

Instructions for using the thesis template

This document is a template on which you can write your final thesis at LUT University. It meets the requirements for the content, structure and layout of the BSc and MSc theses as well as the accessibility criteria for material published in the LUTPub repository. It is especially important that you use the template in formulating the title page, abstracts, table of contents, list of references and citations.

The template is applied in all BSc and MSc thesis projects that start after 11 August 2021.

The actual thesis template starts on the following page. Write your own thesis using this template and delete the introductory texts (e.g. this help page) and other content in the template that you do not need.

The attachments include important instructions remember to read them as well. The thesis supervisor can give additional instructions.

In addition, read other thesis guidelines released by the Lappeenranta–Lahti University of Technology LUT:

- Thesis instructions in the [eLUT portal](#)
- LUT Academic library, [pages for thesis students and researcher](#)
- LUT Academic Library, [information retrieval guide](#)
- LUT Academic Library, [copyright guidelines](#)
- LUT University [Code of Conduct](#)
- Plagiarism detector [Turnitin](#) guidelines for LUT students
- Graduation process and instructions in the [eLUT portal](#)



**TITLE OF THE BACHELOR'S OR MASTER'S THESIS IN CAPITAL LETTERS,
BOLD TYPE, LEFT-ALIGNED, STARTING 11 CM FROM THE TOP OF THE PAGE**

Possible subheading

Lappeenranta-Lahti University of Technology LUT

Your school xxx

Your degree programme xxx

2022

Author's first name and last name

Examiners: Title, First name and Last name (e.g. Professor John Smith)

Title, First name and Last name (e.g. Professor John Smith)

ABSTRACT

Lappeenranta-Lahti University of Technology LUT

Your school: LUT School of Business and Management / LUT School of Energy Systems / LUT School of Engineering Science

Your degree programme: Energy Technology / Business Administration / Chemical Engineering / Mechanical Engineering / Computational Engineering / Electrical Engineering / Software Engineering / Industrial Engineering and Management / Environmental Technology

Author's name

Thesis title in English in bold type (possible subtitle included)

Master's thesis / Bachelor's thesis

2022

25 pages, 1 figures, 1 tables and 6 appendices

Examiners: Title, First name and Last name (e.g. Professor John Smith)
Title, First name and Last name (e.g. Professor John Smith)

Keywords: List keywords that define the content of the thesis and help find it.

Use single line spacing in your abstract and justify the text as you would the rest of your thesis text body. The abstract and its identifying information must fit on one A4 page. The abstract is a public document, and therefore, you need to exclude any confidential information from it.

The abstract is an independent summary of the thesis and should be intelligible as such, without the original document.

A good abstract is written in complete and concise sentences. Do not express personal opinions in the abstract – describe the thesis as an outside reporter would. Do not make detailed references to the original text. Present the key results of the research.

If you have not received your basic education in Finnish or Swedish and are writing your final thesis in English, write your abstract only in English.

TIIVISTELMA

Lappeenrannan–Lahden teknillinen yliopisto LUT

Oma schoolisi: LUT-kauppakorkeakoulu / LUT Energiajärjestelmät / LUT Teknis-luonnontieteellinen

Oma koulutusohjelmasi: Energiatekniikka / Kauppatieteet / Kemiantekniikka / Konetekniikka / Laskennallinen tekniikka / Sähkötekniikka / Tietotekniikka / Tuotantotalous / Ympäristötekniikka

Tekijän nimi

Työn suomenkielinen nimi lihavoituna (myös mahdollinen alaotsikko)

Diplomityö / Kandidaatin työ

2022

25 sivua, 1 kuvaa, 1 taulukkoa ja 6 liitettä

Examiners: Tarkastaja(t): Titteli Etunimi Sukunimi ja Titteli Etunimi Sukunimi
Tarkastaja(t): Titteli Etunimi Sukunimi ja Titteli Etunimi Sukunimi

Avainsanat: Listaa tähän avainsanat, joiden perusteella tutkielma voi haettaessa löytyä

Tiivistelmätekstin riviväli on 1, ja se tasataan molempiin reunoihin, kuten muukin opinnäytetyön leipäteksti. Tiivistelmätekstin tunnistetietoineen on mahdollista yhdelle A4-arkille. Tiivistelmään ei voi sisällyttää salassa pidettäviä tietoja, vaan se on aina laadittava julkiseksi.

Tiivistelmä on itsenäinen esitys DI-työstä/pro gradu -tutkielmasta, ja sen tulee olla ymmärrettävissä sellaisenaan. Hyvässä tiivistelmässä virkkeet ovat täydellisiä, lyhyitä ja ytimekkäitä. Tekijän mielipiteet eivät näy, vaan hän kuvaa työtään kuin ulkopuolinen raportoija. Tiivistelmässä ei viitata yksityiskohtaisesti alkuperäistekstiin. Tutkimuksen keskeisimmät tulokset sisältyvät tiivistelmään.

Opiskelijat, joiden koulusivistyskieli ei ole suomi tai ruotsi ja jotka kirjoittavat opinnäytteensä englanniksi, kirjoittavat tiivistelmän ainoastaan englanniksi.

ACKNOWLEDGMENTS

(Optional)

You may thank people who have supported you in your work on the thesis.

SYMBOLS AND ABBREVIATIONS (may be included, but not relevant for all theses)

Roman characters

p	pressure	[bar, Pa]
qm	mass flow rate	[kg/s]
R	gas constant	[J/kg K]
T	temperature	[°C, K]
U	voltage	[V]
V	volume	[m ³]
v	specific volume	[m ³ /kg]
x	vapour content	

Greek characters

α	incidence angle	[°]
γ	thermal conductivity	[W/mK]

Constants

g	gravitational acceleration	9,81 m/s
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Dimensionless quantities

Re	Reynolds number	
----	-----------------	--

Subscripts

1	inflow
2	outflow
kr	critical
mit	mit measured

Superscripts

'	stator
''	rotor

Abbreviations

CFD Computational Fluid Dynamics

ORC Organic Rankine Cycle

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1 INTRODUCTION

The introduction explains the reasons for the research and what it aims to achieve. It also gives a brief overview of the methodology used and key results. The first paragraph should answer the following questions: What is your thesis about? Why is this topic important to study right now? Why is it important in general? The first paragraph entices people to read your thesis.

The second paragraph briefly presents the key findings of previous studies, and the third one explains what previous research has not taken into consideration or examined. In other words, it explains why your study is necessary. Conclude your introduction by relating the objectives, research problem, research questions, limitations and thesis structure briefly.

4 CONCLUSIONS

The conclusions explain how well your research achieved its objectives, what its findings were and what they mean in a wider perspective and for the future. The conclusions should examine how your findings differ from or coincide with those of previous studies. Analyse the impact of your research: its theoretical or practical contribution and wider societal importance. In addition, mention possible limitations of your study and research topics that should be dealt with in the future.

Remember that if or when someone other than your supervisor reads your thesis, they will most likely read the introduction and conclusions first.

REFERENCES

- Hirsijärvi, S., P. Remes, and P. Sajavaara (2009). *Tutki ja kirjoita*. 15th ed. Tammi.
- Stratton, C. R. (1976). "Needs assessment for communication system design". In: *Journal of Technical Writing and Communication* 6.2, pp. 135–144.
- Virtanen, V. (2011). *Esimerkkilähteen otsikko*. URL: <http://esimerkki.fi/> (visited on 01/01/2018).

Note: More information on referencing is available in Appendix B

A APPENDIX: TEXT PROCESSING AND LAYOUT IN A THESIS

Good text processing skills make writing your final thesis and using this template easier. Therefore, you should make sure you have the sufficient basic skills to edit long documents with text processing software before you start. This involves applying the styles, understanding automatic referencing and knowing how to divide your text into sections.

The essential thing is to understand the following basics of Word:

- Do not modify your layout by adding consecutive spaces or line breaks. If you need to press Enter or the space bar more than once, you are probably doing something wrong. When you want to start a new paragraph, press Enter once at the end of the sentence and use styles to create a space between the paragraphs.
- Do not do numbering manually. Word has efficient automatised tools for this. Section numbering and page numbering are applied in this template but also automatised numbering of figures/tables is possible. They keep the numbers in the right order even if you modify, add or remove information.
- Do not add hyphenation at the end of a line manually. Word's automatic hyphenation tool can be used in this template. If you need to add more hyphens, select manual hyphenation in Word. The automatic hyphenation is usually turned off, but you can activate it yourself.

Line spacing, font, margins, alignment, page numbering and headings

Official layout guidelines state that the line spacing should be 1.5 except for the abstract and possible direct citations, where the spacing is 1. You can choose from two fonts: Times New Roman (12 pt) or Arial (11 pt). This template has been written in Times New Roman 12 pt (Style LUT Normal). Leave an empty line before and after tables and figures.

Leave the following margins:

- top and left 35 mm
- bottom and right 20 mm.

The page number of the title page is 1, but the page numbering should not be visible before the first page of the table of contents. Place the page numbers at the top of the page, either centred or in the right-hand corner. Page numbering ends on the final page of the reference list: appendices do not have page numbers unless the appendix is multiple pages.

Always use heading styles in your headings (LUT Heading 1, LUT Heading 2, LUT Heading 3). Always place chapter headings (LUT Heading 1) on a fresh page. If you add large figures or tables, remember to check that the empty space after the figure or image covers no more than 20% of the page.

Always use heading styles in your headings (LUT Heading 1, LUT Heading 2, LUT Heading 3). Always place chapter headings (LUT Heading 1) on a fresh page. If you add large figures or tables, remember to check that the empty space after the figure or image covers no more than 20% of the page.

The thesis should include no more than three heading levels, and the headings should progress in a logical order (first LUT Heading 1, then LUT Heading 2, etc.). If you need even more detailed subheadings, do not number them, and leave them out of the table of contents. Concise headings that describe the text sufficiently are the best. You can use question marks or exclamation marks, but do not add a period if the heading is a regular sentence.

A heading cannot be followed by a heading. Always write something between them. For instance, there must be text between headings 1 and 1.1.

Lists are a good way to express things clearly. Use the same type of bullet or symbol in lists throughout your thesis. A section should never end in a list. There should always be two or three sentences after a list.

B APPENDIX: REFERENCES

The text must include references to the sources you use. LUT University applies the Harvard referencing style, also called the author-date style with in-text referencing and a detailed reference list at the end.

The purpose of a reference is to provide sufficient information on a source used in the study, allowing the reader to consult the original source for further information. The reference enables the reader to find detailed information on the source easily in the list of references. You should refer to the original and most recent sources. If no new studies have been published on the topic in question, also older ones may be used.

Referring to a source means that you explain the contents of the source material in your own words. Direct citations, on the other hand, are placed in parentheses (“ ”). Plagiarism or using another person’s original material without appropriate referencing is not allowed.

Referencing technique

In the Harvard system, the citation is placed in parentheses directly in the text to indicate the passage that has been cited from another source. Place the citation before the period that ends the sentence when it refers only to the sentence in question (Kaasinen et al. 2020, 173–174). If you are referring to more than that one sentence, introduce the source you are summarizing or paraphrasing at the beginning of the paragraph. Then, refer back to the source when needed to ensure your reader understands you are still using the same source.

Typically, the citation mentions the author (the last name is sufficient, unless authors of several sources have the same last name), the publication year and the page number. Please note that the author does not always have to be a person, but it may also be an organisation, for instance. If the source does not mention who the author is, the reference should include the name of the publication instead of the author. (Nykänen 2002, 77.) The author (or the title of the work) is very commonly mentioned as a part of a sentence: “According to a study conducted by Möttönen (2007, 68), a pike is a fish”.

If the source has more than one author, they are all mentioned in the reference by their last name and separated with the word ‘and’ or the symbol ‘&’. Make later references to the same work with the first author’s last name and “et al.” If you reference several works published by the same author in the same year, add lower-case letters (a, b, c...) after the publication year to distinguish the sources. Use the same alphabetical organisation also in the list of references.

There are several referencing and citation styles. It is essential to consistently use the same style throughout the thesis. Examples and detailed instructions on referencing:

[LUT Academic Library's instructions](#) on how to cite electronic documents

[Aalto University citation guide](#)

[Harvard referencing](#), University of Sheffield

C APPENDIX: TABLES, FIGURES, EQUATION, NUMBERS. SYMBOLS AND ABBREVIATIONS

It is a good idea to illustrate your text with figures and tables. Figures and tables must have captions and consecutive numbering. The captions of tables are placed above the table and those of figures below the figure. Refer to the figures and tables in the text body, preferably before you introduce them, and align them with the text body.

Remember to add alt text (alternative text) to your figures and tables to ensure accessibility. Alt text is read with a designated reader and can be viewed even when the image cannot be displayed on the page. The MS Word text processing software creates alt text automatically, but you should make sure it describes the object sufficiently and understandably. You can modify the alt text by right-clicking on the figure or table.

Tables

Remember to add alt text (alternative text) to your figures and tables to ensure accessibility. Alt text is read with a designated reader and can be viewed even when the image cannot be displayed on the page. The MS Word text processing software creates alt text automatically, but you should make sure it describes the object sufficiently and understandably. You can modify the alt text by right-clicking on the figure or table.

Table 1: Sensor measurements

Voltage U [V]	Pressure p [Pa]
0.984	0
2.252	150
2.772	300
3.181	450
3.615	600
3.817	750
4.088	900

Figures, charts, graphic elements

Images help illustrate your text. The text should contain a reference to the image Figure 1. Number your figures and place a caption underneath – not inside the figure.

You should use a software programme such as Excel or Matlab to draw charts. Charts should be clear and easy to understand. Use a white background. A background grid is allowed if it

does not make the figure difficult to interpret. Variables and measurement points should be clearly visible. Name the axes and their units.

Create as much of the figures yourself as you can. Use the same font as in the text body and equations. If you use images created by someone else, remember to cite them correctly. Remember that images are copyrighted works, the use of which must always be authorized by the author. Captions need to be in the same language as the text body.

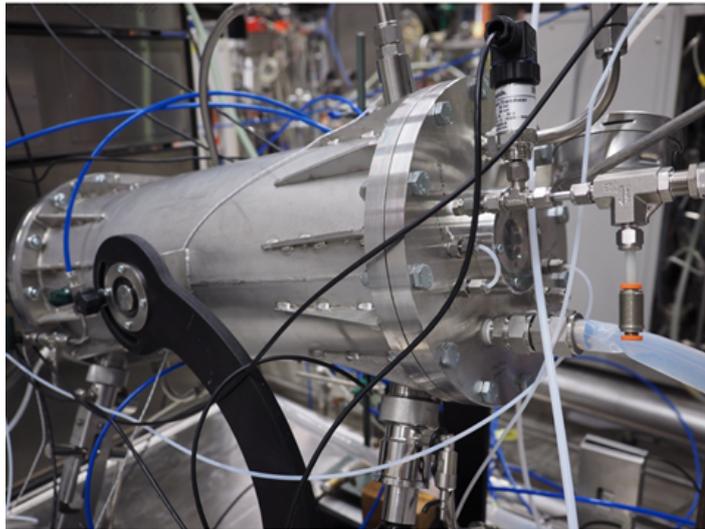


Figure 1: Gas fermentor (VTT 2020, LUT image bank)

Do not end a paragraph in a figure or table. Add text underneath, such as comments on the figure. Large figures, tables, long equations and other supporting material can be appended, if needed.

Numbers, symbols and equations

Numbers in the text are usually approximations. Their accuracy depends on the observational error. Include only significant figures in the results. Interim results should include at least two figures more to avoid round-off errors. Present large and small figures in powers of ten 10^n , where n should preferably be divisible by three.

Equations and other mathematical expressions must consist of standardised symbols if ones exist. You may use other symbols only if there are no applicable standardised or established ones.

Explain the symbols in an equation when you use them for the first time. Write each equation clearly on its own line and indent it. Number your equations consecutively or by paragraphs so that the number is in parentheses on the right side of the equation and aligned to the right.

You can refer to an equation only after you have presented it, with certain exceptions, such as if the object you are referring to is far ahead. Example:

$$pv = RT \quad (C.1)$$

where p is pressure [Pa], v is specific volume [m^3/kg], R is the gas constant [J/kgK] and T is temperature [K].

When writing symbols for your thesis, it is recommended to check the spelling with the MS Word equation editor. It follows general rules for the writing of symbols, e.g.

- Write scalars in italics and vectors in bold, not in italics. Don't write dimensionless quantities in italics.
- Write subscripts upright unless there is a need to italicise them. Write abbreviated subscripts and numerals e.g. as follows: $\Delta\sigma_w$, σ_1 , σ_{min} . For instance, in the summation $\sum_i^\infty x_i$ the subscript needs to be italicised because it represents a variable.
- If you wish to express change in e.g. pressure Δp , write Δ in a regular font. In some cases, Δ may also be a variable and should then be italicised. π is the ratio of a circle's circumference to its diameter. π may be the pressure ratio.
- Do not italicise mathematical operators such as $\sin x$ or $\lg y$.
- Distinguish absolute values as follows: "variable_=_number_unit", with the exception of a percentage sign after a numeral, e.g. $a = 5.2 \text{ mm}$, $\gamma = 97.7\%$
- Use a decimal point (".") in accordance with international standards. In contrast, a decimal comma is used in theses written in Finnish. This also applies to figures and tables.

List of symbols and abbreviations

List symbols and abbreviations and their definitions that are not common knowledge separately on their own page before the table of contents. Divide them into groups: Roman symbols, Greek symbols, and finally, abbreviations. Give the page the heading Symbols if there are no abbreviations or Abbreviations if there are no symbols.

When you use a symbol or abbreviation in the text body for the first time, introduce it to the reader for example as follows: "The concept design for manufacturing and assembly (DFMA) is...". After this, you can use only the abbreviation, and the reader can verify its meaning from the abbreviation list. Do not add concepts to the list of symbols and abbreviations that you do not mention in your text body.

D APPENDIX: APPENDICES TO THE THESIS

Appendices may include e.g. interview questions, survey forms or other content relevant to the work but not necessary to include in the text body.

In your text body, refer to the appendices by adding their title in parenthesis Appendix A where relevant. Give all appendices a title based on their content and list them in the table of contents in the order in which they are referred to in the thesis.

Single-page appendices do not require page numbering. Multiple-page appendices do.

E APPENDIX: PUBLISHING THE THESIS

LUT's degree regulations state that Bachelor's and Master's theses are public documents. They are published in the LUTPub repository, and related instructions are available on the [library web site](#).

Together with the first examiner, make sure that the commissioner of your thesis is aware of the publicity requirements from the very beginning of the discussions. If it is necessary to include information in your Master's thesis that the commissioner wants to keep secret, the university may allow keeping the Master's thesis confidential for up to two years. In such cases, the commissioner needs to provide the university with a notification on the confidentiality requirements. The student is responsible for submitting the confidentiality notification to Student Services no later than in connection with the assessment application. The notification must relate the scope of the confidentiality, grounds for it and the confidentiality period in full years. The confidentiality period starts from the date the thesis is assessed. Information that needs to remain confidential for over two years must be excluded from the thesis text. The thesis will be evaluated based on the version submitted to the university.

All theses in LUTPub must fulfil accessibility requirements. Your text must be as legible as possible to readers. Remember

- to use styles to create headings,
- embed hyperlinks into your text or a description of the linked content; do not include URL addresses,
- add/check the alt text of your figures and tables describing briefly the main content in writing.

F APPENDIX: LATEX TRICKS

During this appendix, some general commands are demonstrated.

Using *chapter*, *section*, *subsection* commands, it is possible to add new titles that will be automatically added to the table of contents.

References in the bibliography can be cited using *cite* command. For example Stratton 1976. *Cite* command supports also multiple sources. For example: Hirsijärvi et al. 2009; Virtanen 2011. In addition author's name can be referenced using *citeauthor* command. For example: Hirsijärvi et al.

Using *gls* command, it is easy to reference abbreviations. For example when the command is used first time: Computational Fluid Dynamics (CFD), abbreviation is fully opened. When the command is used second time, only short version of the abbreviation will be used: CFD. This feature is useful, if the text is later refactored. Using *glspl* it is possible to insert plural form of the abbreviation. For example Organic Rankine Cycles (ORCs).

Titles, figures, tables and many other things can be labeled using *label* command. Later these labels can be automatically referenced using *autoref* command. For example Appendix F. Additionally link is automatically created.

Using *itemize* environment and *item* command, it is possible to define unordered lists. For example:

- Item 1
- Item 2

Using *enumerate* environment and *item* command, it is possible to define ordered lists. For example:

1. Item 1
2. Item 2

Lists can also be nested naturally. For example:

1. Item 1
 - (a) Sub item 1
 - (b) Sub item 2

When placing figure, LaTeX tries to find optimal placement that use space as efficiently as possible. Sometimes this doesn't end up looking great, because figures are placed too far a way from the text. Figures can be forced to be placed before point x using *FloatBarrier* command.

It is also possible to create new commands using LaTeX using *newcommand*. See example definition and usage of the green check mark bellow:

This is a green check mark: ✓.

Using appropriate commands, it is possible to create quite advanced structures. For example when presenting survey questions following definitions could be useful:

1. How good this template was?

	1	2	3	4	5	6	
Very bad	<input type="radio"/>	Very good					