

THESIS GUIDELINE

Master Program in Electrical Engineering



TELKOM UNIVERSITY

AGUSTUS 2014

1. THESIS CONTENT

In thesis writing, the most difficult part to write is Chapter 1 (Introduction). As they say, the most difficult part of any endeavor is the starting point. This is because the first chapter is where you conceptualize your entire research. The whole research/thesis can be reflected in Chapter 1 including expected results or outcomes. For your guidelines, please read the following sample format of Chapter 1

CHAPTER 1: THE PROBLEM

Chapter 1 should include the following, namely: 1) Rationale; 2) Theoretical Framework; 3) Conceptual Framework/Paradigm; 4) Statement of the problem; 5) Hypothesis (Optional); 6) Assumption (Optional); 7) Scope and Delimitation; 8) Importance of the study; 9) Definition of terms.

1.1 Rationale

- a. Background of the study
- b. Describe the problem situation considering global, national and local forces.
- c. Justify the existence of the problem situation by citing statistical data and authoritative sources.
- d. Make a clinching statement that will relate the background to the proposed research problem.

1.2 Theoretical Framework

Discuss the theories and/or concepts, which are useful in conceptualizing the research.

1.3 Conceptual Framework/Paradigm

1. Identify and discuss the variables related to the problem.
2. Present a schematic diagram of the paradigm of the research and discuss the relationship of the elements/variables therein.

1.4 Statement of the Problem

1. The general problem must be reflective of the title.
2. It should be stated in such a way that it is not answerable by yes or no, not indicative of when and where. Rather, it should reflect between and among variables.
3. Each sub-problem should cover mutually exclusive dimensions (no overlapping).
4. The sub-problem should be arranged in logical order from actual to analytical following the flow in the research paradigm.

1.5 Hypothesis

2. A hypothesis should be measurable/ desirable. It expresses expected relationship between two or more variables. It is based on the theory and/or empirical evidence.
3. There are techniques available to measure or describe the variables. It is on a one to one correspondence with the specific problems of the study.
4. A hypothesis in statistical form has the following characteristics:
 - a. It is used when the test of significance of relationships and difference of measures are involved.
 - b. The level of significance if stated.

1.6 Assumption

1. An assumption should be based on the general and specific problems.
2. It is stated in simple, brief, generally accepted statement.

1.7 Scope and Delimitation

Indicate the principal variables, locale, timeframe, and justification.

1.8 Importance of the Study

1. It describes the contributions of the study as new knowledge, make findings more conclusive.
2. It cites the usefulness of the study to the specific groups.

CHAPTER 2: REVIEW OF LITERATURE AND STUDIES

This chapter starts with a brief introductory paragraph concerning the researcher's exploration of related literature and studies on the research problem. It states the main coverage of said chapter, to wit: 1) Related Literature and 2) Related Studies.

1. It should be organized thematically to confirm to the specific problems;
2. It should synthesize evidence from all studies reviewed to get an overall understanding of the state of the knowledge in the problem area;
3. As much as possible, the reviewed should be limited within the ***last ten years***.
4. A statement showing how the related materials had assisted the researchers in the present study should be the last part.

CHAPTER 3: RESEARCH METHODOLOGY

This chapter of a thesis commences a brief statement and enumerating the main topics that are to be covered in it; namely; 1) Research Design; 2) Sources of Data (Locale of the Study and Population/Sampling); 3) Instrumentation and Data Collection; and 4) Tools for Data Analysis.

3.1 Research Design

The appropriate research design should be specified and described (including requirement, modelling of system/product/method development, detailed description of system/product/method design).

a. System/product/method Implementation

Describe the place where the study was conducted and the rationale behind its choice, the environment of the system (devicespecification, tools specification and language, which were used in the implementation)

b. Experiment Scenario

Describe the experiment scenario (including the objective, the procedure of the experiment and the variable which will be used in the experiment).

3.2 Population/Sampling

Describe the population of interest and the sampling of subjects used in the study.

3.3 Instrumentation and Data Collection

- Describe the instrument, what it will measure, how to interpret,
- Discuss how the validity and the reliability will be established. Specify the level of reliability (probability).
- Give details of instruction given to assistants if persons other than the researcher gather data.
- State qualifications of informants if used in the study.

3.4 Tools for Data Analysis

- Determine and justify the statistical treatment for each sub-problem
- Determine and justify the scales of values used and the descriptive equivalent ratings, if any.

Writing Chapter 3 of a thesis requires the assistance of a statistician (in most cases). This is because it is in this chapter that the thesis writer is usually required to indicate what statistical tools he intends to use in data analysis. Here is the basic format of Chapter 3.

CHAPTER 4: DATA PRESENTATION AND ANALYSIS

In thesis writing, the most difficult part to defend is Chapter 4 because it is in this section where you will present the results of the whole study. Here is a sample thesis format.

4.1 Presentation of Data

- Present the findings of the study in the order of the specific problem as stated in the statement of the Problem.
- Present the data in these forms:
 - Tabular
 - Textual
 - Graphical (optional)

The ZOOM LENS approach may be used for purposes of clarity in the presentation of data, i.e. general to particular, macro to micro or vice versa.

4.2 Analysis of the Data

Data may be analyzed quantitatively or qualitatively depending on the level of measurement and the number of dimensions and variables of the study.

Analyze in depth to give meaning to the data presented in the data presented in the table. Avoid table reading.

State statistical descriptions in declarative sentences, e.g. in the studies involving:

a. Correlation

- State level of correlation
- State whether positive or negative
- Indicate the level of significance
- Make a decision

b. Differences of Measures

- State the obtained statistical results
- Indicate the level of significance of the difference
- Make a decision

c. Interpretation of Data

- Establish interconnection between and among data
- Check for indicators whether hypothesis/es is/are supported or not by findings.
- Link the present findings with the previous literature.
- Use parallel observations with contemporary events to give credence presented in the introduction.
- Draw out implications.

In thesis writing, the Chapter is simply a summary of what the researcher had done all throughout the whole research.

4.3 Summary of Findings

- a. This describes the problem, research design, and the findings (answer to the questions raised). The recommended format is the paragraph form instead of the enumeration form.
- b. For each of the problems, present:
 - The salient findings,
 - The results of the hypothesis tested

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS (FUTURE WORKS)

5.1 Conclusions

- These are brief, generalized statements in answer to the general and each of the specific sub-problems.
- These contain generalized in relation to the population. These are general inferences applicable to a wider and similar population.
- Flexibility is considered in making of conclusions. It is not a must to state conclusions on a one-to-one correspondence with the problems and the findings as all variables can be subsume in one paragraph.
- Conclusions may be used as generalizations from a micro to a macro-level or vice versa (ZOOM LENS approach).

5.2 Recommendations

- They should be based on the findings and conclusion of the study.
- Recommendations may be specific or general or both. They may include suggestions for further studies.

- They should be in non-technical language.
- They should be feasible, workable, flexible, doable, adaptable.
- An action plan is optional.

Other parts of a thesis usually include the bibliography, appendix or appendices, and curriculum vitae. Writing them is much easier than Chapters 1-5 because these are simple annotations and/or citations of references.

The following is a sample format of these parts and how to write them:

OTHER PARTS

BIBLIOGRAPHY

It should include all materials used and reviewed by the researcher arranged according to type, e.g. books, periodicals, unpublished materials, etc. (IEEE Bibliography format is suggested)

APPENDIX

It may contain the following:

1. Letters and other forms of communication
2. Instruments used
3. Sample computations
4. Additional tables and figures

Note: The thesis writer is advised to consult his/her head of study program or school dean for institutional policies on the format of the thesis.

2. Format and Appearance

2.1 Paper and Duplication

To insure durability, permanency, and opacity, all copies must be on good quality white bond paper, of at least 75 g, with size 21 by 29.7 cm (A4). Only single-sided copies will be accepted.

Photocopies must be made from the original, and all pages must have high contrast with consistently dark print throughout the thesis.

The print must be permanent; it must not smudge.

All pages must be copied onto acceptable paper, as described above. Inferior copies and copies not made on approved paper will not be accepted. It is recommended that you work with a reputable copying firm or bindery when having your thesis reproduced.

2.2 Type

The type size should be 11-point. Times New Roman font is acceptable. The typeface and size must be consistent throughout the thesis. Bold face letters and symbols, and italics may be used for special emphasis and foreign words.

In the body of the thesis, different sizes may be used to set chapter titles, section headings, footnotes, endnotes, examples, quotations, tables, and charts from the rest of the text, as long as they are easily readable. Laser and ink-jet prints are preferred.

No ink corrections, strikeouts, correction fluid or tape, paste-ups, insertions between lines, and letraset are permitted on the final bound copies. If you must make corrections, do them on the original manuscript before it is copied (but not by ink corrections and strikeouts which are never allowed). **All print must be in permanent black ink and must appear on only one side of each page.**

2.3 Spacing

The general text of the manuscript must use **1.5 spacing** although tables, long quotations, footnotes, endnotes, bibliographies, and captions may be single-spaced.

2.4 Margins

The left margin (binding side) must be at least 4 cm wide to allow for binding; the other three margins must be at least 2.5 cm wide. However, in preliminary pages, the first pages of chapters of the text and the first pages of references and appendices pages, the top margin must be at least 5 cm. The margins are depicted in the following figure.

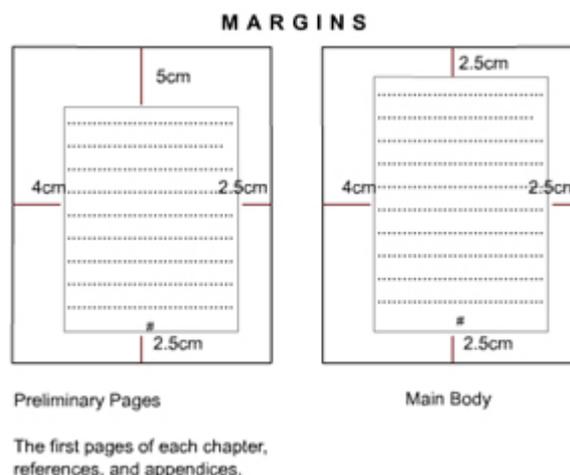


Figure 1

Narrower margins are not acceptable.

Absolutely nothing should appear in the margins. This means that ***all headings, page numbers, text, tables, illustrations, etc., must be contained completely within the area bounded by the margins.***

If right justification is used without hyphenation, right-justified text containing long technical and scientific words may result in unsightly white spaces between words, which are not acceptable.

2.5 Centering

All materials must be centered between the text margins rather than between paper edges. After the manuscript is bound, centered material will appear to be centered on the page.

In paragraphs, two types of formatting can be used. If spacing between paragraphs is used, then there is no need for indentation. If indentation is used, then no spacing must be used between paragraphs

2.6 Word and Text Divisions

Words must be divided correctly at the end of a line and may not be divided from one page to the next. Use a standard dictionary to determine word division. At least two lines of a paragraph must appear together at the top and bottom of every page. A subheading must be followed by at least two lines of a paragraph.

2.7 Pagination

All page numbers of the thesis must ***appear in the same location on the page***. You have three choices for this location: the upper right-hand corner, bottom right-hand corner or bottom center of the page. In any case, ***page numbers must be at least two single spaces above or below the nearest line of text, but within the margin boundaries*** as stated above. All page numbers must be in the same font and size. The page number of main body pages, must be in the same location.

The following pagination plan should be used:

- a) ***For the preliminary pages, use small Roman numerals (i, ii, iii, iv, etc.).*** The Title page and the Approval page do not have numbers but count as pages i and ii, respectively. Actual page numbering begins with iii on the Self Declaration Against Plagiarism page.
- b) ***Use Arabic numerals beginning with "1" on the first page of the text and continue throughout the rest of the thesis, including bibliography, appendices, and CV.*** All pages must be numbered consecutively, including pages containing chapter pages, illustrations, such as tables, figures, plates, and photographs.

2.8 Binding

All ***master's theses*** are to be bound in ***dark blue*** cloth. A bound copy of the thesis should measure 21.5 by 28.5 cm.

Two general rules of thumb should govern the presentation of any thesis: keep the format as simple as possible, and be consistent with the format throughout the thesis.

Every thesis has three main parts or divisions: the preliminary pages the text, and the reference matter (See Figure 2). You must follow the order of pages shown in the figure. **Required sections are marked with asterisk.**

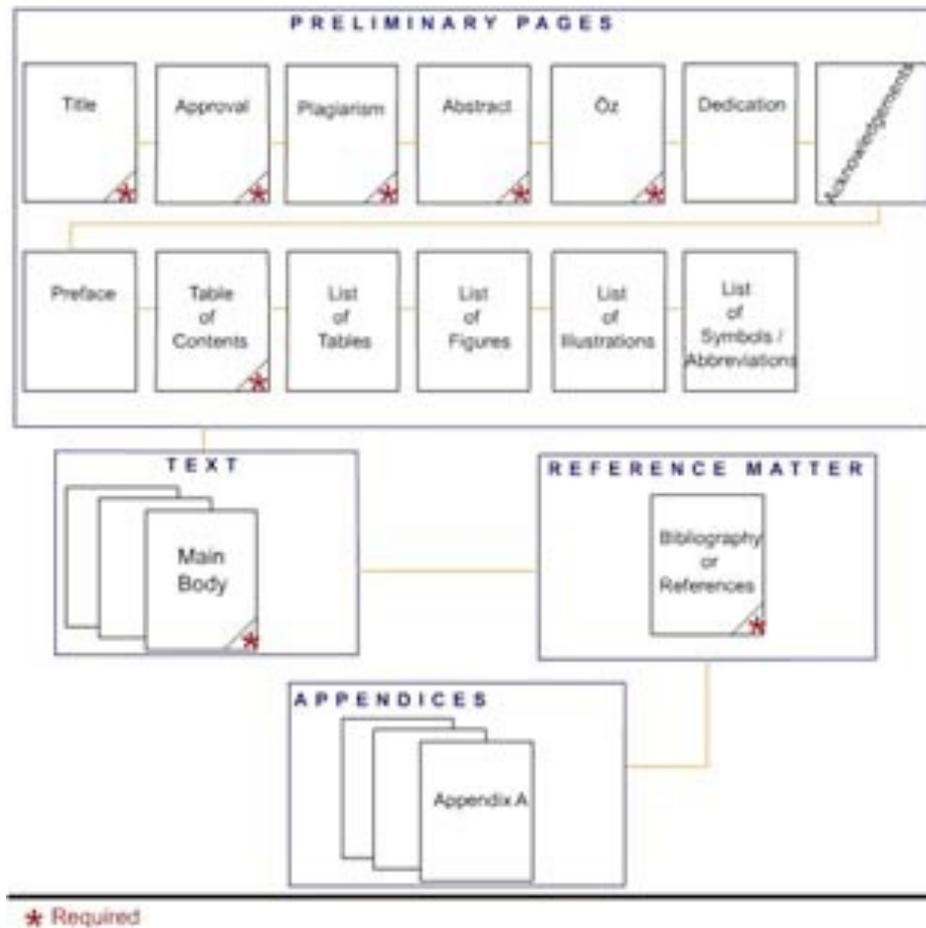


Figure 2

3 Specific Guidelines for the Parts of the Thesis

3.1 Preliminary Pages

3.1.1 Title Page

The title must be single-spaced, in all capital letters, and should begin at 5 cm from the top of the page. The information retrieval systems consulted by many scholars to locate theses and relating to their own work use the key words in the title. Consequently, the title must not contain chemical or mathematical formulas, symbols, superscripts, subscripts, Greek letters, or other non-standard abbreviations and characters; words must be substituted.

See **APPENDIX A** to obtain a sample title page

3.1.2 Approval Page

An example of Approval page should be looked like in Committee Members should be listed as

1. chairperson of the jury
2. the second name belongs to supervisor,
3. the third name belongs to co-supervisor if exists
4. the rest is in alphabetical order of first name

In addition, the affiliations of the committee members should be given. It is strongly recommended that the approval page of the thesis be signed in **blue ink**.

See **APPENDIX B** to obtain a sample approval page

3.1.3 Self Declaration Against Plagiarism Page

This page includes the statement signed by the author about plagiarism. The bold font face should be used on this page. Actual page numbering starts with “iii” on this page.

See **APPENDIX C** to obtain a sample Self Declaration Against Plagiarism page

3.1.4 Abstract

The abstract gives a succinct account of the thesis, including a statement of the problem, procedure and methods, results, and conclusions. It **must not exceed 250 words**, must not include diagrams, and should not include mathematical formulas unless essential.

The heading ABSTRACT appears without punctuation, centered between the text margins, 5 cm from the top of the page. The title of the thesis in all capital

letters begins centered at least two spaces below the heading. Equal 3 single spaces should be leaved as shown in the Figure 6. If abstract takes more than one page, at least 2,5 cm margin should be leaved for the top margin of the other page.

Maximum five keywords must be written at the end of the abstract.

See **APPENDIX D** to obtain a sample abstract page.

3.1.5 Dedication, Acknowledgements, and Preface

If included, each of these items must appear on a separate page. A heading for the dedication is not required, but it must have a page number. If used, the dedication must be brief and centered on the page. A sample Dedication is provided in **Appendix E**.

Like the dedication, acknowledgments and preface are optional. They must have headings and should use the same spacing as the text (i.e. 1,5 spacing). The heading ACKNOWLEDGMENTS or PREFACE appears centered between the text margins without punctuation 5 cm from the top of the page; text begins at least three spaces below the heading as can be seen in Figure 7. If ACKNOWLEDGEMENTS takes more than one page, at least 2,5 cm margin should be leaved for the top margin for the other pages.

3.1.7 Table of Contents

The table of contents must list the title of each chapter and its parts and sections, references or bibliography, appendices, and vita (if applicable). The wording used for all entries in the table of contents must match exactly with what is used in the text. Each entry must have leader dots which connect it to its corresponding page number.

The heading TABLE OF CONTENTS appears without punctuation centered between the text margins 5 cm from the top of the page. The listing of actual contents begins at the left margin at least three spaces below the heading as can be seen in Appendix H. If TABLE OF CONTENTS takes more than one page, at least 2,5 cm margin should be leaved for the top margin for the other pages.

See **APPENDIX G** to obtain a sample table of contents page.

3.1.8 List of Tables, List of Figures or List of Illustrations

A list of tables or list of figures may be included for the convenience of the reader. If included, first LIST OF TABLES than LIST OF FIGURES will immediately follow the table of contents on a new page.

The heading LIST OF TABLES or LIST OF FIGURES appears centered between the text margins without punctuation 5 cm from the top of the page; the listing begins at the left margin at least three spaces below the heading.

Each entry should have the same number and the same caption or title used in the text, although a long caption may be abbreviated to the extent of using only the first full sentence.

As in the table of contents, each entry must have leader dots, which connect it to its page number.

No reference should be used for the tables of figures in this section.

See **APPENDIX H** to obtain a sample list of tables page.

See **APPENDIX I** to obtain a sample list of figures page.

3.1.9 List of Symbols and/or Abbreviations

If included, you should follow a format consistent with acceptable practice in your discipline.

3.2 The Text

The text, or the body of a thesis, is divided into multiple chapters to help the reader in understanding the subject matter. Although the detailed organization of the text varies among academic disciplines, the formatting of the text must be consistent throughout. All headings and subheadings should be presented in the same way in each chapter, in terms of capitalization, placement on the page and kind of type used. No headers, giving the titles of chapters or other sections, are allowed at the top of the pages.

Chapters are numbered consecutively in Arabic or Roman numerals and capital letters (CHAPTER 1, CHAPTER 2, etc., or CHAPTER I, CHAPTER II, etc.). In addition to general titles like INTRODUCTION, the chapters need substantially descriptive titles as well.

Only chapters should begin with a new page. Within a chapter, the presentation of subsections must be continuous; partially filled pages of text are acceptable only on non-textual pages, such as those presenting tables and illustrations. **Subsection numbering must not go beyond three levels** (e.g. 1.2.3 Subsection Title) unless absolutely necessary.

The heading CHAPTER 1 in all capitals is centered between the text margins 5 cm from the top of the page; the title goes two spaces below. The text begins at least three spaces below as can be seen in Figure 9.

In many cases, the main body of the thesis will include certain materials other than ordinary text, such as illustrations, formulas, quotations, footnotes, and endnotes. In such cases, the following guidelines should be observed.

3.2.1 Illustrative Material

Illustrations include drawings, charts, figures, tables, diagrams, plates and photographs. These may be inserted wherever the author feels appropriate, but as a general rule, should appear as near as possible to the part of the text relating them.

Table numbers and captions are placed one space above the top line of the illustration; figure numbers and captions are placed one space below the last line or bottom of the illustration.

Illustrations of any kind must be numbered consecutively. This includes appendices, if you have them. You may follow a straight sequence (1, 2, 3, etc.) or preferably use a decimal approach (1.1, 1.2, 1.3,.., A.1, A.2, where the first digit is the chapter or appendix number, and the digit after the decimal point is the illustration number).

Illustrations may run longer than one page. In such cases all subsequent pages of the illustration must include at least the illustration number and the notation that it is continued, e.g., "Table 1 (cont.)" or "Table 1 (continued)."

All headings and captions must be prepared either in the same typeface and point size used for the text, or in the same typeface and point size as every other heading and caption. Choose a point size that can be read easily, especially for tables.

Illustrations of one-half page or less in length may appear on the same page with the text, separated from the text above and below by triple spacing; illustrations longer than one-half page are better placed on a separate sheet.

Illustrations that are too large to be placed sideways between the left- and right-hand margins should be rotated counterclockwise 90 degrees so that the top of the illustration runs parallel to the left-hand margin of the page. The caption or legend for such an illustration must also be rotated. When illustrations are presented in this manner, the usual margin requirements remain in effect, and ***page numbers should appear in their normal place.***

Color may be used in figures and photographs only with prior permission from the Graduate School. Photographic illustrations must be originals or well-done photographic copies of the originals. Standard photocopies of photographs are not acceptable. Wherever required, mounting of illustrations should be done with a technique that ensures durable and good quality result (e.g., dry mounting). With dry mounting, the paper to which photographs are attached will not curl.

Other methods, such as library paste, rubber cement, spray mounting, or tape, are not acceptable: such mounting techniques are not permanent, and the adhesives used will eventually destroy both the paper and the photograph. If audio-visual material (e.g., videotape, cassette, etc.) is needed to accompany and supplement the text, it should be adequately described within the continuity of the text. Such material will be submitted only with the Departmental copy. Stored information in the form of computer discs will be submitted only with the Departmental copy.

Computer print-outs must conform to the margin specifications, must be dark and legible with high black and white contrast, and must be copied on thesis-quality paper.

Authors may treat oversized materials in one of the following three ways:

- Captions may be placed on a separate page, facing the illustration. Consequently, it is the right margin of a facing page, not the left, that must be at least 4 cm for binding purposes. If an oversized illustration is rotated and the caption appears on a facing page, the caption must also be rotated.
- An illustration may be photo-reduced, but its page number and caption must be the same size and typeface as in the rest of the illustrations.
- An illustration may be folded and inserted in either of the following ways:
 - o Fold the illustration and insert it in a white or manila envelope no larger than 16.5 by 24 cm, which may be mounted on paper of the proper weight for inclusion in the thesis. Each page enclosed in the envelope must be included in the pagination of the thesis; the page on which the envelope is mounted should have a single page number or inclusive page numbers, as needed, or,
 - o Fold the illustration and mount it on 21 by 29.7 cm sheet.

3.2.2 Formulas

Mathematical and chemical formulas, equations and expressions may be printed, neatly hand-lettered, or both. If reference is made to them, they must carry numerical identification on the right hand side of the equation. You may follow a straight sequence (1, 2, 3, etc.) or preferably use a decimal approach (1.1, 1.2, 1.3,..., A.1, A.2, where the first digit is the chapter or appendix number, and the digit after the decimal point is the equation number) for identification

(Equation 4) OR (Equation 3.3)

3.2.3 Quotations

Short, direct prose quotations of three typewritten lines or less should be incorporated into the text, enclosed in double quotation marks. Prose quotations, which exceed three lines, should be set off from the text in single spacing and indented in its entirety at least four spaces from the left margin, with no quotation marks at beginning or end.

Quotations of poetry that are two lines or longer should normally be set off from the text, line for line as in the original and centered between the text margins without quotation marks. Quotations of poetry may be 1,5 or single-spaced, following the original as closely as possible.

Segments of computer programs may be treated as quotation.

3.2.4 Footnotes and Endnotes

Notes may be in the form of footnotes, placed at the bottom of each page, or endnotes, placed at the end of each chapter or at the end of the thesis before the bibliography.

Footnoting practices differ widely among publications in the sciences, the humanities, and the social sciences. Candidates should consult with their departments regarding accepted footnoting practice in their individual disciplines.

The most common mode of presentation for both footnotes and endnotes is to single-space within, and double-space between, each listing. If placed at the bottom of each page, footnotes must be separated from the text by a complete horizontal line one space above the first line of the footnote.

Arabic numerals, asterisks or small letters should be used for footnotes and endnotes. In either case, the label used may appear either above the line or in parentheses even with the line.

3.3 The Reference Material

The reference material consists of a bibliography or references, which is required, and appendices, which are optional.

3.3.1 Bibliography or References

A bibliography is a selected list of all books, articles, and other source material related to the thesis research and is always in alphabetical order, with the author's last name first.

In some disciplines it is customary to list all of the references at the end of the thesis in a section headed "References," "List of References," or "Literature Cited" instead of "Bibliography." One of these headings should be used if the references in the thesis are cited by year, e.g., Smith (1966), or by number, e.g., Smith [3] or [3]. If numbers are used, the listing should be in numerical order, and the author's last name need not be first.

- In certain scientific and engineering disciplines, the references may be given at the end of each chapter instead of at the end of the thesis.
- Do not give the bibliography or references a chapter number, but it must have page numbers written in the same typeface and size used for pagination throughout the thesis.
- The heading BIBLIOGRAPHY or REFERENCES is centered between the text margins without punctuation 5 cm from the top of the page; the list begins four spaces below.
- ***Each bibliographic entry should be single-spaced with double spacing between entries.***
- The candidate's major department should be consulted for a reference style that is appropriate to the discipline and acceptable to the department.

3.3.2 Appendices

Some authors may desire to include certain materials of the thesis in an appendix rather than in the main text. For example, an appendix may contain test forms, detailed apparatus description, extensive tables of raw data, computer programs, etc.

- If the information to be appended requires only one appendix, the heading APPENDIX should appear centered between the text margins 5 cm from the top of the page. Then the heading of the appendix appear 2 spaces below. Then the text begins three spaces below.
- If the information to be appended requires more than one appendix, each should be given a letter (Appendix A, Appendix B, etc.). The heading APPENDICES should appear centered between the text margins 5 cm from the top of the page. Then the subheading APPENDIX A with its title appear two spaces below. Finally the text begins three spaces below. For the later appendices (A; B, C..) at least 2,5 cm top margin should be leaved and the title APPENDIX B with its appendix should be appeared. Then the text begins three spaces below.
- The typeface and size should be those used for chapter titles.
- Spacing need not be the same for each of the appendices. Documents and case studies may be single-spaced, whereas spacing for the explanations of methods and procedures may be similar to that of the text.
- Each appendix with its title must be listed separately in the table of contents as a subdivision under the heading APPENDICES.

- All appendices must have page numbers written in the same typeface and size used for pagination throughout the thesis.
- If an appendix contains photocopied material, the photocopies should be of letter quality.

APPENDIX A: TITLE PAGE

THE TITLE OF THE THESES

A THESIS SUBMITTED TO
THE SCHOOL OF ELECTRICAL ENGINEERING



BY

YOUR NAME
YOUR STUDENT ID

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF ELECTRO-TELECOMMUNICATION IN
THE SCHOOL OF ELECTRICAL ENGINEERING

AUGUST 2014

APPENDIX B:
APPROVAL PAGE

Title of the thesis

This Thesis is approved and authorized to be filed in The Graduate Program of Electrical Engineering, The School of Electrical Engineering, Telkom University

By:

Your name
Your Student ID

Date (DD/MM/YY) _____

First Supervisor,

Second Supervisor,

(Title and Name)

(Title and Name)

APPENDIX C: SELF DECLARATION AGAINST PLAGIARISM

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Date/Month/Year _____

Name, Last name : Martin Abadi

Signature : _____

Date/Month/Year _____

Name, Last name of First Supervisor:

Signature : _____

Date/Month/Year _____

Name, Last name of Second Supervisor:

Signature : _____

APPENDIX D: ABSTRACT

ABSTRACT

Multi-path is a technique to increase the reliability of the internet connection in IP network. The implementation of this technique can be described as a host with two TCP paths work together, when one of them fails the other will back up the connection. Since TCP does not support multi-homing, the right term for this technique is multi-path. The fairness problem arises when multi-path host uses the same bottleneck link with another single-path host. This problem can be solved by scaling down each sub-flow on the multi-path by modifying the Congestion Control on Westwood+. This paper will design a Multi-path protocol which will use the same weighing method on BMC and a few modification on weight calculation by exploiting the Bandwidth Estimation on Westwood+ congestion control, this multi-path protocol will be mentioned as Normalize Uniform High-Adaptability (NUHA) TCP. The simulation will be conducted on HSDPA air interface to represent the wireless condition using network simulator 2. The results show that the multi-path protocol NUHA TCP works well in high loss network without violating the fairness.

Keywords: Westwood+, Wireless Multi-path, Fairness, Congestion Control

APPENDIX E: DEDICATION

To My Parents

APPENDIX F: ACKNOWLEDGMENTS

ACKNOWLEDGMENTS

I express sincere appreciation to my supervisors Dr. Hendrawan and fazmah Arif MT for his guidance and insight throughout the research. Thanks go to the other

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