yourself.

§ If a result is believed to be inaccurate due to an instrument reading, make an assessment of the instrument error and calculate the effect on the result in question.

§ Do not say "results are not as expected" unless you clearly told the reader what was expected and in what way they differ.

§ Do not say "results are not very accurate" or "results are inaccurate" unless you can back up your statement by giving an estimate of accuracy. The same goes for words like "poor", "good", etc.

§ Do not present a verbal version of your graphs (i.e. merely describing their shape) say why they appear as they do.

4.8 Conclusion

The conclusion should be a set of concise, complete statements summarising the main findings of the report, with key numerical data provided in support whenever possible. Your concluding remarks should relate directly to the objectives of the report and be brief statements of what was decided in the discussion. When writing a report, it is often useful to imagine that the reader will only look at the abstract and conclusion of your report to get a quick feel for its contents; you should write these two sections accordingly.

Conclusions are not:

- Results "were as expected" or "not as expected". Even if you have stated your expectations (and students rarely have), your reader does not want to go and look them up in order to find out what conclusions you are making,
- That you learned a lot, that the practical was interesting, that the apparatus broke down, that the practical was "unsuccessful", etc. - these were not the objectives of the experiment, or
 - That the results were good, bad, inaccurate, etc. unless you have argued these points in the discussion and you have quoted actual figures in the conclusion.

5. Common Errors

Table 3: Some common errors

Error	Correction	Comment
Table title appears below a table.	The title must appear above the table as shown in Table 1 above.	
Figure title appears above a figure.	Figure titles must always appear below a figure and are normally centred. Eg	Eg, "Figure 1. Graph of armature voltage as a function of the field current."
Center, meter (for length), recognize, etc	Centre, metre, recognise (Note a voltmeter is spelt meter.)	Use the correct spell checker. (UK) or (South African)
Referring to equation (2)	Referring to Equation (2)	Note capital E
Referring to table 2	Referring to Table 2	Note capital T
In section 4.3	In Section 4.3	Note capital S
In chapter 3	In Chapter 3	Note capital C
7. References	References	The Reference title must not be numbered.

5. Acknowledgements

Many of the ideas contained in this guide have been gleaned from similar documents published by other Schools/Departments and organisations, and the authors gratefully acknowledge their assistance, in particular: Mr. R J Hayes, formerly of the University of Durban-Westville; the School of Pure and Applied Physics and the School of Mechanical Engineering - both of this University; and Clemson University, USA. Section 2.10 has been compiled with input and assistance from Mrs. J Parker, Howard College School of Law, University of Natal Durban.

Further Reading

Dieter, *Engineering Design*, McGraw-Hill Paperback.

De Bono, *De Bono's Thinking Course*, BBC Publications.

Prof A D Broadhurst and Dr B S Rigby

10 February 2003

ELECTRICAL, ELECTRONIC & COMPUTER ENGINEERING

I hereby declare that the contents of this report are my own original and unaided work, except where specific mention is made to the contrary in the form of a numbered reference.

Author's full name

Author's student number

Author's signature

Date

