PROJECT EPR400/EPR402 STUDY GUIDE

APPENDIX 4
REQUIREMENTS FOR THE FINAL REPORT

Last revision: 9 September 2022
Revision notes:

A. OVERVIEW
THE TWO FINAL REPORT SUBMISSION ITEMS

The final report will be evaluated as a core part of the ECSA Graduate Attributes to be evaluated. This section of Appendix 4 provides a summary of the two submission items. Section B expands on the exact requirements of submission item 1. The content of submission item 2 is described below. Section C describes formatting requirements.

You need to read this entire Appendix to the study guide with care before writing your final report.

Note that the submission consists of two items. A complete submission includes both of these items. Incomplete submissions are not accepted.

Submission Item 1: the final report, including an appendix that contains technical documentation. This is submitted as a ***single*** pdf document. Only pdfs are accepted, and no other formats. Submit on the AMS.

Submission Item 2: all the code that was developed. Submit this on the AMS.

Submission item 1, the final report, documents the story of your year's work in a main report. It intends to document what you have designed, implemented and tested, and this should be done in a systematic way.

The final report also contains an appendix called Appendix: Technical Documentation. This is part of the single pdf that contains the entire final report.

Please refer to Section B for details on the requirements.

Submission item 2 contains all of **the code** that you developed for your project. This is a separate submission item on the AMS (under "Submission item 2" on the AMS). Submit *all* the computer code and software models that you developed in one or more files. This includes code developed for a PC platform (e.g., C, C++, C#, Python), simulations developed (e.g., in Matlab, C, Octave, Simulink, Python…), simulations in any specialist software package (e.g., SPICE, Comsol, NEC, FEKO, PSIM, electromagnetic simulators, network simulators, optical network simulators), code and models for FPGAs (e.g. VHDL code, other models in MaxPlus, Quartus, Mentor Graphics packages), DSPs or microprocessors (e.g., C or assembly code), circuit designs (e.g., Orcad, Pads, Eagle), microelectronics design files and simulations.

Overlap between main report and technical documentation appendix

There will certainly be some overlap between the main report and the appendix containing the technical documentation. This is to be expected. The main report and the technical documentation *should be seen as separate documents with very different objectives*.

- **The main report** documents your thought processes and the details of the design, to enable the examiners to evaluate your work, to evaluate whether there was a systematic design, implementation and testing process and to evaluate whether you acted as expected of an engineer by following correct processes and performing solid engineering work.
- **The technical documentation appendix** and code are used by your study leader, future students or engineers that will follow in your footsteps and that would need to understand some of the deeper details of (e.g.) your software, or that may need to repeat some aspect of the work.

Submission deadlines

Strict report submission deadline

→ The report submission deadline appears on the Project Clickup site.

→ IMPORTANT. **Note that submission of the report is part of the examination**.

→ This is handled in the same way as a written online examination. *This means that no late submissions are accepted!* The rules are the same as for any written online examination. Once the upload grace period has concluded, the AMS submission will close, and students that did not submit will automatically be refused entry into the oral examination.

→ IMPORTANT. **It is a requirement that students upload preliminary versions of the final report onto the AMS**.

- Three preliminary versions will have to be uploaded: 3 days before the final report is due, 10 days before the final report is due, and 17 days before the final report is due. Please see the Project Clickup page for exact dates.
- The objective with this is (a) to ensure that you have a recent official backup even if you should lose all of your personal backups and (b) to ensure that students commence with the report early enough and that there is a *paper trail of systematic progress*.
- These preliminary uploads will not be evaluated. However, if an issue should arise at the final upload deadline, these preliminary uploads will be used as evidence for the process up to that point.
- As a safeguard on the last three days before the final submission deadline, you may upload earlier versions of the final report onto the AMS at “final report”. If more than one upload appears here, only the last one that was uploaded before the AMS closed at the deadline will be used.

Submission deadline for submitting code

All of the code that you developed is submitted on the AMS *by the report submission deadline*. Failing to do so will result in the status being “incomplete submission”, meaning that the student will automatically be refused entry into the oral examination.

The sections that follow expand on the requirements for the submission items.

B. SUBMISSION ITEM 1
THE FINAL REPORT: REQUIRED CONTENT

Introduction

The final report documents what you have designed, implemented and tested in a systematic way. The final report will be evaluated as part of the ECSA Graduate Attributes to be evaluated.

Content. The final report contains Parts 1, 2, 3 and 4 described below. Part 3 is referred to as the *main report*. The required content of the report is described in sections to follow.

Length of the final report. Requirements and guidelines for the length of each section are given below, but the total length of the main report (i.e. this is Part 3 of the report, described below) should be between 50 (minimum) to 75 pages (maximum). For page count purposes, the main report *excludes* everything up to and including the Project Proposal (Part 2); the main report page count starts on page 1 of Part 3 of the report, and excludes the References section and Appendix 1 (the latter being Part 4 of the main report).

→ Note that main report section of fewer than 50 pages is usually incomplete *and will probably not be accepted.*

→ A main report of more than 75 pages is not allowed under any circumstances.

Suggested numbers of pages per section as given below provide a guideline of how long sections will typically be. These are *not* rules. E.g., the Results section is not required to be a minimum of 12 pages and a maximum of 15 pages. These are good guidelines, however. If you are significantly outside of these guidelines, you are writing too little or too much. If you go over the guideline in one section, you will need to cut back in a different section to meet the page count restrictions.

Prescribed layout and content. It is ***compulsory*** that the final report should contain the layout and content described below. See the example on the Project website as well.

> ⚠ WARNING. **Do not develop your own template. Use the template provided. You will fail the report if you use an own template.**

Formatting. Follow the formatting rules in section C.

> **WARNING**
>
> *Take note before you start writing: absolutely no part of the report is intended for marketing.* Specifically:
>
> - Ensure that what you write in the report is the **ABSOLUTE TRUTH** and reflects the status of your project on the day of submission of the report.
>   - → Do *not* guess at what may happen between the writing of the final report and the day of the oral exam.
>   - → If some aspects of the project are incomplete, or if some specifications have not been met, you are obliged to say so.
> - In other words, and very important: Do not attempt to foresee or falsify results. If what you write in your report is not truthful, the consequences may be severe.

There are *four main sections* in the final report, listed below.

- Part 1. The preamble, including a plagiarism declaration
- Part 2. A project definition section (or problem identification section), **containing the unaltered, approved Project Proposal that appears on the AMS**
- Part 3. The main report that provides complete technical design and implementation details
- Part 4. Appendix: Technical documentation

The headings in bold below (and within a margin to margin frame for the Part headings) are the headings *exactly* as they should appear in the final report. Use the correct font size, though (use the template).

Formatting hint: the margin to margin frame is just a single-row, single-column table in Word.

Part 1. Preamble

This page should commence with a heading that should read:

```
Part 1. Preamble
```

Note: text appearing in `this font` is an example of text that will appear in your report.

The preamble should commence on page (i) (Roman numerals) and is typically no more than one page long.

► *This is the only section of the report written in the first person.* No other section of the report may be written in the first person.

Commence with a one sentence description of the work. An example appears below.

```
This report describes work that I have done in my final year project, developing
a low power communication system for long distance data transmission.
```

Include *exactly* the following text after this.

```
Project Proposal and technical documentation
This main report contains an unaltered copy of the approved Project Proposal
(as Part 2 of the report).

Technical documentation appears in Part 4 (Appendix 1).

All the code that I developed appears as a separate submission on the AMS.
```

Next, specify whether this project builds upon a previous project or not. You have to briefly indicate what was done by yourself and what was done by others. You *must* include a paragraph with this information with the heading that appears below. Here is an example:

Project history

This project extends a previous project by Owens (2021), but my implementation is completely new. I borrowed some ideas from Owens, but only regarding the antenna design procedure and nothing else.

I reused FFT code from a library and did not develop this myself.

Your manuscript *must* be language edited (or proofread, i.e. edited for grammar, spelling and phrasing) by a *knowledgeable* person. The text in the following example should be used to indicate that your manuscript has been language edited.

Language editing

This document has been language edited by a knowledgeable person. By submitting this document in its present form, **I declare that this is the written material that I wish to be examined on.**

My language editor was mr. John Duckstein (***example***).

J. Duckstein 6 November 2022

Language editor signature Date

The report will <u>not be accepted</u> without the signature of the language editor, *or* a confirmation email from the language editor. If the latter option is taken, this letter or email message is attached right at the end of the report, and in place of the signature you simply write "proof of language editing is attached".

Submission without his/her signature or confirmation of language editing will ensure that the report retains a "incomplete" status, in which case you will be refused entry into the oral examination.

Finally, indicate whether the work that you present was your own work. Then certify the accuracy of the information on this page by signing at the bottom of the page.

The report will <u>not be accepted</u> without your signature. Print the page, sign, scan and include into the pdf document, or add an electronic signature.

The following text must appear in your report.

I, ______________________________ understand what plagiarism is and have carefully studied the plagiarism policy of the University. I hereby declare that all the work described in this report is my own, except where explicitly indicated otherwise. Although I may have discussed the design with my study leader, fellow students or consulted various books, articles or the internet, the design work is my own. I have mastered the design and I have made all the required calculations in my lab book (and/or they are reflected in this report) to authenticate this. I am not presenting a complete solution of someone else.

Wherever I have used information from other sources, I have given credit by proper and complete referencing of the source material so that it can be clearly discerned what is my own work and what was quoted from other sources. I acknowledge that failure to comply with the instructions regarding referencing will be regarded as plagiarism. If there is any doubt about the authenticity of my work, I am willing to attend an oral ancillary examination/evaluation about the work.

I certify that the Project Proposal appearing as the Introduction section of the report is an unaltered copy of the approved Project Proposal.

J.R. Nnamani *6 November 2022*

____________________________ ___________

J.R. Nnamani Date

Table of Contents

The Table of Contents follows the declarations described above, and should commence on a new page (still using Roman numeral page numbers). This will typically be page ii. Page numbers of each section are given at the right margin. The Table of Contents should only list sections that follow, i.e. it should not list itself or anything else that is part of the Preamble.

List of Abbreviations

Commence this section on a new page (still using Roman numeral page numbers). This will typically be page iii. Here you have to provide a list that defines all abbreviations used in the text, *including* more common abbreviations like SNR, rms, DC, AC, RAM, FPGA and GSM.

Remember that you also have to define each abbreviation at the first instance thereof in the text of the report.

You should also provide definitions of notation in this section. E.g., if you use x for scalars and $\boldsymbol{x}$ (bold print) for vectors, this is the correct place to define this.

Part 2. Project definition: approved Project Proposal

Following the Preamble, you should have a page that contains only a heading, which should be as follows.

```
Part 2. Project definition: approved Project Proposal
```

This heading is followed by this exact text.

```
This section contains the problem identification in the form of the complete, approved Project Proposal, unchanged from the final approved version that appears on the AMS.
```

The rest of the page will be blank.

On the next pages, insert a complete copy of your final, approved Project Proposal. The formatting of the original Project Proposal should be unchanged, i.e. *include this in the landscape format in which the Project Proposal was submitted early in the year*.

This will be your *approved* Project Proposal that appears on the AMS, *without any alterations other than these*:

(i) Correct any grammar or editing errors that needed to be corrected.
(ii) Perform any formatting corrections that may be necessary.

Leave all other formatting as it was in the Project Proposal (e.g. frames/blocks around headings). Sections are not renumbered and page numbering remains as it was.

> Important note: any alterations to the approved Project Proposal, other than formatting updates or corrections to grammar, may be construed as fraudulent behaviour.

While this will be your final, approved Project Proposal as it appears on the AMS, please remove any highlighting and comments from the document, *except* any comments that appear in the Feedback block on the first page of the Project Proposal. **Anything that appears in the Feedback block should be retained and should appear in the version included in your final report**.

If you submitted an Engineering Change Proposal, this section will contain the final *approved* Project Proposal that appears on the AMS.

Part 3. Main report

Following Part 2, you should have a page (which will be the last page having a page number in Roman numerals) with just the heading: `Part 3. Main report`. The rest of the page will be blank.

The Literature study section follows on the next page, and this will commence on page 1 of the main report. Use the following headings exactly as given here.

1. Literature study

Commence this section on a new page. The typical length of this section is between four and eight pages.

In this section you have to provide a summary of information from the literature that was required to complete your project and that places your work into context. It is an extension of the literature study in the first semester report.

> ☞ **Hint:** Your task in this section is to show that you have acquired and evaluated the requisite knowledge, information and resources.

Literature sources to be consulted include journal articles from technical journals (e.g. IEEE, Springer, Elsevier or Wiley journals), technical information from good quality technical websites, books and standards documents.

Organise this section into

(i) a description of the background and context (typically between three and seven pages), referring to the relevant literature, and

(ii) a brief summary of how you applied this background (one to two pages).

The former is a structured summary of what other people have done before you that supports your work, including (but not limited to) how others have solved similar or related problems. The latter summarises what has been learnt in the literature study and describes how you applied what you learnt from literature (and perhaps expanded what has been reported on before in the literature).

Notes on how to prepare a literature study appear on the Project website. Hint: One way to approach a literature study is to regard it as an argument. You want to show your reader, by referring to several examples (i.e. citing the relevant literature), what others have done and where shortcomings exist that you needed to address with your project.

A good literature study will *not* be an article-by-article summary of the material you read, but will merge the material into a unified view of the literature. To see what a good literature study looks like, look at the introduction section of (almost) any article published in an IEEE journal. Review articles (often appearing in the Proceedings of the IEEE) are usually particularly good examples of literature studies.

You should give at least six references to articles in technical journals (often IEEE journals, but you may also include others), and perhaps further references to other material.

► *Remember that there should be a one-to-one correspondence between the citations in the text and the reference list. I.e., do not include an item in the reference list if it is not cited in your report.*

You should use either IEEE-style or Harvard-style referencing format. Kindly check which format your study leader prefers. Descriptions of both may be found on the internet. A description of IEEE format may be found on the websites of IEEE journals. Whichever format you choose, use it consistently.

The exact formatting is less important than using a consistent format throughout. E.g., you could use APA-format, which is very Harvard-like (author-date format), as long as you use this consistently.

2. Approach

Commence this section on a new page. In this section, you will be giving the reader an *overview* of how you approached the problem, instead of just jumping directly into the technical detail. If one does not give a proper overview, the technical detail easily becomes a disconnected series of paragraphs. The approach section should be brief and will act as an introduction to section 3 of your report, so that the reader will understand *why* you provide the technical details that appear in section 3.

> ☞**Hint:** it is important to have a clear "storyline" in the report. One of the main things that examiners often miss in reports is ***why*** you are writing something. **Make sure that your report is not a disconnected series of paragraphs**.

The Approach section answers the questions, WHY and HOW? In this section you need to tell the reader how you planned to achieve the objectives mentioned in Part 2 (the Project Proposal) and why you include technical details that appear further on in the report. I.e., describe the approach or the way in which you solved the problem. *This is a high-level view of the steps followed to solve the problem.* Don't jump into any detail of the mathematics, the design or the experiments yet, but explain at a *conceptual level* what you did to solve the problem.

You will need to focus on your concept design, the design alternatives and tradeoffs considered, and your eventual preferred solution. You will typically refer to your functional analysis to explain how different functional blocks were implemented and why. Explain how the functional design (as given in Part 2 that contains the Project Proposal) has been translated into a first concept design. For example, to implement a specific logic function, you may have used discrete logic, or an FPGA, or a microprocessor. Explain *conceptually* **what** you did, and explain **why** you did it in this way. You may use hardware block diagrams and/or software flow diagrams as aids.

The approach section will typically be one to two pages long.

3. Design and implementation

► <u>This is the most important part of your report and should contain a **deep level of technical detail**</u>. Here you should give all the necessary technical details, e.g.:

- theoretical analysis, mathematics that describe the problem and the solution,
- design equations,
- component values calculated,
- simulations that have been done,
- experiments that have been conducted,
- software and hardware that have been developed.

> ☞ **Hint.** It should be clear from what you write in this section that there is a solid theoretical foundation to your project **and** that you have mastered this (as opposed to thinking up own naive solutions). In other words, **your engineering education and solid scientific approach should reflect clearly in your design**.

Here are two examples of *too little* technical detail.

- *If a student developed an image recognition system, he/she should not only describe the code, the software flow diagram or the functions implemented in software, but also needs to give all the necessary mathematics that describe the image processing algorithms.*

- *If a student designed a circuit, it is of no value to show the circuit layout without design equations and component values.*

> ☞ **Hints**
>
> - **Spend most of the available space in the report on the most important aspects of your design**. These would typically be the first number of requirements in your approved Project Proposal (as the requirements would usually be in order of importance). Ensure that you document your design clearly for these core aspects of the project.
>
> - Document everything *that you would like to claim credit for*, and ***don't waste pages on anything that does not carry credit*** (keeping the maximum allowed number of pages in mind).
>
> - **Remember that you won't get credit for a design if you don't give the technical detail.**
>
> - **Remember that you will only get credit for your OWN first principles design and implementation**. Off the shelf solutions, copies of designs from (e.g.) blogs or data sheets, code found in libraries, user interfaces, data bases
>   – *none of these require engineering design effort and therefore do not carry any credit in Project*. Please see the zero-credit items listed on the Project Clickup page.
>
> - You won't get credit for discussion of engineering basics, e.g. Ohm's law. Focus on your own contribution and those aspects not covered in other modules.

Section 3 of the report commences with a design summary, followed by paragraphs and subsections that contain technical detail.

3.1 Design summary

> ⚠ Important! **Ensure that the summary table (described below) is included in your report. Inclusion of this table is a <u>strict requirement</u>.**

Commence subsection 3.1 with a sentence that says something like:

```
This section summarises the project design tasks and how they were
implemented (see Table 1).
```

Then create a table with three columns, like the one below. The tasks summarized here are

(i) those that correspond to <u>the deliverables</u> (line 5) in the table of section 4 of the Project Proposal,

as well as

(ii) the <u>design and implementation tasks</u> mentioned in section 6.1 of the Project Proposal.

As mentioned before, it is important to understand that you will only get credit for design and implementation tasks that you carried out *yourself* (and *not* for off-the-shelf items).

Deliverable or task	**Implementation**	**Completion of deliverable or task, and section in the report**
Here you need to indicate the specific task, e.g. "design of a PCB for the main electronics",or "Development of optimisation routine" **Each task should appear in a new row in this table.**	Here you need to summarise what you did to complete this particular task, e.g. "The PCB design was completed, using the PCBCAD package. This was done from first principles", or "the PCB design was replaced with a veroboard design, completed from first principles", or "optimization was completed in Matlab, but without the Optimization Toolbox. All code was developed from first principles", or "optimization was completed in Matlab, but the Optimization Toolbox was used, and while some code was developed from first principles, numerical methods for optimization weretaken off the shelf".	(i) Here you indicate whether the task has been completed, or not, by simply writing either "completed" or "incomplete". Do not guess what you will be able to show at the demo! The text here needs to be the truth *at the time of submission of the report.* (ii) Also indicate where in the report the reader would be able to find the complete description (typically in one of the following subsections of section 3).

Example		
DC-DC converters had to be designed and implemented by the student.	The student completed the design and implementation.	Completed. Section 4.2.8
The inverter had to be designed and implemented by the student.	The student did not complete the inverter. The design was completed and simulated, but the implementation in hardware did not work correctly.	Incomplete. Section 4.2.9

Table 1. Design summary.

Following on subsection 3.1 will be a set of self-defined subsections that contain all of the details of your design.

All of the design aspects that you report on should be appropriately organised into paragraphs and sections. This part of the report may be divided into several sections if required (i.e. 3.2, 3.3 and so on). You may use subheadings like
3.2 Theory,
3.3 Analysis,
3.4 Modelling,
3.5 Simulation,
3.6 Optimisation,
3.7 Hardware design,
3.8 Hardware implementation,
3.9 Software design,
3.10 Software implementation, and
3.11 Statistical analysis.
These are examples of typical subheadings. **You may decide which subheadings will be appropriate**.

☞ Hints

- Ensure that there is a clear storyline or "golden thread" that ties everything you describe together.
- All of your design calculations have to be included in the report.

Circuit descriptions and calculations of component values must accompany any circuit diagrams that you include. **Circuit diagrams should always include component values**.

Ensure that all your work is properly motivated. Ensure that you do not give disconnected descriptions of designs or experiments, but describe *why* a design was done or *why* a test or experiment was carried out and *how* this contributed to the solution of the problem. When explaining models and simulations, explain *which* parameters are important and *why* they are important.

Always explain any assumptions clearly.

Section 3 (Design and Implementation) of the report documents the core of the project and will typically be around 30 to 40 pages long.

4. Results

Commence this section on a new page.

This section is firstly a description of *how you measured or confirmed that your system complies with the expected outcomes* (system requirements and specifications as described in sections 4 and 5 of the Project Proposal).

Secondly, you should give your *actual measured results* in the sections that follow. *All* your results should be described in this section, *even those that you regard as unsuccessful.*

Commence with the section heading below.

4.1 Summary of results achieved

> ⚠ **Important! This subsection is extremely important! Ensure that the summary table (described below) is included. <u>This is a strict requirement</u>.**

You should commence the Results section of your report with a summary table *(compulsory)* that compares the *intended* outcomes with the *actual final outcomes.*

The *intended outcomes* include:

(i) the <u>core mission requirements of the system or product</u> (line 1 of the table in section 4 of the Project Proposal),
and

(ii) the <u>target specifications</u> (line 2, section 4 of the Project Proposal)

The *actual final outcomes* are then:

(i) how each core mission requirement is reflected in the final product,
and

(ii) the *actual* specifications of the final product (where appropriate, the *measured* specifications)

> ⚠ WARNING. **Ensure that what you indicate here is the absolute truth, i.e. the *actual* measurements or outcomes, and not outcomes that you guessed or hoped for. This is very important.**

The table should have three columns.

- <u>Intended outcome</u>, where (i) all the core mission requirements of the product and the corresponding target specifications, and (ii) all the field conditions are listed (i.e. those that were documented in the approved Project Proposal in sections 4 and 5). *A text description, or a text description along with the measurable specification is given in this first column*. These were the intended outcomes of the project exactly as given in the approved Project Proposal).
- <u>Actual outcome</u>, where the measured values or the actual outcomes are given.

- Location in report, which is an indication of where exactly in the report the reader can read more about the particular result.

  The table will look like Table 2 below (this is the same example that also appears in the final report template).

Intended outcome	**Actual outcome**	**Location in report**
Core mission requirements and specifications		
The motor should be able to rotate at a speed that can propel the vehicle forward at at least 10 km/h.	The measured maximum speed was 12.6 km/h.	Section 4.2.6
The system should switch between the sources that supply the vehicle depending on energy demand. The battery should supply the vehicle up to 75% of its current rating. When exceeding this rating, the SC should take over the supply.	The switching does take place, and data gathered and stored on the vehicle's on-board memory during an actual drive test shows that switching to the SC happened at a current of 2.3 A. The vehicle continued to drive on either source.	Section 4.2.2
The system must be able to determine the placement of each runner in the race with an error of at most 0.05 seconds.	Runners could consistently be placed within 0.1 ms, as determined from photographs.	Section 4.2.7
Bit error rate (BER) should be low. BER should be below 1E-6.	The BER was measured as 10 bit errors in 1000 bits.	Section 4.2.1
Delivered power should be adequate for the load. 2 kW should be delivered to the load.	The system could not deliver the required power into the load. The system could deliver 800 Watts into the load before overheating.	Section 4.2.3
Field condition requirements and specifications		
The system should supply power and actual environmental conditions (sunshine or rain; day or night)	The system was never tested under rainy conditions. The system could not supply power under any conditions other than bright sunlight.	Section 4.2.6
The system should use actual real-time data, corrupted by real world noise, arriving over a noisy wireless link.	The system could work error-free for at least one hour under these actual field conditions.	Section 4.2.1

Table 2
Summary of results achieved.

4.1 Qualification tests

This subsection must be detailed. While section 4.1 summarises the results, section 4.2 expands on precisely how you tested your system and measured these outcomes. In this section you need to give complete descriptions of *how* the design was verified and qualified.

You need to show how compliance with all of the requirements and specifications appearing in section 4 of the Project Proposal was verified.

> Important! Document the qualification tests **in order of importance**, from most important to least important. This will almost always be the same order as the requirements in section 4 of the approved Project Proposal.

You will need to describe each test or experiment that you performed in a formal manner (as explained below), and in order of importance. In other words, the fundamental functional and/or performance requirement (requirement 1 in section 4 of the Project Proposal) would be the most important to confirm in a test and should appear first.

I.e., the first qualification test described will be for your single most important specification. E.g., if you designed a path-finding robot, this specification will consider the ability of the robot to fulfil this task, and will *not* consider (e.g.) the power supply design.

This section will look like this (using the headings below).

4.2 Qualification tests

Qualification test 1: (title of test goes here; the title will typically refer to the first requirement in section 4 of the Project Proposal, e.g.

`Qualification test 1: Measurement of closed-loop controlled vehicle speed`

- *Objectives of the test or experiment*
- *Equipment used*
- *Test setup and experimental parameters*
- *Steps followed in the test or experiment*
- *Results or measurements* (document your measurements graphically where possible: e.g. a captured signal that shows the input and output of a circuit, numbers that reflect measure values, perhaps given in table format, or graphs that reflect measurements (e.g. BER graphs, errors or percentage correct against SNR, deviation from desired value over time, etc.)
- *Observations* (objective comments or description of what you see in these results)
- *Statistical analysis* (add this *where appropriate*, or leave out if not appropriate for the particular measurement)

You then continue to the further qualification tests. The next heading will be Qualification test 2 and the same pattern is repeated in each of the qualification tests.

For example, Qualification test 2 may have a heading that looks like this:

`Qualification test 2: Test of switching between battery and supercapacitor`

Headings and subheadings shown above will appear exactly like that in the report, i.e. without a heading number; simply bold print for the Qualification test heading, and italic print for the subheadings (objectives, equipment used etc.).

► You need to focus on the main requirements of the system, so that one would seldom have more than around five or six tests, and in some instances a student would report only two or three.

> Important! Ensure that your qualification tests **capture the operation of your system as a whole**, i.e. the main project requirements, rather than focusing on fine details or subsystems.
>
> **IMPORTANT. It is up to THE STUDENT to PROVE that his/her system complies with requirements.**

It sometimes happens that a student documents no qualification tests for the system as a whole, but rather focuses on less important aspects. Please ensure that this does not happen.

Under the heading "*Equipment used*", indicate in exact detail which equipment was used (e.g. a Tektronix TDS2002C oscilloscope). You should also include the design of any hardware and/or software that you specifically developed to qualify your design or perform your experiments in this subsection. The latter may be regarded as part of the tools that you required to solve the engineering problem, so if you need a dedicated section to describe these tools, create a new subsection that appears before the qualification tests. This will then be section 4.2, and the qualification tests will become section 4.3.

The subsections "*Results and measurements*" and "*Observations*" are, respectively, where you need to *show* the results (typically in the form of tables or graphs in the "*Results and measurements*" subsection) and *describe* them objectively (in the "*Observations"* subsection).

These two subsections are intended to give an *objective* description of the outcomes of experiments that were intended to verify system functionality and specifications.

Ensure that in the latter of these subsections you describe the results *objectively* without attaching your own interpretation to them or coming to conclusions from them - this you will do in the Discussion section (Section 5 of the report). In the present section you need to describe that which any electrical/electronic/computer engineer looking at the measurements or graphs would also observe. I.e., these are simply *observations*.

As a guideline, this section will be around 12 to 15 pages long, including figures.

5. Discussion

> **This section is extremely important**! This is where the examiners will appraise your ability to evaluate your own work, which is very important for an engineer, and which is part of ECSA GA 9.

Commence this section on a new page. In this section you will be giving your own *interpretation* and *evaluation* of the results, and will then place your work into context.

The idea in the Discussion section (specifically in section 5.1 and 5.2) is that you have to stand back and give your own (**properly motivated**) opinion of what you have achieved. I.e., these are your *findings*.

Findings are more than just *observations*. Here you need to evaluate your work and place your results into context.

Consider aspects like: does my solution solve the problem? Does it solve it to a larger extent than other (published) solutions? What are the *implications* of my solution? In other words, because I have solved this problem, it will now be easier to do this or that; more cost effective to do this or that? How do my solutions correspond to what others have done before me?

> *Important note:* ensure that this section is *detailed* enough and that *you are completely honest* – this is where the evaluators will judge whether you have been working and thinking like an engineer and *whether you can take responsibility* for your work. **The readers of the report will evaluate your engineering judgement (one of the ECSA GAs that are evaluated) from what you say in these paragraphs.**
>
> For example, it would be of *no value* to say "my system is better than any previous one" or the "the system works perfectly".
>
> The chances are fair that it won't be better than all other existing systems, so rather say it as it is. Saying "my system is good at this aspect, but not so good at that aspect" (with proper motivation for your statements) *will show that you have the ability to evaluate your own work.*

This section should contain *at least* the following headings and descriptions. You may also include some of your own paragraph headings as desired.

5.1 Interpretation of results

What do the results mean? Are they very good, acceptable, or poor? What are the implications? It is important to be *honest* here. If the results are not what you hoped for or designed for, you as an (aspiring) engineer *should be able to recognise that*, and the exam panel <u>will specifically evaluate this aspect</u>.

> ❗ It is very important to demonstrate that you can stand back and critically evaluate your own work. Examiners don't *only* evaluate the quality of engineering, but *also*
> (i) whether you understand shortcomings in your design or implementation, their implications and how one would overcome them in (perhaps) future designs;
> (ii) the difference between lab conditions and the real world.

You should also indicate in this section *why* you think the results turned out as they did and what you think the application and/or consequences of the results are. Consider questions like:

- What is the cause or origin of a specific result?
- What is the effect?
- How were your measurements influenced by external factors?
- Why could you not meet a particular technical specification?

Expand the discussion on (design) considerations (briefly mentioned in the Approach section), the alternatives that you have considered and trade-offs.

Evaluate (in hindsight) the choices that you have made and defend them (where appropriate). What worked well and what did not? You may address aspects like: specific implementation choices made (e.g., which part of the design was implemented in software and which in hardware) and the consequences; which techniques you chose (e.g., which design procedure, which method for deriving a model, which method for solving differential equations, which experimental protocol) and whether these were good choices; technical and economic feasibility and implementability.

5.2 Critical evaluation of the design

In this subsection, address (i) aspects to be improved; (ii) what you regard as particularly strong points of your design; (iii) what you regard as the extremities of the abilities of the system beyond which you expect it to fail.

You don't need to use the subheadings below, but they may be helpful in organising this section.

Aspects to be improved in the present design

Are there any unsolved problems in your present design? Are there aspects of the design that you would improve on if you had more time, more funding, or could start the project from scratch?

Are there problems that you could not solve?

> ☞ Hint: if you did not do everything that you promised in your Project Proposal, or if you did something in an entirely different fashion, explain this in this section. For example, it may be that the outcome of a specific experiment prompted you to perform designs or experiments that were not planned initially.

Strong points of the current design

What turned out well in the design or in the project? And why? E.g., because of the way it was designed, the system is especially robust (e.g. against noise, against hacking, against mechanical damage). With which parts of the results are you pleased, and why? In hindsight: were the implementation alternatives chosen appropriate?

Under which circumstances is the system expected to fail?

What are the design limitations? What are possible criticisms against the results? What will happen when a failure occurs, i.e. will the system fail gracefully or will it blow up? E.g., in a particular software design, if more than 10 users log on, the system will not be able to carry the load and everything will slow down (or the program will crash). Or, in a secure network, under which circumstances will a hacker be allowed access? Or, in a communication system design, under which circumstances will the communication link be lost? Thus, try to think of all the circumstances, whether inherent in your design or environmental, that will or could cause your system to fail.

Stand back and critically evaluate what you have achieved. Try to think of which aspects other engineers or researchers will criticise. Compare your results and interpretation thereof with findings reported in literature.

5.3 Design ergonomics

In this brief section, give a description of the ergonomics that you built into your design. This will include any aspects relating to the *interaction of the user with the product*. You may include a discussion of user-friendly graphical interfaces, layout of front panels, positioning of controls, accessibility of physical interfaces, packaging, ease of installation (relevant for both software and hardware), reliability of software and other relevant aspects of the design.

5.4 Health, safety and environmental impact

You have to include a brief summary of the safety features of the design in this section. This may include aspects (where relevant) like electrical safety, provision for safety against burns (where hot surfaces appear in the product) and hearing protection (for a noisy product, e.g., an alarm). This particular section may be less relevant for strongly software-focused projects, but a clearly motivated statement to the effect that the design does or does not create potential health or safety risks must still be included.

Next, address environmental protection issues of your design. State clearly how you designed your product to contribute to environmental protection. E.g., discuss aspects like: How could your product potentially pollute the environment? Does it create noise (which may include, e.g., acoustic noise)? Does it contribute to electromagnetic noise? What happens if your product reaches the end of its lifetime - can it be recycled? How have you considered and/or solved these problems in the design?

5.5 Social and legal impact of the design

In this section, discuss all legal and social issues relating to your design. State clearly which legislation or regulations your product has to comply with, and describe how you incorporated these into your design. Also include comments on the possible social impact of your product. E.g. will it contribute towards solving problems like AIDS, poverty, crime or the supply of electricity, water and communications to rural communities? Will the product, if perhaps eventually marketed, create job opportunities or save people money or time? Identify possible cultural issues relating to your design.

If your project required ethics clearance, this should be mentioned in this section, and you should mention the ethics clearance number assigned.

As a guideline, the Discussion section will be around six to eight pages long.

6. Conclusion

Commence this section on a new page. In this final section you should present a brief summary of your most important results and findings. This is in fact a succinct summary of the previous three main sections (Design and Implementation, Results, and Discussion). This section should be a clear, complete and concise summary of the work, focusing on *what was done*, *what has been achieved* and *your findings*.

> ☞ Hint: Remember to be very honest here about what you achieved, *and* what you did *not* achieve.

Note that this section is written in the third person *just like the rest of the report*. Conclusions must be technical and be *applicable to your design* and **not** to your *personal experience*. **It is *not* acceptable** to write (for example): "the project was very rewarding".

The following subheadings have to be used for this section.

6.1 Summary of the work completed
6.2 Summary of observations and findings
6.3 Contribution
6.4 Suggestions for future work

This section *should be at least one page long* and *may not* be longer than four pages.

The content of each of these four subsections is described below, with example text that elucidates what is required here.

6.1 Summary of the work completed
Summarise the work done. The example text below shows what a particular student may have written.

```
6.1 Summary of the work completed
This report describes work carried out on the design of a voice
communication system, with the objective of using very low power to
achieve reliable wireless communication over long distances.

A literature survey was completed on modern communication system design.
The hardware and software for a low power communication system was then
designed from first principles. At the core of the system is an existing
DSP board, and all additional hardware subsystems were designed and
```

implemented. Python software was developed to simulate the system, as well as C code for the DSP, and assembly language code for a PIC processor that resides on the hardware that was designed. The system was implemented and several field tests were carried out. A voice communications channel was set up between the University and a home in Midrand. The main result is shown in the BER graph in section 3.3 of the report.

6.2 Summary of observations and findings

Summarise the results and their interpretation here. The example text below shows what a particular student may have written.

6.2 Summary of observations and findings

Successful voice communication of good quality was achieved over a distance of more than 50 km. It was found that it is possible to achieve long distance communication with low power by employing an appropriate design. Figure 1 in section 3 shows that the bit error rate (BER) is dependent on communication distance.

An important discovery was that the modulation scheme plays a major role in determining the relationship between distance achieved and power used. One implication of this is that the carrier frequency and modulation scheme has to be designed carefully, while considering the tradeoff between BER and power.

6.3 Contribution

This subsection is used to indicate clearly to the reader what you did that was new.

(i) Specifically, you need to indicate what was new to *you*. E.g. which software did you master that was not included in a previous module? (Matlab or Python would typically not count as "new"). Which new theory (not covered in previous modules) did you have to master? Which new hardware (not used in previous modules) did you use?

(ii) Indicate clearly what your own contributions were, and what the contributions of other people were. For example, give some insight into your interaction with your study leader – did you consult him/her regularly, and to which extent did you follow his/her *instructions* (e.g. "you have to use this particular processor") and his/her *guidance* (e.g. "you need to focus less on this aspect and read more on that aspect"). Indicate whether your study leader helped you directly or indirectly with aspects of the project, like finding errors in your code or hardware design. Explain how much you learned from your friends in class or perhaps engineers in industry. Explain which software modules were taken directly from elsewhere, which were modified from other code, and which you developed on your own.

The example text below shows what a particular student may have written here.

6.3 Contribution

New software that had to be mastered to complete this project was Comsol. Comsol is a finite element package, which is not something that undergraduate students would usually have any knowledge of, and that is not covered in any undergraduate modules.

Specifically, the Comsol multiphysics module was used. In order to use this, a thorough understanding of turbulent water flow had to be developed. Literature was consulted, and especially chapter 4 in the textbook by Nicholson (2012) was mastered. The mathematics used in Comsol largely reflects the underlying theory explained in this

```
chapter of the textbook.

No new code was developed, but multiple simulations were developed in
Comsol. From these, an entirely new implementation was developed without
any inputs from the study leader. Once the hardware implementation was
completed and several errors were discovered, the study leader provided
guidance with investigating the origin of these errors.

Code was mostly developed by the student, with a strong reliance on
existing libraries. As the code was of large scope, some modules were
taken directly from existing libraries, while other modules were coded
from first principles. Friends in class initially helped with coding
in R for statistical analyses, as this was complex and completely new
to the student.
```

6.4 Future work

Explain briefly how your work can be carried forward by yourself or another person following in your footsteps. This section explains where you feel other engineers may expand or improve your work. You may also describe new design alternatives that you discovered, but could not attempt because of time or funding limitations.

For example, a student may write the following.

```
6.4 Future work
The communication protocol did not work as well as expected and
was not immune against noise. Future work should include the
investigation of protocols that will improve signal-to-noise-
ratio.

The processing platform used, the Xeroid S7, was not an optimal
choice. Particular difficulties to overcome when selecting a
new platform would be the low sample rate of the on-board ADC.

Finally, more experiments are needed to confirm that image
recognition is in fact an improvement over existing literature
under all noise conditions.
```

7. References

Commence this section on a new page.

Your work does not exist in isolation. You should have consulted several sources to complete your project. You need to give at least six references to articles in technical journals. In addition, you may also cite high quality technical books or high quality technical material found on the internet (and *not*, for example, from amateur sites like Hackaday or Instructables).

You may use either the Harvard referencing format of the study guide, or another author-date format (like APA), or you may use the IEEE referencing format. Whichever you prefer (or your study leader prescribes – please check), you need to adhere *consistently* to the particular format. E.g., Bioengineering requires Harvard or APA format, while Electromagnetism requires IEEE format. Please find out from your study leader.

☞ Hint: No references may appear in the reference list that are not cited in the report.

Even if you are of opinion that nobody has ever done a similar project, either of these is usually true: there are people who worked on similar projects, or you built upon someone else's work. Ask yourself the question: where did you learn how to approach this problem?

For example, say you designed a system including a high rate A/D converter that samples data from a plant and transmits these data via a wire link to a remote PC. You may wish to refer to books or articles on bit error rate, communication protocols, transmission lines, high frequency PC board design and sampling.

Finally, do not refer to your study leader as (e.g.) "prof. Smith" in your report. Use a proper reference to a book or journal article by him/her, or otherwise if you think it necessary to quote your study leader, quote him/her in the same fashion as you would quote other specialists (check how this is done for a particular selected referencing format). Do not give any other references to your study leader. This is your project that you have to defend on your own.

Part 4. Appendix: technical documentation

► It is important to note, as indicated before, that <u>all</u> the details needed to understand your work <u>must</u> be part of the main report (Part 3 of the final report).

The technical documentation (Part 4) is used to give more complete (and often additional) detailed technical information. It should include detail that another engineer may require to debug, reproduce and manufacture your design.

The information in the technical documentation is organised into sections called ***Records***. You will find that some of the records below coincide or overlap with information already supplied in the main report. Even when this is true, **you need to repeat the required information** in the technical documentation, as the latter will have a readership different to that of the main report.

Also note that you may not refer the reader of the main report to the technical documentation section for aspects that needed to be addressed in the main report.

FORMATTING OF THE TECHNICAL DOCUMENTATION SECTION
The formatting rules are the same as for the main report. See section C of this Appendix to the study guide. This appears below.

Numbering of pages and figures
Page numbers, figure numbers and table numbers continue from those in the main report. The page numbers also continue from the main report.

CONTENT OF THE TECHNICAL DOCUMENTATION SECTION
The technical documentation section should have the following content, using *exactly* the headings and numbering as below.

Each record should commence on a new page. You may also add new records where appropriate. These should be included *after* those mentioned below. The original record names and numbers (below) may not be changed.

A.1 HARDWARE part of the project

Record 1. System block diagram

Give a description in block diagram format of the hardware part of the system. You may give this as several block diagrams where appropriate, for example:

```
Record 1. System block diagram
      Record 1.1. System block diagram of transmitter
      Record 1.2. System block diagram of receiver
```

Record 2. Systems level description of the design

This is the description that accompanies the block diagram in record 1 that explains how the system or product works.

Record 3. Complete circuit diagrams and description

There should be one complete circuit diagram showing all modules of the system**.** Component names and values must be readable and should appear in at least in 6 point font.

If you have a more complex circuit, add additional circuit diagrams to show detail of the different modules.

Add text to describe the operation of the circuit, including design equations and design calculations. You may also refer the reader to a specific section in the main report if the design equations and calculation appear there.

Record 4. Hardware acceptance test procedure

This is a description of how a user (assume that this will be another engineer) should check whether the system is functioning correctly. E.g., "After the system has been switched on, LED 1 should be on to indicate that data has been received". Write this section in a protocol format, i.e. a list of instructions that describe what the user must do, and what the results should be.

Record 5. User guide

No marketing-style user guide is required (i.e. user guide in glossy format). All that is required are brief instructions (directed to an engineering readership) on how to set up your system and how to get it running. This should *not* be a marketing document.

A.2 SOFTWARE part of the project

Record 6. Software process flow diagrams

Include software flowcharts and/or other process flow diagrams to explain the structure and functioning of your software. E.g., if you used UML (Unified Modelling Language) to design models of your software, include this under this record.

Record 7. Explanation of software modules

This is a text description to explain the implementation and operation of your software modules.

Record 8. Complete source code

This record heading appears here for completeness, although all software code appears separately. Therefore, simply write:

```
Complete code has been submitted separately on the AMS.
```

Record 9. Software acceptance test procedure

This is a description of how a user (another engineer) should check whether the system is functioning correctly. E.g.:

```
After the software has been launched, the green button on the top left
of the screen should flash to indicate that data is received. The user
should then send the jpeg image denoted with "test1.jpg". A clear
image of a man looking in a mirror should appear at the receiver
within 4 seconds.
```

Write this section in a protocol format, i.e. a list of instructions that describe what the user must do, and what the results are expected to be.

Record 10. Software user guide

No marketing-style user guide is required (i.e. user guide in glossy format). All that is required are brief instructions (directed to an engineering readership) on how to set up your software and how to operate it. Include pictures of your GUI.

A.3 EXPERIMENTAL DATA

Record 11. Experimental data

While the main report should contain the main results, *more complete* results should be given here. For example, in an image processing project, a student may have highlighted number plate recognition results in the main report by giving two or three examples, but then has to give more complete representative results here in the technical documentation for more repetitions, tests or simulations. In other words, select examples of where the system fares well, but also of where it fails, in order to give a complete and accurate overall picture of the results.

C. FORMATTING

It is easy to follow the rules for proper formatting and it is expected that a final year engineering student should be able to do this accurately.

> ☞ Hint: Students that make mistakes here, will be penalised *heavily*.
>
> **Remember that there are no revisions of your final report**. The report that you submit is what you wish to be evaluated on.

If the report is not of acceptable standard regarding formatting, layout, grammar and language editing, the student may be qualifying herself/himself for either examination refusal, or for a supplementary exam, or to fail the module.

The table below contains the report formatting rules.

Title page	Use the template on the Project website.
Language	The report should be in high quality English.
Format	The report is submitted on the AMS as single pdf.
Fonts and font sizes	**Body text:** <u>Use 12 point font size for the main text of the report.</u> Use a serif font like Times Roman, Baskerville, or Caledonia, and NOT a sans serif font like Arial or Helvetica. <u>Do not mix fonts</u> in your report, but use the same font and font size throughout. **Text on figures and tables:** use the same font size and font type consistently across all figures. The minimum font size allowed on figures is <u>8 point font</u>. Sans serif fonts *are* allowed on figures (but are *not* allowed in the main text, see previous bullet). **Text on figure and table captions:** Figure and table caption are printed in **bold** text. Use the same font size and font type consistently across all figure and table captions. You are allowed to select a font size for captions from 10 point to 12 point font size. Sans serif fonts *are* allowed in figure and table captions (but are *not* allowed in the main text, see first bullet). **Text in headings:** Use the same font for headings than was used for body text. Font sizes for headings are given below. Headings may be printed in colour if preferred, as long as you do this consistently across all headings at the same level of heading.
Justification of text	Use *full justification* for all text (body text, table and figure captions), except for headings. Headings are left-justified.

Spelling	Spelling errors are *completely unacceptable.* It is required that a knowledgeable person (this could be yourself, a friend in class, a parent) or a language editing specialist edit your manuscript. The name and signature of your language editor should appear on the summary page as in the example on the Project Clickup page. Note that it is your responsibility to ensure the correctness of spelling and language. Your study leader **may not** and will not proofread or edit your report. The report is part of your examination.
Grammar	Similarly, poor language and grammar is *unacceptable.* See notes about spelling above.
Tense	Write your report in the past tense, unless not appropriate in a particular sentence. Assume that by the time people read the report, the project has been completed. E.g., instead of writing "the hardware that will be developed", you should write "the hardware that was developed". However, ensure that what you write makes sense: e.g., usually, specifications are given in the present tense.
Style	Write in formal style. You *may not* write in the first person (except in the Preamble). Do not write either in conversational style or in telegram or sms style. Always use full sentences, including when you give a bullet list. Do not give a chronological account of what you did. The report should be factual and not bound to you as a person or to a particular timeline. This is a technical report, not a personal narration of your experiences and ideas. Give the facts in a brief, clear and professional manner.
Header	Each page of the report should have a header containing your initials and surname at the left margin, and the section name at the right margin. Please refer to the final report template for an example.
Footnotes	If you want to refer to a footnote in the text, put the number of the footnote directly to the right of a word as superscript, for example: "Here FDM[1] is used instead of TDM[2]". You must then give an explanation at the bottom of the same page. Draw a line across the page at the bottom of the page (typically from margin to margin) and place the footnote below this line. Number the footnote with the same superscript number against the left margin. Print the footnote in 8 point font size. Footnotes are numbered consecutively throughout the text.
Layout of the report	• See the Project website for a template for the title page. Use the template spacing, fonts and font sizes. • The title page should not have a page number. The rest of the report then follows as described above under "B. Contents of the final report", commencing with the Preamble and

	ending with the References. Section headings numbered 1 through 6 (Literature study through References), as well as the Summary, Table of contents, List of abbreviations and any appendices are all main headings and should typically be printed in 18 point font. Commence each of these sections that appear under a main heading on a new page. • Use at least one introductory sentence after a heading. • *Never* commence a section with a figure.

Sections	Begin each *main section* on a new page. Main sections are Parts 1, 2 and 3 of the report as described in Section B above, and then within Part 3 main sections are Literature study, Approach, Design and Implementation, Results, Discussion, Conclusion, References.
Section numbering	Use the exact section and paragraph numbering scheme as described in Section B of this Appendix.
Page numbers	All sections up to and including "List of Abbreviations" should have Roman numeral page numbers (i, ii, iii, iv, etc.). Use normal numerals for page numbers from the Part 3 onwards. Page numbers should appear at the bottom right of each page except the cover page of the report.
Page layout	Use the template provided on the Project website. Where there are differences between the guidelines below and the template, the latter takes priority. If you deviate from this slightly, ensure that your format is consistent. **Guidelines** • Margins (guideline): 25 mm left, 25 mm right, 25 mm bottom, 25 mm top. • Line spacing: single • Part headings (i.e. for the four main parts of the report, i.e. Part 1. Preamble through Part 4.): 24 point bold, lowercase. • Section headings: Sentence case, 18 point bold font (these are 1. Literature study, …, 6. References) ; subheadings: 14 point bold uppercase; sub-subheadings 12 point bold and italic. For further depth of subheadings: lowercase, 12 point bold and italic. • Numbering of headings: Use the numbering scheme above. Subheadings: (e.g.) 1.1.; sub-subheadings: (e.g.) 1.1.2.; for further depth of subheadings: use (a), (b) and so on; for even further depth of subheadings: headings in bold and italics are suggested, but no numbering is used. • Left justify headings. • Underline section headings with a horizontal line from margin to margin. • Page numbering: lower right corner. • Print only on one side of the paper. • Leave one blank line between paragraphs and do not indent the first word of a paragraph.

Equations	• Number equations sequentially from 1, with the equation number in round brackets ( ), right-justified.
	• The easy way to do this is to create a one-line, two column table. Use the first column for the equation and the second column for the equation number. Then simply remove all borders around and within the table. This is how Equation 1 below was created.
	• Leave one line open after an equation. If you feel that readability is improved, you may also leave an open line before an equation.
	• An equation should read like any other sentence regarding the punctuation. <u>All symbols must be defined</u>. Print symbols in italics. Centre the equation. Here is an example:
	
	`The equation for a straight line is`
	$y=mx+c,$ (1)
	
	`where` *m* `is the slope and` *c* `the` *y*`-axis intersection.`
	x `is the independent variable.`
	
	• When the equation is at the end of a sentence, the equation ends with a full stop.
	• <u>All equations must be referred to in the text of your report</u>.
	• When referring to an equation in the text of the document, this is the way to do it:
	
	`As is shown in Equation 1, the influence of…`
	
	Thus, write `Equation 1` or `Eq. 1`, but not `equation (1)`.

Figures and tables	• Tables and figures may not flow from one to the next A4 page, and A4 sized figures are preferred to larger figures. • Don't, however, use larger figures than necessary. Preferably keep figures small, but typically not smaller 8 cm x 8 cm. • Figures and tables should be centered on the page. • All tables and figures should preferably have the same orientation as the rest of the text, or be placed with the bottom of the figure facing towards the outside edge of the page. • Under all circumstances, the caption should be upright. • Text in figures should be in the same language as the rest of the text. Fonts and font size were described earlier in this list. • Make sure all your figures are formatted similarly and that the font type and size is consistent throughout all figures. <u>Do not copy figures from different sources that use different styles and fonts</u>.

	• Where figures are scanned, *make sure the resolution is as high as the rest of the text*, and that text is clearly readable and not smaller than 8 point font. • Number tables and figures separately from number 1 (Figure 1, Figure 2, …, Table 1, Table 2, … . • *Do not use frames around figures*. • Captions appear *below* figures and *below* tables. Figures and tables should each have a short description printed in the caption. Figures should *not* have a caption or description at the top as well (e.g., as would appear in typical Excel-style figures). • Print the figure or table number as well as the caption in bold. Below is an *example* of a caption. **Figure 1.** **The figure shows data as measured for the protection circuitry. Note that the current limits at 10 A.** • If figures are copied from other sources, give credit to these. E.g., "This figure was taken from Conroy (2018)", or "this figure was modified from Mokoena (2021)". • Figures are there to illustrate concepts explained in the text. <u>Therefore, all figures must be referred to in the text of your report.</u>
Software	No long program listings are allowed other than in the technical documentation (Part 4). However, you may (and should) reproduce sections of code in the report to explain the implementation of a specific function. Handle these code snippets as if they were figures. These figures should normally be limited to one page maximum. If your complete code is just a few pages long, it may appear in the main report. Otherwise, it should appear as part of the technical documentation only.

* * * * *