

Firstname Lastname

A DESCRIPTIVE TITLE

A Specifying Subtitle

Faculty Name
Thesis type
January 2019

ABSTRACT

Firstname Lastname: A Descriptive Title
Thesis type
Tampere University
Degree Programme
January 2019

The abstract is a concise, self-containing one page description of the work: what was the problem, what was done, and what are the results. Do not include charts or tables in the abstract. Put the abstract in the primary language of your thesis first and then the translation when that is needed. International students do not need to include an abstract in Finnish.

Keywords: keyword, keyword, keyword, keyword, keyword

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TIIVISTELMÄ

Firstname Lastname: Kuvaava otsikko
Opinnäytetyön taso
Tampereen yliopisto
Tutkinto-ohjelma
Tammikuu 2019

Tiivistelmä on suppea, 1 sivun mittainen itsenäinen esitys työstä: mikä oli ongelma, mitä tehtiin ja mitä saatiin tulokseksi. Kuvia, kaavioita ja taulukoita ei käytetä tiivistelmässä. Laita työn pääkielellä kirjoitettu tiivistelmä ensin ja käännös sen jälkeen. Suomenkieliselle kandidaatintyölle pitää olla myös englanninkielinen nimi arkistointia varten.

Avainsanat: avainsana, avainsana, avainsana, avainsana, avainsana

Tämän julkaisun alkuperäisyys on tarkastettu Turnitin OriginalityCheck -ohjelmalla.

PREFACE

This document template is intended to support writing theses in the technical fields in Tampere University. The template is based on the earlier one from the Tampere University of Technology, but it has been updated to use in Tampere University from 2019 onwards. The final output from this template is already an archive compliant PDF/A-1b document, as required for publication of the thesis.

Acknowledgements to those who contributed to the thesis are generally presented in the preface. It is not appropriate to criticize anyone in the preface, even though the preface will not affect your grade. The preface must fit on one page. Add the date, after which you have not made any revisions to the text, at the end of the preface.

Tampere, 7th January 2019

Firstname Lastname

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LIST OF SYMBOLS AND ABBREVIATIONS

a	acceleration
CC licence	Creative Commons licence
F	force
ISO	International Organization for Standardization
\LaTeX	a document preparation system for scientific writing
m	mass
\mathbb{R}	real numbers
SI system	international system of units (Système international d'unités in French)
TAU	Tampere University
TUNI	Tampere Universities
URL	Uniform Resource Locator

1 INTRODUCTION

This document template conforms to the Guide to Writing a Thesis in Tampere University [3]. A thesis typically includes the following parts:

- Title page
- Abstract in English (and in Finnish)
- Preface
- Contents
- (Lists of figures and tables)
- List of abbreviations and symbols
- 1. Introduction
- 2. Theoretical background
- 3. Research methodology and material
- 4. Results and analysis (possibly in separate chapters)
- 5. Conclusions
- References
- (Appendices)

Each of these is written as a new `\chapter` or using an appropriate command (e.g. `\abstract`). Read this document template and its comments carefully. The titles of chapters from 1 to 5 are provided as examples only. You should use more descriptive ones. The title page is created by inserting the relevant information into the commands near the start of the template. The table of contents lists all the numbered headings after it, but not always the preceding headings.

Introduction outlines the purpose and objectives of the presented research. The background information, utilized methods and source material are presented next at a level that is necessary to understand the rest of the text. Then comes the discussion regarding the achieved results, their significance, error sources, deviations from the expected results, and the reliability of your research. The conclusions form the most important chapter. It does not repeat the details already presented, but summarizes them and analyzes their consequences. List of references enables your reader to find the cited sources.

This document is structured as follows. Chapter 2 discusses briefly the basics of writing and presentation style regarding the text, figures, tables and mathematical notations. Chapters 3 and 4 summarize the referencing basics and the whole document. Each part also features tips to solving some of the detailed issues that relate to writing in \LaTeX .

2 WRITING STYLE

Effective written communication requires both sound content and clear style. Keep the layout of your thesis neat and pay attention to your writing style.

2.1 Text

Do not worry about the layout of the text, this template takes care of it already. Brief basics of writing style:

- Always think of your reader when you are writing and proceed logically from general to specific.
- Highlight your key points, for example, by discussing them in a separate `\section` or `\subsection`, or presenting them in a table or figure. Use italics (`\emph`) for emphasis, but don't overdo it.
- Avoid long sentences and complicated statements. A full stop is the best way to end a sentence.
- Use active verbs to make a dynamic impression but avoid the first person pronoun I, except in your preface.
- Avoid jargon and wordiness. Use established terminology and neutral language.
- The minimum length of sections and subsections is two paragraphs, and you need to consider the balance of chapters. Paragraphs must always consist of more than one sentence.
- Do not use more than three levels of numbered headings, such as 4.4.2. This is covered already by the template.
- Do not use too many abbreviations. Use capital and small letters consistently.

2.2 Figures

You must refer to all the figures in the body text. The reference should preferably appear on the same page as the actual figure or before it. Figures and tables must be numbered consistently and primarily placed at the top of the page, but you are free to decide where they fit best. \LaTeX takes care of the numbering, if you specify a unique `\label` right after the `\caption` of a figure (or a table). Cross-referencing is done by inserting this identifier as the argument to `\ref`. Never start (or preferably end) a chapter with a figure, table, equation or list. The caption is placed under the figure.

All figures must be explained in the text body, so that the readers know what they are supposed to notice. Figures generated by analysis software usually need further editing, see Figure 2.1 for an example. The figures should be in the same language as other text (even if Figure 2.1 violates this recommendation). The recommended font size is the same as that of the body text, 10 pt. The figures must be readable, even if your thesis is printed in greyscale. Whenever possible, use images in vector formats such as `.eps` or `.pdf` (\LaTeX does not digest `.svg` files...), as they can be scaled without loss of quality. \LaTeX itself also comes with powerful packages for drawing vector graphics (`tikz`) [10] and graphs (`pgfplots`) [2]. Figure 2.2 shows an example of a graph generated using the latter.

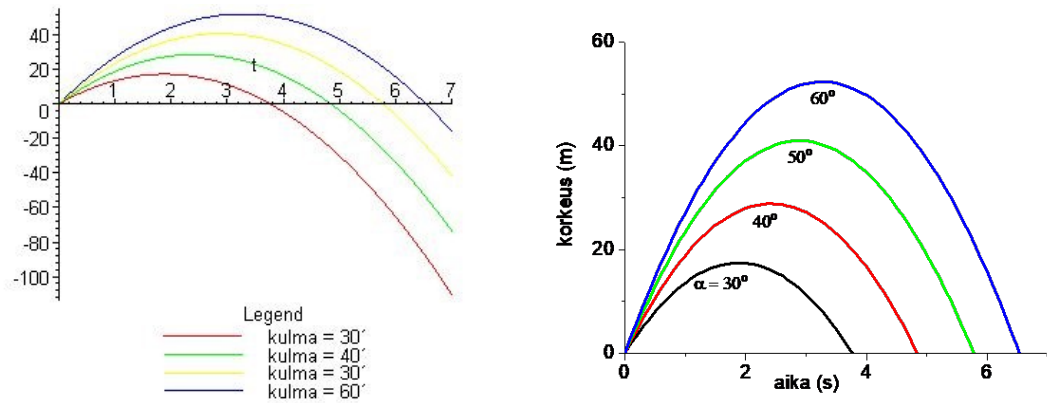


Figure 2.1. Diagrams should be edited before publication. The diagram on the right is an edited version of the one on the left.

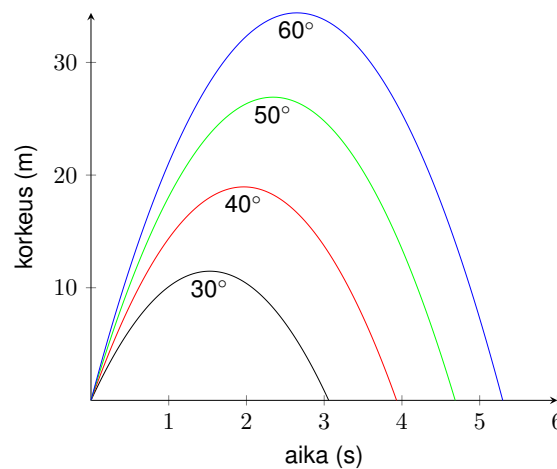


Figure 2.2. An example of a graph along the lines of Figure 2.1 drawn using *pgfplots*.

2.3 Tables

Taulukot sopivat hyvin erityisesti numeerisen informaation esittämiseen tiiviissä muodossa. Kuvien tapaan taulukot numeroidaan ja varustetaan otsikolla, kuten taulukossa. Taulukkok teksti sijoitetaan samalle sivulle taulukon kanssa ja taulukon yläpuolelle. Suureet, lyhenteet ja symbolit selitetään tarvittaessa tekstissä. Kaikkiin taulukoihin on viitattava tekstissä, mieluummin ennen taulukkoa. Taulukon keskeinen sanoma ja tulkintaohjeet selitetään tekstissä.

Taulukon sarakkeet otsikoidaan, ja suureet sekä yksiköt laitetaan näkyviin. Jos otsikkoriviä tarvitsee erottaa muusta taulukosta, tee se korostamalla (`\emph`). Taulukon järjestyksellä on suuri merkitys. Jokaista solua ei pidä ympäröidä reunaviivalla, koska taulukosta tulee raskaslukuinen. Lisää vaakaviiva taulukon ylä- ja alareunaan. Vaakaviivoja voi käyttää esimerkiksi 4–5 rivin välein, ellei tietoja muuten ole jaettu kategorioihin tai selkeys sitä vaadi. Sarakkeen numeroarvot tasataan desimaalipilkun kohdalla, jolloin arvoja on helppo vertailla. Tämä tapahtuu \LaTeX issa helposti `siunitx`-paketin [12] taulukkomateriaalin avulla. Tavoitteena on, että suureet ilmaistaan SI-yksikössä ja käytetään joko vakiintuneita etuliitteitä tai kymmenen potenssin muotoja siten, että ne voidaan laittaa otsikkoriville (katso tässäkin `siunitx`). Muutamia suosituksia taulukoiden ja kuvien käytöstä löydät lähteestä [9].

Tables are convenient for presenting information in a concise way, especially numerical data. Tables have numbered captions, see Table 2.1 for an example. The caption is placed on the same page but above the table, unlike the captions that accompany figures. You must refer to all the tables in the body text. In addition, you must discuss the content of any tables in the body text to ensure that readers understand their relevance.

Mark the titles of the columns and units clearly. You can use `\emph` to highlight the titles, if

Table 2.1. An example of evaporation conditions in two different thin film structures.

compound	thickness (nm)	correction	pressure (mbar)	temperature (°C)	current (mA)	velocity (nm s ⁻¹)
SiO ₂	181.0	1.10	3.0 · 10 ⁻⁵	90.6	20– 23	0.2
TiO ₂	122.1	1.55	15.0 · 10 ⁻⁵	91.1	93–100	0.1

necessary. The order of the columns and rows must be carefully considered. Do not surround all the cells with a border, as it may make your table harder to read. Put a line on top and bottom of the table. You can add a horizontal line between every 4–5 rows, if the data is not grouped into categories. The numbers are aligned at the decimal point for easy comparison. This is easily done in \LaTeX using the tabular material from the `siunitx` package [12]. You should preferably use SI units, established prefixes and rewrite large numbers so that the power of ten should be placed in the title of the column instead of each row, if possible. More suggestions can be found in [9].

2.4 Mathematical notation and equations

Numbers are generally written using numerals for the sake of clarity, for example “6 stages” rather than “six stages”, which is nevertheless strongly preferred to “a couple of stages”. You should also use a thousand separator, i.e. instead of 55700125 write 55 700 125. Never omit the leading zero in decimals. A comma is used as a decimal separator in the Finnish language and a period in the English language. These details are covered by this template and the `siunitx` package [12], if allowed to do so.

Like numbers, it is advisable to abbreviate units of measurement. There is a space between the number and the unit, but you must keep them on the same line. The space is somewhat shorter than a word space, see 1.0 μm and 1.0 μm for comparison. It is better to compile a table or graph than include a great deal of numerical values in the body text. Use precise language and put numbers on a scale (small, fast, expensive).

Use generally known and well defined concepts and standard conventions and symbols for representing them. New concepts should be defined when they appear in the text for the first time. Upper case and lower case letters mean different things in symbols and units of measurement. Do not use the same symbol to mean different things.

Strings of mathematical symbols such as $\Theta(n^2)$ are typeset in \LaTeX using the math mode. Simple formulas may be displayed within the body of the text without numbering. As an example of a highlighted formula, the Newton’s Second Law of Motion can be written in the following way:

$$m\mathbf{a} = \mathbf{F}, \quad (2.1)$$

where m denotes the mass of an object, \mathbf{a} its acceleration, and \mathbf{F} the net force it experiences. Please note that all the variables must be defined at the point of their first appearance. The formulae are shown in a different typeface on purpose and the symbols are almost always italicised. Vectors can be written in boldface as above (the convention in printed material) or with an arrow, such as \vec{v} . Dimensional numbers can be written using the `\SI` command:

$$\|\mathbf{F}\| = m\|\mathbf{a}\| = 10\text{ kg} \cdot 9.81\text{ m s}^{-2} = 98.1\text{ N}.$$

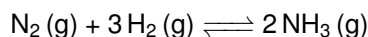
Mathematical formulae are numbered, if they are written on separate lines and referred to in the main body of the text. The number is usually put in parenthesis and right aligned, see equation (2.1) for an example. Include any punctuation (commas, periods) surrounding an equation in the equations themselves, such as shown in (2.1). Occasionally the elements of mathematical text are preceded by an identifier, such as Definition 1 or Theorem 1 [8].

Do not start a sentence with a mathematical symbol but add some word, such as the name or type of the symbol in front of it. Variables, such as x and y , are generally presented in italics, whereas elementary functions, special functions and operators are not: $\sin(2x + y)$ or

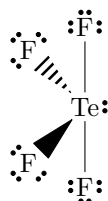
$$\lim_{x \rightarrow -1} \frac{x^2 - 1}{x + 1} = -2.$$

As a rule of thumb, it is best to rely on the automated formatting of an equation editor, such as the one provided by \LaTeX [7].

Even those requiring different chemical symbols are not left without support by the \LaTeX system. Molecular formulae and stoichiometric equations, such as $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ and



are typeset using the `mhchem` package [5], and complete structural formulae can be constructed with the aid of the `chemfig` package [11]. The Lewis structure of tellurium tetrafluoride (TeF_4) is shown as an example of the latter.



There is a learning curve to writing these elements, especially the structural formulae, but it is good to know that there are ways of accomplishing them.

2.5 Programs and algorithms

Codes and algorithms are written using a `monospaced font`. If the length of the code or algorithm is less than 10 lines and you do not refer to it later on in the text, you can present it similarly to formulas. If the code is longer but shorter than a page, you present like a figure (see Program 2.1) titled “Program” or “Algorithm”. See the typesetting commands in this template for a method of setting the name manually.

You should add some comments to the code and indent it consistently. The actions performed by the code must be outlined in broad terms in the body text. Line numbers make it much easier to refer to the code in the text. \LaTeX includes a package called `listings` [4, 7], which can handle code very conveniently, include real code files, add row numbers, and highlight the reserved words. Use this for any code representation in \LaTeX .

```

1 void sortTable( CharPair table[], int size )
2 {
3     // Sort the table so that at each iteration the element
4     // belonging to the beginning of the table is moved to
5     // the appropriate position.
6     for( int i = 0; i < size; ++i )
7     {
8         // Find the smallest (lexicographically first)
9         // character from the rest of the table.
10        int smallestIndex = i;
11        for( int j = i; j < size; ++j )
12        {
13            if( table[ j ].toReplace
14                < table[ smallestIndex ].toReplace )
15            {
16                smallestIndex = j;
17            }
18        }
19        // Switch the smallest element to its own index.
20        CharPair tmp = table[ i ];
21        table[ i ] = table[ smallestIndex ];
22        table[ smallestIndex ] = tmp;
23    }
24    return;
25 }

```

Program 2.1. An example of presenting a program source code.

3 REFERENCING STYLES

Different referencing styles determine how you create in-text citations and the bibliography (list of references). Two common referencing styles are presented in this chapter:

1. Numeric referencing (Vancouver system), such as [1], [2], ...
2. Name-year (Harvard) system, such as (Weber 2001), (Kaunisto 2003), ...

A numeric reference is inserted in square brackets, whereas the last name of the author and the year of publication are given in parentheses. Both styles are acceptable, but the conventions for referencing vary between disciplines. You must pick one and use it consistently throughout your thesis.

The most commonly used tool for creating bibliographies in \LaTeX is the $\text{Bib}\text{\LaTeX}$. It is, however, old already, and the $\text{Bib}\text{\LaTeX}$ [6] is a more flexible and powerful system to replace it. In practice, most of the scientific publishing relies on the deprecated tool, but a change is at hand. For these reasons, this template guides towards using $\text{Bib}\text{\LaTeX}$.

Both of the mentioned systems are based on gathering the bibliographic information from the sources to a `.bib` file using a specialised syntax. The program reads both this file and the document being written, and then forms the references and the bibliography based on this information. The following contains instructions for using both citation styles with $\text{Bib}\text{\LaTeX}$. This template defaults to the use of the numeric system, and this can be reverted to the other style by adding `authoryear` as an optional argument to the document class.

3.1 In-text citations

In-text citations are placed within the body of the text as close to the actual citation as possible. The citation is generally placed within the sentence before the next period.

Weber argues that... [1].
 Cattaneo et al. introduce in their study [2] a new...
 The result is... [1, p. 23]. One must also note... [1, pp. 33–36]
 In accordance with the presented theory... (Weber 2001).
 It must especially be noted... (Cattaneo et al. 2004).
 Weber (2001, p. 230) has stated...
 Based on literature in the field [1, 3, 5]...
 Based on literature in the field [1][3][5]...
 The topic has been widely studied [6–18]...
 ... existing literature (Weber 2001; Kaunisto 2003; Cattaneo et al. 2004) has...

Each of the sources listed in the `.bib` file must be associated with a unique identifier at the beginning of the entry. These identifiers should be chosen as descriptively as possible, since all citations are created using them. In the numeric system each citation is typeset using the `\cite` command, for example `\cite{notsoshort}`. This produces [7], for instance, depending on the final list of references. Additional information can be introduced using the optional arguments: writing `\cite[p. 30]{notsoshort}` produces [7, p. 30] and `\cite[see][p. 30]{notsoshort}` results in [see 7, p. 30].

The name-year system is more complicated simply because of the greater number of options available, as seen above. The $\text{Bib}\text{\LaTeX}$ logic remains the same, however, the commands change. The most important commands are `\parencite`, `\parencite*`, `\citeauthor` and `\textcite`, which produce (Oetiker et al. 2018), (2018), Oetiker et al. and Oetiker et al. (2018), respectively. More commands can be found in the documentation [6].

3.2 List of references

At least the

- author(s),
- title,
- time of publication,
- publisher,
- pages (books and journals), and
- website URL

are provided per source as bibliographic information, if known. The Bib \LaTeX takes care of presenting them in an internally consistent manner. When using this system it is imperative to know the type of the source: a journal article, a book, conference proceedings, a report and a patent are only examples of the various possibilities. This information is also included in the `.bib` file, and the presentation is automatically taken care of based on the type of the source. Below there is an example of the syntax and information needed in the `.bib` file for citing a journal article.

```
@article{braams1991babel,
  title={Babel, a multilingual style-option system
for use with \LaTeX's standard document styles},
  author={Braams, Johannes L},
  journal={TUGboat},
  volume={12},
  number={2},
  pages={291-301},
  year={1991}
}
```

The above shows as

- [1] J. L. Braams. Babel, a multilingual style-option system for use with \LaTeX 's standard document styles. *TUGboat* 12.2 (1991), 291–301.

Braams, J. L. (1991). Babel, a multilingual style-option system for use with \LaTeX 's standard document styles. *TUGboat* 12.2, 291–301.

in the different citation styles. It is preferable to order the list of references alphabetically by the first author's last name. This template conforms automatically to this convention. An excellent way for the easy formation of citation entries is to find a template using Google Scholar. It produces a good first try for the use of Bib \TeX and Bib \LaTeX . In addition to the documentation, [1] provides a good summary of the different citation types and their associated fields.

4 CONCLUSION

This template and the writing guidelines should help achieving a consistently formatted and clear documents. A similar template is also available for Word.

Every writing and presentation must have a conclusion. This fact is here emphasized by having this short and rather artificial summary also in this template. A concise summary table can be a good way for providing an overview of the most important points.

Lastly, some final points regarding this template. It has been developed in the Overleaf environment, and the author warmly recommends the usage of its version 2 in writing theses. The easiest way to gain access to the document template is to ask for a copy link to the project from the supervisor of the work, or from the maintainer of this template. To use Overleaf, however, requires a user account and constant access to the Internet.

Hopefully, an up-to-date version of the template is also available in the university intranet. The template has been tested and found to work in the Windows system MikT_EX and the Unix-based system T_EX Live environments. The first of these can automatically install the possibly missing packages, but with the latter you may have to install them, or up-to-date versions of them manually.

REFERENCES

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A EXAMPLE APPENDIX

This text is intended as an example for making an appendix in this document template. A little longer one makes it look like a proper paragraph.