UMP THESIS GUIDE

CENTER FOR GRADUATE STUDIES
UNIVERSITI MALAYSIA PAHANG
PREFACE

The preparation of graduate thesis is a logical and scrupulous process. It involves numerous steps. The Universiti Malaysia Pahang (UMP) Thesis Guide describes the formatting standards set forth by the Center for Graduate Studies. This guide helps students in the preparation of their theses. The guide covers facet of thesis writing from the language to be used, to technical specifications that include typeface and font size, number of pages for a Masters and PhD thesis, pagination, line spacing, units, chapter format and references style. The guide is divided into five chapters which explain in detail the formatting requirements and submission options to be followed by all students writing theses at the Universiti Malaysia Pahang.
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CHAPTER 1

INTRODUCTION AND GENERAL INFORMATION

1.1 PURPOSE OF THE GUIDE

The Universiti Malaysia Pahang (UMP) Thesis Guide is prepared to provide guideline for the preparation of students at UMP, Malaysia. It establishes the technical parameters within which all students must observe such as margin settings, spacing, format and style, the sequence of pages within the document, and items required for final submission. Since most of the students will publish during and after their graduate education, it is logical to encourage the use of this Guide as reference for practices. The application of this concept is not simple. However, it becomes necessary for students to understand the various elements of a manuscript and general formatting requirements in various academic publishing. Although knowledge and use of formatting are essential, the regulations established by the guide precede over any other manuals for final submission of a thesis in UMP.

The fact that UMP accepts a thesis and awards the degree, place its academic reputation on the line. While the technical quality and content of the thesis are evaluated by the examiners, Center for Graduate Studies (CGS) imposes format requirements to ensure an appropriate academic appearance of the manuscript.

1.2 BACKGROUND INFORMATION

The commitment of Center for Graduate Studies at UMP has always been to assist students in meeting the goals of consistency, logical organization, attractiveness and correctness in thesis preparation. The Center for Graduate Studies is responsible for the review and approval of the final copies of the thesis. It provides the guidance in document preparation through this guide and submitted thesis will be checked by CGS assigned person.
1.3 LANGUAGE OF THESIS

Unless approval from the senate has been obtained for the use of other language, the thesis should be written either in English or Bahasa Melayu. There should be consistency in the use of the language, especially the spelling style either British or American, throughout the thesis. The Roman alphabet should be used unless required by the discipline otherwise.

1.4 SUBMISSION

A student is required to forward the notice of submission of thesis to the Dean, CGS at least three months before the actual date of submission. A form for the notice of the submission can be obtained from CGS office. The submission has to be completed during the term of candidature.

1.5 CONSISTENCY IN FORMAT

The element that contributes most to the attractiveness and readability of the thesis is consistency. Consistency in formatting means that the students satisfy a series of convention regarding spacing, heading, sequencing and other aspects of appearance to visually guide the reader throughout the document, thus enabling the reader to concentrate on content. Consistency of thesis preparation is critical since it influences the examiner’s response to its content and ultimately the acceptance of the document by the Center for Graduate Studies.

1.6 DEFINITION OF TERMS

_Typeface or Font_

These terms apply to all the features available within the family of print characters including bold, italics and the various fonts such as Arial, Times New Roman and Courier, etc.
In the discussion of formatting, text is used as a generic term to designate the main body of the thesis and to distinguish this element from preliminary pages, references, tables, figures and appendices.

**Preliminary Pages**

The preliminary pages serve as a guide to the contents and nature of the thesis. These pages comprise of the examiners approval document, title page, declarations, dedication, acknowledgements, abstract, table of contents, list of tables, list of figures and list of symbol/abbreviations.

**Table**

Table presentations in which verbal, numeric or graphical information are arranged in a systematic way in rows and columns. Tabular information allows the student to express precise information to a reader in a structured format.

**Figure**

Any diagram, illustration, graph, chart, map, photograph or material that does not fit into the restricted format for a table is a figure. Figures generally show relationship or illustrate information rather than present precise data.

**Equation**

Equations are considered to be part of the text and therefore should not be set apart from the text within a box or in any other way.

**Appendix**

An appendix can be used for supplementary material that is related to the text. In some cases, table and/or figures are placed in an appendix to avoid interrupting the text.
CHAPTER 2

TECHNICAL AND Formatting Specifications

2.1 PAPER SPECIFICATIONS

2.1.1 Size

A4 (210 mm × 297 mm) size papers should be used.

2.1.2 Quality

The copy should be on simile paper (minimum quality 80 grams). Duplicate copies should be on quality photostat or offset paper. Neither risograph copies nor carbon copies are acceptable. The students should use normal print and a quality printer.

2.1.3 Colour

Only white paper is acceptable.

2.2 GUIDELINES FOR TYPING

2.2.1 Typeface or Font

Typeface affects the physical appearance of a thesis more than any other single element. Word processing software package provides the opportunity to use different typefaces, sizes and font attributes such as bold or italics. The size of the type is determined by point size. Text is most readable in 10, 11 or 12 point. The students are required to use Times New Roman with 12 font size throughout the thesis including headings and page numbers except special foreign languages.
2.2.2 Headings

The title of a chapter should be typed using **bold capital letters** and centered. A new chapter must start on a new page. Chapters and their sub-sections must be given titles. The titles should be typed using **bold letters** and should not be underlined.

2.2.3 Spacing

Spacing has both artistic and utilitarian effects on the appearance of the document. General manuscripts should have 1.5 line spacing. Single line spacing should be used for the following

(i) Acknowledgements  
(ii) Abstract and its translation  
(iii) List of tables, figures, symbols and abbreviations  
(iv) Footnotes  
(v) References

The following guidelines should be observed:

(i) The spacing between upper edge of a page and a chapter number should be 50 mm;  
(ii) The spacing between a chapter number and the title, and between the title and the first line of the text should be 2×1.5 line spacing;  
(iii) The spacing between the last line of a text with the title of a sub-section should be 1.5 line spacing;  
(iv) The spacing between the title of a sub-section and the first line of a text should be 1.5 line spacing;  
(v) The spacing between paragraphs should be 1.5 line spacing;  
(vi) The number and the title of a sub-section should be aligned with the left margin;  
(vii) A new paragraph should not begin on the last line of a page;
(viii) The spacing between the last line of a text and a table, or a figure should be 1.5 line spacing;

2.2.4 Paragraphing

All paragraphs should have the first line indented 12.7 mm from the left margin.

2.3 PRINTING AND DUPLICATION

Only one side of the sheet should be printed. After binding, the printed page should be on the right side. The final copies of the thesis must be produced using a laser printer. Inkjet, dot matrix or bubblejet printers shall not be used to produce the final copies of the document. Make sure that the photocopies or offset copies are in good quality.

2.3.1 Copies of the Thesis

Copies of the thesis for external examiner, internal examiner and supervisor/ co-supervisor and postgraduate committee should be submitted bound with black coloured cover for Masters and maroon coloured cover for PhD thesis.

2.3.2 Copies of the Final Submission

Three (3) copies of the thesis should be submitted to the CGS after it has been examined and passed by the examiners.
2.3.3 Colour of the Cover

The colour should be used according to the types of degree

- Doctor of Philosophy : Maroon
- Masters : Black
- Degree (Final Year Project) : Green

2.4 INFORMATION ON THE COVER

2.4.1 Front Cover

The front cover should be written in capital letters with the title of the thesis, the candidate’s name, the name of degree award and the university’s name

Details on the cover should be in gold coloured CAPITAL letters (not bold face) with font size of 20 points and should be in the following order:

(i) Title of the Thesis (arranged in inverted pyramid, 50 mm from the upper edge of the cover)
(ii) Full Name of the Student (name as appears on identification card/ passport)
(iii) Name of the Degree (for example, DOCTOR OF PHILOSOPHY)
(iv) Name of the University (UNIVERSITI MALAYSIA PAHANG, 50 mm from bottom edge of the cover).

(Please refer to Appendix A1)
2.4.2 Spine of the Thesis

Details should be in gold coloured CAPITAL letters using font size of 20 points in the following order:

(i) Name of Student (50 mm from the upper edge of the cover)
(ii) Name of the Degree (abbreviated form, for example, Ph.D./M. Eng. (Mech.))
(iii) Year of Degree Awarded
(iv) Name of University (UMP; abbreviation of Universiti Malaysia Pahang, 50 mm from the bottom edge of the cover)

(Please refer to Appendix A2)

2.5 MARGINS SPECIFICATIONS

All pages should be set with the same margin. Student should maintain the following margin specifications:

<table>
<thead>
<tr>
<th>Margin</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top edge</td>
<td>30 mm</td>
</tr>
<tr>
<td>Right side</td>
<td>25 mm</td>
</tr>
<tr>
<td>Left side</td>
<td>35 mm</td>
</tr>
<tr>
<td>Bottom edge</td>
<td>25 mm</td>
</tr>
</tbody>
</table>

These margins define the minimum white space to be maintained on all sides of a page. All materials included in the document including the text, tables, figures must fit within these margins.

Note:

(i) The beginning of each chapter, except for references and appendices, must begin 50 mm from the top edge of a page.
(ii) Tables and figures must follow the specifications.
(iii) The last paragraph on a page must have at least two (2) lines of the text otherwise it should begin on the following page.
(iv) The last word in the last line on a page must not be followed by a hyphen.

2.6 PAGINATION

2.6.1 Position of Page Number

Page numbers should come into view on the right hand corner, 15 mm from the upper edge, and the last digit should be 25 mm from the right edge of the paper. The candidate should follow the same font as rest of the text without trimming.

2.6.2 Numbering System

All chapters and their sub-sections should be labeled and numbered. The chapters should be numbered using Arabic numeric, i.e. Chapter 1, Chapter 2, Chapter 3 and so on. The sub-sections should not be indented but arranged in a structured manner not more than three levels as follows.

1 First level (Title of the chapter)
1.1 Second level (Title of the section)
1.1.1 Third level (Title of the sub-section)

If the length of a title is more than one line, single line spacing should be used. Sub-sections beyond level three should be labeled using the characters with italic and bold face. Preliminary pages (beginning with the title page) should be numbered consecutively in lower Roman numbers such as i, ii, iii and so on. The text should be numbered using the consecutive Arabic numbers such as 1, 2, 3 and so on. Pagination using letter suffixes (example 10a, 10b) is not allowed.
Note:

(i) The first page (title page) is counted even though the page number does not appear on the print.

(ii) The first page of each chapter is counted although the page number does not appear on the print.
CHAPTER 3

THESIS ARRANGEMENT AND LAYOUT

3.1 ARRANGEMENT OF THESIS

The layout and content of the thesis should be in the following order:

TITLE PAGE
THESIS CONFIDENTIAL STATUS
SUPERVISOR’S DECLARATION
STUDENTS’S DECLARATION
DEDICATION (Optional)
ACKNOWLEDGEMENTS
ABSTRACT
TRANSLATION OF ABSTRACT
TABLE OF CONTENTS
LIST OF TABLES
LIST OF FIGURES
LIST OF SYMBOLS
LIST OF ABBREVIATIONS
TEXT
REFERENCES
APPENDICES
3.2 PRELIMINARY PAGES

3.2.1 Confidential Status

Thesis status declaration is done using the Thesis Status Declaration form (see Appendix A3). If the box CONFIDENTIAL or RESTRICTED is marked [/], a letter from the party classifying the information as confidential or restricted must be attached. The letter should clearly indicate

(i) the reasons for classification
(ii) the duration for classification

A typical duration for confidential or restricted classification is three (3) years. A thesis can be classified as confidential or restricted up to a maximum period of five (5) years. Examples can be seen in Appendices A3. If the status declaration form is not submitted or the form is incompletely filled, the University will assume the thesis is unrestricted and therefore the library will make the copies of the thesis available for distribution as published academic exchange materials. The student’s name used on the document must appear as he/she is registered at Universiti Malaysia Pahang. The major and degree to be awarded must be exactly the same as the official major and degree to which the student was offered by the Center for Graduate Studies. The status declaration document is neither numbered nor counted in the numbering sequence of the thesis.

3.2.2 Title Page

The title should describe the content of the thesis accurately and concisely. The title page should provide the following information by using single spacing and in CAPITAL LETTERS in the following order:

(i) Title of the Thesis: (in inverted pyramid, 50 mm from the upper edge of the page)
(ii) Full Name of the Student: (as appears in identification card / passport)
(iii) Purpose of Thesis Submission:
(iv) Name of Faculty/Institute/Center (Title case)
(v) Name of University (Capital letters)
(vi) Month and Year of Degree Awarded (50 mm from the bottom edge of the page)

(Refer to Appendix A4)

3.2.3 Statement of Award

This statement should be written on the title page. It should state the purpose and the award for which the thesis is submitted. Example of statements for various purposes and awards are listed in Appendix A5.

3.2.4 Declaration

The declaration must be on a fresh page. It should be typed 30 mm from the upper edge of the page. A thesis to be submitted for the purpose of examination must obtain prior declaration from the supervisor(s) on the standard and quality of the thesis (refer to Appendix A6). The student should prepare the declaration using exactly the same words in Appendix A7 and is signed. The student declaration also should be typed 30 mm from the upper edge of the page.

3.2.5 Dedication (optional)

If the student wishes to dedicate the thesis, the dedication statement is included on this page. The dedication must be brief, not more that one paragraph and must not contain any number, chart or photograph. It should be placed in the middle of the page. (Refer to Appendix A8)

3.2.6 Acknowledgements

It is normal to acknowledge any individual or organisation that has provided any sort of special assistance in the preparation of the thesis. Permission to quote copyrighted material is also listed here. It is perfectly appropriate to express gratitude
for financial or other support that the student has received. The words ACKNOWLEDGEMENTS should be typed 30 mm from the upper edge of the page. Candidate should avoid lengthy and wordy acknowledgements. This should be written in single line space within a page. (Refer to Appendix A9)

3.2.7 Abstract and its Translation

Thesis submitted to the Center for Graduate Studies must include an abstract. The abstract and its translated version should be on separate pages after the page of Acknowledgements. The word ABSTRACT must be typed 30 mm from the upper edge of the page and centered between the right and left margins. The length of the abstract should be within 350 words and written in one paragraph, single line spacing. Generally, the abstract should provide a concise description of the study and should not be a critique. A number of criteria including comprehensiveness, preciseness, stating the objectives, conciseness and intelligibility must be respected. Normally, an abstract should include the following information:

(i) Brief statement of problem and/or objectives of the study
(ii) A concise description of research design, methodology and materials
(iii) Brief summary of major research findings including their significance
(iv) Conclusions of the research

An abstract should not include the followings:

(i) Additional content, corrections or any information that do not appear in the text of the thesis
(ii) Tables, figures, references and abbreviations or acronyms. Abbreviations or acronyms must be preceded by the full terms at the first use
(iii) Details of experiment, organisms, standard procedures, techniques and instruments
(iv) References to other parts of the thesis and bibliographic references
Abstract should be written in English and Bahasa Melayu. The version to appear first should be of the same language used in the thesis text, for example, for a thesis written in English, the abstract in English should appear first, followed by its Bahasa Melayu version. Even though a thesis has been written in English, the abstract in Bahasa Melayu must also reach an acceptable scholarly standard. Common pitfalls such as spelling errors, incorrect usage of prepositions and prefixes should be avoided. Scientific terms must be used accurately and consistently.

(Refer to Appendix A10 and A11)

3.2.8 Table of Contents

Table of Contents should start on a new page with the word TABLE OF CONTENTS typed 30 mm from the upper edge of the page and centered. A table of contents consists of an ordered list of headings for all the chapters, topics, subtopics, list of references, appendices (if used) with the page numbers that mark the start of each. Titles, headings and subheadings should be worded exactly as they appear in the body of the text.

(Refer to Appendix A12)

3.2.9 List of Tables

This appears on a fresh page with the heading LIST OF TABLES typed 30 mm from the upper edge of the page and centered. The list must contain all the titles of the tables that appear in the text or in the appendix and worded exactly the same as they appear in the text. The page number of the table must also be included. The table number should be arranged according to the chapters.

(Refer to Appendix A13)
3.2.10 List of Figures

This page appears on a new page with the heading LIST OF FIGURES typed 30 mm from the upper edge of the page and centered. This list contains the titles of figures (charts, diagrams, photographs, drawings, maps, graphs and any other kind of illustrations) together with their page numbers, which are listed in the text or in the appendix. The titles must be worded exactly as they appear in the text of the thesis. The page number of the figure must also be included. The figure number should be arranged according to the chapters.

(Refer to Appendix A14)

3.2.11 List of Symbols/Abbreviations

All symbols/abbreviations/terminologies and glossaries that appear in the text should be listed on this page. It should be placed 30 mm from the upper edge of the page. They are listed in the following order:

(i) Roman letters - alphabetical order  
(ii) Greek letters - alphabetical order  
(iii) Superscripts - alphabetical order  
(iv) Subscripts - alphabetical order

(Refer to Appendices A15 and A16)

3.3 THE TEXT

3.3.1 Length

The maximum number of words for a project/dissertation/thesis is as follows:

Doctor of Philosophy:  
Not more than 1 000 000 words
Masters:

By Research: Not more than 60 000 words
By Coursework: Not more than 40 000 words

Degree (Final Year Project):
Not more than 30 000 words

The total number of words does not include footnotes, quotations, appendices, formulae, tables, diagrams and the like.

3.3.2 Major Divisions

Thesis must be divided into a logical scheme that is followed consistently throughout the document. This logical scheme begins with a major division such as a chapter and section. Chapters are the most common division but sections and parts are also permissible. Each chapter must have a title and it should reflect its content. A new chapter must begin on a fresh page. A chapter must be divided into sections. These sections must be given appropriate titles and numbered. Texts must be written in paragraphs. Long paragraph should be avoided. Each paragraph must describe an issue or subject. There must be continuity between paragraphs.

The text starts with a chapter that is CHAPTER 1. The heading CHAPTER 1 must be positioned 50 mm from the top edge of the page and centered. The title of the chapter begins 2\times1.5 line spacing below the chapter title and is according to margin specifications. The same requirements apply to the subsequent chapters.

(Refer to Appendix B)

3.3.3 Subsections/Headings

Any logical system of subsection within a chapter is permissible but the scheme used should be consistent throughout the document. The appearance of the heading must vary in style for each level of the heading unless a numbering sequence is used to indicate level. The headings within a chapter do not begin on a new page unless the
proceeding page is filled with text. If there is no space for a complete heading and at least two lines of the text at the bottom of a page, the new heading should begin on the next page. The primary headings (first headings), subheadings (secondary heading) are left justified. The tertiary headings (more than third level) should be written in italics font with bold face and are not listed in the Table of Contents. The headings and subheadings of the chapter should be the first level, for example, Section 3.1 and 3.2 would denote two consecutive headings in Chapter 3 and Sections 3.2.3 and 3.2.4 would similarly denote two consecutive subheadings in Chapter 3.

(Refer to Appendix B)

3.3.4 Tables in the Text

All tables must be numbered using the Arabic numeric. The caption should be positioned at the top of the table. If the table is presented across the length of the page (landscape direction), the head of the table must be along the bound edge of the thesis. Tables must be numbered according to the chapter. The caption is written in single line spacing and it should be centered. If the caption is written in more than one line, the second and the following line should be aligned to the left caption text. The tables must be numbered with respect to the chapter such as Table 3.1 is the first table that appears in Chapter 3. Table sources should be placed below the table. If the table has a source but has been adapted, indicate by using “Adapted from: …” instead of “Source: …”.

A table should be positioned after it is being cited for the first time in the text. All tables in the chapter can also be grouped together and positioned near the relevant text. Since tables are typeset by the student rather than photographed, copied or imported from an external source, the same typeface used for the thesis must be used for table number, title and data. The size of the typeface for table content should be the same as the rest of the document but may differ slightly if necessary, for example, a font size or two smaller.

(Refer to Appendix C1 and C2)
**Required Format for Tables**

Since tables consist of tabulated material, the use of lines in tables assists the reader in distinguishing the various parts of the table. The table must include the following three horizontal lines:

(i) The table opening line, which appears after the table title and before the column heading
(ii) The column heading closing line, which closes off the heading from the main body of the table
(iii) The table closing line, signaling the end of the table. Any information appearing below the closing line is footnote material.

Different table styles such as a full grid are not acceptable. Tables must have at least two columns which house headings at the beginning of the table. These headings should describe the data to be presented in the table. The headings appear between the table opening line and the closing line must apply to the entire column down to the table closing line. This is especially important when tables continue onto additional pages. It is not acceptable to change column headings on continued pages. One method of avoiding this problem is to add subheadings below the column heading closing line.

(Refer to Appendix C1 and C2)

**Continued Table**

Tables may be continued on as many pages as necessary, provided the column headings remain the same and are repeated on each continued page. The first page contains the table number and title and the subsequent pages contain the remainder of the table and the designation is Table #. Continued.

(Refer to Appendix C3 and C4)
3.3.5  Figures in the Text

Illustrative visual materials such as maps, charts, graphs, drawings, diagrams and photographs are referred as figures. All figures must be clear and of high quality. Figures must be numbered using the Arabic numeric. A caption should be positioned at the bottom of the figure. If a figure is presented across the length of a page (landscape direction), the top of the figure must be along the bound edge of the thesis. Figures must be numbered according to the chapter.

**Typeface**

Since figures are considered illustrations or diagrams and may be imported from an external source, any text that is part of the figure can be in any typeface, provided it is neat and readable. The figure number and title must be in the same typeface as the rest of the thesis because this material is considered to be part of the typeset body of the document.

The caption is written in single line spacing and it should be centered. If the caption is written more than one line, the second and the following lines should be aligned to the left caption text. The figures must be numbered with respect to the chapter such as Figure 4.2 is the second figure that appears in Chapter 4.

(Refer to Appendix D1 and D2)

**Continued Figures**

A figure containing several related parts too large to be included on a single page may be continued onto other pages. The first page contains the figure number and complete title and the subsequent pages contain the remainder of the figure and the designation is Figure #. Continued.

(Refer to Appendix D3)
3.3.6 Placement of Tables and Figures

Tables and figures must be referred in text by number instead of expressions. When more than one tables/figures are referred on a page of text, each table/figure should follow in the order mentioned until all have been placed. In degree of importance, tables/figures are secondary to the text. It means that all text pages must be filled with text. It is recommended that tables/figures are assigned on pages separated from the text to avoid problems in shifting during last minute revisions. However, if the student wishes to incorporate tables/figures within the text, the following criteria must be met:

(i) Table/figure must be separated from the text by extra space (1.5 line spacing).
(ii) Table/figure cannot be continued onto the following page
(iii) Table/figure must be placed at the top or bottom of the page, instead of the center/near to the center of the page. If a new section occurs in the page, the figure can be placed in between the text as shown in appendix B.

There should always be a balance of not less than half a page of the text and not more than half a page of table/figure below or above the text. If multiple tables/figures are included on a page, it is permissible to provide approximately 1.5 line spacing between each table/figure.

Placement in an appendix: When all tables/figures are placed in an appendix, this fact is stated in a note in the body of the text and is not repeated thereafter. This note should be placed on the page of text that refers to the first table or figure in the document. The note could be presented as part of a sentence, parenthetical information or a footnote. When only some of the tables/figures are in an appendix, their location must be clearly indicated as references in the text, unless the numbering scheme makes the location obvious.
3.3.7 Equations in the Text

Equation number should be Arabic numerals enclosed in parentheses on the right hand margin. The equations whether mathematical or/and chemical should be cited in the text and must be numbered with respect to the chapter such as Eq. (4.2) as the second equation that appears in Chapter 4. Equations are placed at the center of a page (refer to Appendix B). If detailed derivation is needed, it is to be placed in an appendix. When a complete version of an equation requires more than a single line, the expression should be divided immediately before a convenient plus or minus sign but not one that falls within the bounds of a set of fences. Actually the best place to break a lengthy equation is right ahead of an equals sign.

3.3.8 References within the Text

Reference/Citation is a mean of formally recognising within the text, the sources from which the information or idea are obtained. The purpose is to acknowledge the work of others, to demonstrate the body of knowledge in which the work is based on and to lead others to further information. Citation in the texts must be written according to this guide. Referencing usually consists of information in parentheses within the text. The purpose of internal referencing is to guide the reader to the appropriate entry in the list of references/bibliography, where complete information is available.

3.3.9 Quotations

Quotations within a sentence should not exceed 40 words and must be placed within quotation marks “ … ”.

All quotations exceeding 40 words must be typed separately in a new paragraph with 1.5 line spacing below and indented without the use of quotation marks. If the quotation is in a different language, it must be written in italic.
3.4 LIST OF REFERENCES

A thesis must include a list of materials used in the preparation of the document. The student should not cite articles that were published from the studies that he/she conducted during his/her candidature as references. The list of references should start on a fresh page with the heading REFERENCES 30 mm from the upper edge of the page and centered. This section should contain all the sources referred to by text. Sources not referred to in the text should not be listed in the references section. The purpose of listing the references is threefold:

(i) To serve as an acknowledgment of sources
(ii) To give readers sufficient information to locate the material
(iii) To save the reader the trouble of attempting to locate material that is not available in the case of personal interviews or correspondences.

The format used for the references should follow the Author-Year system. References cannot be collected at the end of the chapters and only at the end of the document. All references should be listed in alphabetical order. The detailed reference styles are described in Chapter 4.

3.5 HEADER AND FOOTER

The use of header and footer is not allowed.

3.6 APPENDICES

An appendix is a useful device to make available material that is relevant to the text but not suitable for inclusion in it. Thesis does not necessarily have to include appendices. The appendices may comprise of the following: glossary, data from the study, tables, charts, detailed engineering drawing, computer program listings, sample of questionnaires, maps, photographs, and any other such material that is either too
lengthy to be included in the text or not immediately relevant to the discussion in the text.

Appendix can be named as APPENDIX A, APPENDIX B and so on, depending on the types and quantity of information to be included. Specific titles for an appendix can also be given. Appendices should be paginated consecutively with the main text. The heading such as APPENDIX A should be typed 30 mm from the upper edge of the page and centered. If appendices are included, they should be listed according to their titles in the Table of Contents. If there are five or less appendices, their details should be listed in the Table of Contents. If there are more than five, the Table of Contents should include a list of appendices with the page numbers.

3.6.1 List of Publications

All publications (either journals or proceedings) that result from the study that is carried out by a candidate while under supervision and during his/her candidature and for which the candidate is the first author or co-author should be listed clearly and accurately. The publications listed in the appendix are those relevant to his/her research topics and that have been either published or accepted to be published in journals or conferences during the candidate’s study period.
CHAPTER 4

REFERENCE STYLE

4.1 INTRODUCTION

The details of the references cited in the text should be located in the list of references. The list should be placed at the end of the thesis. The list of sources actually cited should be compiled according to the following guidelines, based on the AUTHOR-YEAR system (Harvard System). The references are listed according to alphabetical and chronological order. If more than one references by the same author are cited, these references should be listed chronologically. In the reference list, information from books, journals, newspapers, interviews and similar sources are not classified or categorise into their own categories. References should be typed single spaced. If a reference is not in the language of the text (except for English) then it should be translated into the language of the text.

4.1.1 Author’s Name

The author’s name should be written in full, as it appears on the title page of the publication or as in the copyright information without any titles or honorifics. The name of author with a family name must first be shortened by starting the family name and the rest of his name in initials. The initials (without any extra spacing) are written after the family name and are preceded by a comma.
CHAPTER 4

REFERENCE STYLE

4.1 INTRODUCTION

The details of the references cited in the text should be located in the list of references. The list should be placed at the end of the thesis. The list of sources actually cited should be compiled according to the following guidelines, based on the AUTHOR-YEAR system (Harvard System). The references are listed according to alphabetical and chronological order. If more than one references by the same author are cited, these references should be listed chronologically. In the reference list, information from books, journals, newspapers, interviews and similar sources are not classified or categorised into their own categories. References should be typed single spaced. If a reference is not in the language of the text (except for English) then it should be translated into the language of the text.

4.1.1 Author's Name

The author's name should be written in full, as it appears on the title page of the publication or as in the copyright information without any titles or honorifics. The name of author with a family name must first be shortened by starting the family name and the rest of his name in initials. The initials (without any extra spacing) are written after the family name and are preceded by a comma.

For example,

John Harvard Kennedy is written as Kennedy, J.H.
Zakri Bin Ghazalli is written as Ghazalli, Z.
Mohd Shahrir Bin Mohd Sani is written as Mohd Sani, M.S.

4.1.2 Titles of Publication

Use capital letter for the initial letter of the title and the rest of the title should be in lower case. In case of having abbreviation or acronym in the title, capital letter can be used for that. Moreover, if a proper name includes in the title, capital letters should be used only for the initial letter of the name.

For example,

… 2007. Environmental management issues in Malaysia. ….

English publications with titles beginning with “The” are listed in alphabetical order according to the first letter of the word after it.

4.2 STYLES OF WRITING REFERENCES

(a) References should be listed in alphabetical order:

Ali, I. 2006. …
Ismail, F. 2004. …
Mohammed, S. 2001. …
Sharifah, H.S. 1995. …
Zakri, A.H. 2007. …

(b) The publication of an individual author is listed before another publication in which the same author is the first writer and both publications are in the same year.
Mohd Sani, M.S. 2006. …
Mohd Sani, M.S. and Rahman, M.M. 2006. …

(c) In the case of publications in which one author is the first author and the second and third author are different, the works are listed according the alphabetical order of the names of the second author and third, and so on.

(d) Single author entries by the same author are arranged by year of publication, the earliest should be placed in the first citation.
Rahman, M.M. 2003. …
Rahman, M.M. 2007. …

(e) References by the same author (or by the same two or more authors in the same order) with the same publication year are arranged alphabetically by the title that follows the date. If the references with same authors published in the same year are identified as articles in a series (for example Part 1 and Part 2), order the references in the series order, not alphabetically by title. Lowercase letters a, b,c and so on are placed immediately after the year.

(f) Where two authors have the same family name, they are listed according to the alphabetical order according to the first initial.
Rahman, A. 2006. ...
Rahman, M.M. 2002. ...
Zakri, A. 2003. ...
Zakri, M.G. 2006. …
Zakri, M.Z. 2004. …

4.3 REFERENCES FOR BOOKS

The complete information required for a book is as follows:

1. **Author’s name**, fullstop
2. **Year of publication**, fullstop
3. **Title of book** (italics, sentence case), fullstop
4. **Editor, compiler, translator** (if indicated), fullstop
5. **Name of series, volume number, series number** (where relevant), fullstop
7. **Volume number** (bold), fullstop
8. **Place of publication**, colon
9. **Publisher**, fullstop

1. Name of all co-authors must be listed
2. If published in more than one place, use the place that is named first

For example,


Examples of listing the books referred to are given in Sub-section 4.3.1 to 4.3.6.

4.3.1 Single Author


**Note:**
The second and subsequent lines are typed single-spaced and indented 12.7 mm from left margin.

### 4.3.2 Multi-authors


**Note:**
Names of all authors must be listed. Initials appear after the name without any extra space.

### 4.3.3 New Editions and Reprints


4.3.4 Work that are known by the Titles


4.3.5 Edited Work/Compilations


4.3.6 References with Corporate Authorship


4.4 REFERENCES FOR JOURNALS

The complete information required for a journal articles are as follows:

**Author’s name**, fullstop

**Year of publication**, fullstop

**Title of article** (sentence case), fullstop

**Name of Journal** (*Italics, Title case*), fullstop

**Volume number**, (bold)

**Issue Number** (within parentheses, no bold), colon

**Page Numbers**, fullstop
Volume number must be in Arabic numeric.

Examples of listing the journal articles referred are given in Sub-section 4.4.1 to 4.4.2.

4.4.1 Single Author


4.4.2 Multi-authors


Note

All authors should be listed. Initials positioned after the name with a comma and put the word “and” before last author name.
4.5 REFERENCES FOR PROCEEDINGS

The complete information required for journal articles are as follows:

Author’s name, fullstop
Year of publication, fullstop
Title of article (sentence case), fullstop
Name of Conference/Seminar/Symposium (Italics, Title case), comma
Volume number, (bold, if any)
Issue Number (within parentheses, no bold), colon
Page Numbers, fullstop

Note:
All authors should be listed. Initials positioned after the name with a comma and place the word “and” before last author name.

For example,


4.6 REFERENCES FOR PUBLIC DOCUMENTS

The complete information required for referring the public documents as follows:

- **Country(or State)/Institution,** fullstop
- **Year of Publication,** fullstop
- **Document referred to** (include relevant details in italic), fullstop

Examples of listing public documents referred to are given in Sub-section 4.6.1 and 4.6.2.

4.6.1 Parliament and State Assembly

(i) Parliament and State Assembly

*Acts of parliament*


*Reports and Documents*


*Parliament Debates*

(ii) Government Publications (Federal, State)

Federal Government Gazettes


State Government Gazettes


Federal Government Reports


(iii) Committee Reports


4.6.2 Documents of International Organizations

(i) United Nations


(ii) UNESCO


(iii) IAEA


(iv) WHO


4.7 REFERENCES FOR MAGAZINES

The complete information required for referring the magazines as follows:

Author’s name, fullstop
Year of publication, fullstop
Title of article (sentence case), fullstop
Name of magazine (*Italics, Title case*), comma
Month of publication, colon
Date of publication, fullstop

For example,

4.8 REFERENCES FOR NEWSPAPERS

The complete information required for referring the newspapers as follows:

Author’s name, fullstop
Year of publication, fullstop
Title of article (sentence case), fullstop
Name of Newspaper (Italics, Title case), fullstop
Date and Month of publication, colon
Page Numbers, fullstop

Examples of listing the newspaper referred are given section 4.8.1 and 4.8.2.

4.8.1 With Author’s Name


4.8.2 Without Author’s Name

The title of the article should be placed before the year of publication.

For example,


4.9 NEWS REPORTS FROM NEWSPAPERS

The complete information required for referring the news reports from the newspapers as follows:

Author’s name, fullstop
Year of publication, fullstop
Title of article (sentence case), fullstop
4.9.1 News/article with Author’s Name


4.9.2 News/article without Author’s Name


4.9.3 Letters to the Editor


4.10 GENERAL REFERENCES TO NEWSPAPERS

The complete information required for general references to the newspapers as follows:

- **Name of Newspaper** (*Italics, Title case*), fullstop
- **Year of publication**, fullstop
- **Date and Month of publication**, fullstop

For example,


New Straits Times. 2006. 10 December.
4.11 REFERENCES FOR FILM, VIDEO AND SLIDES

4.11.1 Films

The complete information required for referring a film is as follows:

Title of film (sentence case, italics), fullstop
Year of production, fullstop
Type of film, (for example, film or documentary drama), fullstop
Origin of film, colon
Name of production House/Company, fullstop

For example,


4.11.2 Videos

The complete information required for referring a video is as follows:

Title of video (sentence case, italics), fullstop
Year of production, fullstop
Type of video, fullstop
Origin of video, colon
Name of production House/Company, fullstop

For example,

4.11.3 Slides

The complete information required for referring a slide is as follows:

- **Author's name**, fullstop
- **Year of production**, fullstop
- **Title of slide** (sentence case, italics), fullstop
- **Type of slide**, fullstop
- **Origin of slide**, colon
- **Name of production House/Company**, fullstop

For example,


4.12 REFERENCES FOR MAPS

The complete information required for referring a map is as follows:

- **Author's name**, fullstop
- **Year of production**, fullstop
- **Title of map** (sentence case, italics), fullstop
- **Scale of the map**, fullstop
- **Place of publication**, colon
- **Name of publisher/Company**, fullstop

For example,

4.13 UNPUBLISHED MATERIALS

Examples of listing the unpublished materials referred to are given in Section 4.13.1 to Section 4.13.4.

4.13.1 Thesis

The complete information required for referring a thesis is as follows:

Author’s name, fullstop
Year of publication, fullstop
Title of thesis (italic, sentence case), fullstop
Type of the thesis, fullstop
Place (institute, town, state) where thesis is kept, comma
Country, fullstop

For example,


4.13.2 Working Paper and Abstract for Conference

The complete information required for referring the working paper and abstract for conference is as follows:

Author’s name, fullstop
Year of publication, fullstop
Title of article, fullstop
Type of the documents, fullstop
Name of the conference/seminar/symposium, fullstop
Place of conference/seminar/symposium, colon
Date and month, fullstop

For example,


4.13.3 Technical Reports

The complete information required for referring the technical reports is as follows:

Author’s name, fullstop
Year of publication, fullstop
Title of report, fullstop
Type of the report, fullstop
Place, colon
Identification number, fullstop
Collection number, fullstop

For example,

4.13.4 Interview

The complete information required for referring the interviews is as follows:

Author's name, full stop
Year of interview, full stop
Title of interview, full stop
Place of interview, full stop
Interview, colon
Date and month of interview, full stop

For example,


4.14 ELECTRONIC REFERENCES

Generally, references from the electronic sources for instance CD-ROM, internet, websites, electronic journals and electronic mail should provide the following information:

Name of author, full stop
Year, full stop
Title of article, full stop
Name of journal/book (italics)
Volume Number (bold)
Issue number (within parentheses), colon
Page Numbers, full stop
Website/file/e-mail address, comma
Date of access (within parentheses)

However, the information may be adjusted if necessary, without affecting the validity of the reference materials.
For example,


4.15 REFERENCES WITHIN THE TEXT

References in the body of the text are made to acknowledge the source of writing which is taken from other books, articles or papers. The complete bibliographical details are recorded in the list of references at the end of the thesis. The references cited in the text should be indicated using the **AUTHOR-YEAR** system. In this system, references within the text must include only the **Author** and **Year** of publication. Examples of citation in the text are given in Subsection 4.15.2- 4.15.5.

4.15.1 Single Author

The surname of the author followed by the year of publication is written in the relevant place in the text. If the name of the author is written as a part of a sentence, the year published should be written in parentheses.
(i) Noor (2007) has stated that 

(ii) ... as has been carried out by Mohd Sani (2008).

(iii) In a study on the teaching and learning of mechanical engineering (Rahman, 2008) ....

(iv) In a study on the teaching and learning of mechanical engineering, Mohd Sani (2007) expressed the view that ... . Mohd Sani also said that ....

If the author’s name is used as part of the sentence, as examples (i) and (ii), only the year is within the parentheses. If it is not, both the author’s name and year of publication, with a comma in between are placed within the parentheses (refer to example (iii)).

If the same source is referred to more than once within the same paragraph, the year of publication does not need to be repeated as there is no possibility of confusion with another work by the same author (refer to example (iv)).

4.15.2 Multi-authors

Where the work of two authors is referred to, then both names must be mentioned each time it is referred to:

(i) As Rahman and Rosli (2008) carried out their study ....

(ii) As has been proven (Rahman and Ariffin, 2006).

If the reference is made to a work authored by more than two, the name of the first author is written followed by “et al.” and the year of publication is typed after a comma.

(i) Rahman et al. (2006) has proposed that ....

(ii) ... has been studied (Kadirgama et al., 2005).
4.15.3 Corporate Author

Corporate authors are usually spelled out each time they appear in a text citation. The names of some corporate authors are spelled out in the first citation and abbreviated thereafter. Nevertheless, references to works by an organisation are written as follows:

(i) Ministry of Higher Education (MOHE, 2005)
(ii) Institute of Engineers, Malaysia (IEM, 1969) …
(iii) The name of institution (organizations, government agencies and other can be abbreviated:

National Institute of Mental Health (NIMH, 2006) is referred to the first citation and as NIMH (2006) for subsequent text citation.

Jawatankuasa Tetap Bahasa Malaysia (JKTBM, 1979) is referred to as JKTBM (1979).

4.15.4 Authors with Same Name

If the list of references includes works by two or more authors with the same name, to avoid confusion, the full name or initials of each author must be used each time one of these works cited.


4.15.5 Multiple References

Two or more references made at the same place should be separated by semicolons. Then, the word “and” should be placed before the last author’s name.
For example,

( Mohd Sani, 2004; Rejab, 2005 and Rahman et al. 2007)

(Noor, 2006; Rahman et al. 2006, and Ariffin and Rahman, 2007)

If more than one reference materials by the same author in the same year are cited, use small letter of alphabets (a, b, c and so on separated by comma) to distinguish them. The suffixes are assigned in the reference list, where references are in alphabetical order by the title.

(Rahman et al., 2003a, b, 2004)
Several studies ( Rejab, 2006a, b; Rahman, 2008 and Kadirgama et al., 2009)

List two or more works by different authors which have been cited within the same parentheses in alphabetical order by the first authors surname. Separate the citations by semicolons.

Several studies (Noor, 1998; Rahman et al., 2000, and Rahman and Rejab, 2008)

Cross referencing is not allowed in a thesis. Only primary sources should be used.

Note: Foot notes can be used to make immediate clarification.

4.16 REFERENCES FOR THE AL-QUR’AN

The number of verses used and quoted from the Al-Qur’an should be placed at the end of the text. The reference should indicate the Qur’an, the chapter and the number of verse, for example, Al-Qur’an, Al-Imran 3: 92.
4.17 REFERENCES FOR THE AL-HADITH

References to the hadith are specific collections indicated by the number or name of the book (kitab) and the chapter where it appears, for example, Al-Bukhari, Sahih, Kitab 1, Chap 1: page number, City: Publisher.

4.18 ABBREVIATIONS IN REFERENCE LIST

Accepted abbreviations in the reference list for parts of books and other publications are listed in Table 4.1.

Table 4.1: Abbreviations in the reference of books and other publications

<table>
<thead>
<tr>
<th>Description</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter</td>
<td>Chap.</td>
</tr>
<tr>
<td>Edition</td>
<td>ed.</td>
</tr>
<tr>
<td>Revised edition</td>
<td>Rev. ed.</td>
</tr>
<tr>
<td>Second edition</td>
<td>2nd ed.</td>
</tr>
<tr>
<td>Editor (Editors)</td>
<td>Ed. (Eds.)</td>
</tr>
<tr>
<td>Translator(s)</td>
<td>Trans.</td>
</tr>
<tr>
<td>No date</td>
<td>n.d.</td>
</tr>
<tr>
<td>Page (pages)</td>
<td>p. (pp.)</td>
</tr>
<tr>
<td>Supplement</td>
<td>Suppl.</td>
</tr>
</tbody>
</table>
CHAPTER 5
UNITS, NUMBERS, QUANTITY AND FUNCTIONS

5.1 UNITS

Use internationally recognized units of measure such as System International (SI). Units should be written numerically not in words, for example, 5 m instead of five meters unless if they are the first word of a sentence. Use abbreviated form of units, for example, 5 sec instead of 5 seconds or 5 m instead of 5 meters. The unit of measurement should be clearly separated from the corresponding numerical value by a standard single space, for example, 4 m instead of 4m, 5 sec instead of 5second, 5 kg rather than 5kg. The abbreviation for kilo is k not K and centimeter is cm not c.

Units that are named after a person should be written as follows:

5 Newton should be 5 N
5 Joule should be 5 J

The use of units should be consistent, for example 5 N/m$^3$ or 5 Nm$^{-3}$, or 45 m/sec or 45 m per sec.

Do not place a full stop after a unit except when it is at the end of a sentence. There are no plural forms for abbreviations of units, for example, 5 cm instead of 5 cms.

5.2 NUMBERS

Numerical (quantitative) information plays a key role in much scientific writing. It is essential that candidates should carefully check every piece of reported data to guarantee the absence of errors including typographical mistakes. This requires devoting particularly close attention to tables and figures. All integers less than ten should be spelt out unless they are attached to units of measure, for example, 5 kg,
15 mL. Use the figures of the number if the integer is more than and equals to 10. If a sentence begins with a number or symbol, it should be written in words or change the sentence structure or order. Use numerals for a series of figures, for example,

(i) In a lecture room, there are 50 chairs, 55 tables, 3 white boards and 15 umbrellas.
(ii) The numbers of frequency were selected in this study including 50, 100, 150, 200, 250 and 300 Hz.

The zero should be included in numbers written as decimals, for example, 0.4 m instead of .4 m. Decimal numbers should be clearly distinguished. Date should be written without a comma, for example, 31 August 2007. A range is most frequently signaled with the assistance of a dash, for example, the period of time should be written as 1993-2000, 2003-07.

Numbers up to the four digits should be written without a comma or space between them. Numbers larger than four digits should be written with a space before each set of three digits, for example, 213 000, 21 000 000, 252 000 000. Numbers written as decimals have spaces like this: 0.001, 0.000 05, 35 321.062 42.

5.3 QUANTITY OR VARIABLE

Specificity can be conferred on a letter symbolising a quantity or variable by attaching one or more qualifying subscripts and/or superscripts to it. Sometimes, it can be crowned with a “hat” in the form of a straight line or other distinctive mark.

For example,

(i) \( C_p \) (both italicized) is used to represent the heat capacity \( (C) \) at constant pressure, \( p \)
(ii) \( g_n \) (g italicized, n normal) represents for the acceleration due to earth’s gravitational force, \( g \), while the “n” here signifies “normal”.
A clear explanation should be supplied when any symbol makes its first appearance in a document. In addition, it is strongly recommended that all symbols presented in the text especially those representing quantities, be meticulously defined in a separate “List of Symbols”. The list must identify applicable units of measurement and should be positioned near the beginning of the work.

For examples,

\[ C_L \text{ liquid phase specific heat, } J \text{ kg}^{-1} \text{ K}^{-1} \]
\[ D \text{ diameter, m etc.} \]

(iii) An expression of a measurement as the product of a numerical value and a unit, candidates should adjust the unit to a suitable prefix. Thus resulting the numerical value fall between 0.1 and 1000. In other words, it is better to write 30 µL rather than the equivalent 0.030 mL.

(iv) A single blank space is used to separate a pair of unit symbols. It is done to represent a product, for example, 80 A s, 34 N m, 10\(^{-3}\) g/(m\(^2\) d).

5.4 SUBSCRIPTS AND SUPERSCRIPTS

The subscripts and superscripts should be set in type roughly 3/5 the size of the corresponding host symbol. In the other words, 7 or 8 pt font would be an appropriate choice to indicate associated symbol displayed in 12 pt type. Subscripts and superscripts belong immediately adjacent to the symbols they are intended to modify. In the case of chemical formulas for charged particles (ions), one of the latter typographic solutions is actually deemed preferable, for example, \( \text{NH}_4^+ , \text{SO}_4^- \). Multiple subscripts that apply simultaneously to a single host symbol would logically appear at the same level vertically. Potential confusion can be prevented by carefully spacing of the collaborating elements or through intervening commas or careful use of parentheses, for example, \( \chi_{n\text{max}} \) is better replaced by \( \chi_{n(\text{max})} \). Now-a-day, the favor practice for typesetting the chemical expression is to consign all formulas to the normal text.
baseline, even ones that are intended to function as indices, in other words, the arrangement, c(H2SO4) is preferred over C_{H2SO4}.

Table 5.1 provides a summary of the most important expressions and formulae.

**Table 5.1:** Basic rules applicable to expressions of mathematical and physical kind.

<table>
<thead>
<tr>
<th>Authorized stylistic treatment</th>
<th>Illustrations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Italic (sloped) type</strong></td>
<td></td>
</tr>
<tr>
<td>Mathematical variables</td>
<td>a, b, c, x, z, A, B, α, β, γ, δ</td>
</tr>
<tr>
<td>Symbols for physical quantities</td>
<td>m, l, t, T</td>
</tr>
<tr>
<td>Symbols for general functions</td>
<td>f(x) = u(x)/v(x), z = q(x,y)</td>
</tr>
<tr>
<td>Symbols for natural constants</td>
<td>R (ideal gas constant), N_A (Avogadro’s number)</td>
</tr>
<tr>
<td><strong>Roman (Upright) type</strong></td>
<td></td>
</tr>
<tr>
<td>Numbers</td>
<td>1, 2, 3, 2005, π, e</td>
</tr>
<tr>
<td>Fences</td>
<td>( ), { }, [ ]</td>
</tr>
<tr>
<td>Operators</td>
<td>d, D, Δ, ∇, (\partial), %, ppm, ppb, ppt, (\frac{df}{dx}), (\frac{\partial g(x,y)}{\partial x})</td>
</tr>
<tr>
<td>Operational symbols</td>
<td>+, -, :, =, &lt;, &gt;, (\neq), (\in), (\Rightarrow), (\not\in), AND, OR</td>
</tr>
<tr>
<td>Symbols for special functions</td>
<td>exp, log, ln, log, sin, cos, tan, Re, Im cos x, exp(-x^2), Re(z) = a+ib,</td>
</tr>
<tr>
<td>Unit symbols</td>
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<td>Unit prefixes</td>
<td>G, M, k, m, μ, n, p, nm, GHz, mbar</td>
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<td>15.7 %, 0.5 %, 25 ppm</td>
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</tbody>
</table>

Symbols for vectors and matrices are to be displayed in **boldface** italic type.

For examples,

\[ B = b_1e_1 + b_2e_2 \]

\[ B = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 1 & 0 \\ 3 & 0 & 1 \end{pmatrix} \]
\( F \) (force), \( E \) (electric field strength)

An appropriate quantity symbol topped with a small arrow (for example, \( \vec{a}, \vec{F}, \vec{E} \)) is no longer recommended. Another rule with respect to type states that the tensors should be represented by roman, boldface characters (no italic), for example, \( A, B, C \).

5.5 MISCELLANEOUS CONVENTIONS

(i) The shorten form of person’s name should be written with a space after the initials, for example, M.M. Rahman not M.M.Rahman.

(ii) Abbreviations have no full stops after each letter, for example, UMP, CGS, ASME etc.

(iii) Elliptical marks consists of three dots (…) either linear or vertical direction. When an ellipsis comes at the end of the sentence, it appears as four dots (…). One dot marks the end of the sentence.

(iv) A single blank space should be inserted between the numerical value and the symbol used to indicate percentage as well as in conjunction with the related expressions ppm (parts per million), ppb (parts per billion) and ppt (parts per trillion), for example, 34 % 0.2 %, 30 ppm, 0.06 ppb.

(v) The symbol combination “°C” is considered a single discrete entity with the meaning “degree Celsius”. It should be set one space removed from the associated numerical value, for example, 135 °C (not 135°C or 135° C). The rule is also applied to the symbols for angular minutes and angular seconds, for example 15.4’, 20’35.2”.

(vi) Information related to error limits or tolerances should be conveyed using a notation like (150 ± 10) mm not the commonly encountered.
REFERENCES

This guide is prepared based on the following references;


APPENDIX A1
SAMPLE OF FRONT PAGE (COVER PAGE)

FINITE ELEMENT BASED DURABILITY ASSESSMENT FOR A NEW FREE PISTON LINEAR ENGINE

ABDUL RAHMAN BIN ABDUL KARIM

NAME OF DEGREE

UNIVERSITI MALAYSIA PAHANG

Edge of the A4 paper
APPENDIX A2
SAMPLE OF THE SPINE

Spine

NAME OF STUDENT PHD/ENG. (MECH) 2008 UMP
(20 gold-coloured font)

Top of the cover page

APPENDIX A3
Example of thesis status validation form

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<th>(Student's Signature)</th>
<th>(Signature of Supervisor)</th>
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</thead>
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<th>New IC / Passport Number</th>
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</tr>
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APPENDIX A3

Example of a thesis status declaration letter

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Sir,

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(ii)
(iii)

Thank you.

Sincerely yours,

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Note: this letter should be written by the supervisor, addressed to Perpustakaan Universiti Malaysia Pahang and a copy attached to the thesis.
APPENDIX A5
SAMPLE OF STATEMENT OF AWARD FOR DEGREE

1. **Doctor of Philosophy**

   Thesis submitted in fulfilment of the requirements for the award of the degree of Doctor of Philosophy (specialisation).

2. **Master of Engineering (by Research)**

   Thesis submitted in fulfilment of the requirements for the award of the degree of Master of Science/Master of Engineering in … … … … … (Specialisation).

3. **Master of Engineering (by Coursework)**

   Thesis submitted in partial fulfilment of the requirements for the award of the degree of Master of Science/Master of Engineering … … … (Specialisation).

4. **Bachelor Final Year Project Report**

   Report submitted in partial fulfilment of the requirements for the award of the degree of Bachelor of … … … … … (Specialisation).
APPENDIX A6
SAMPLE OF SUPERVISOR’S DECLARATION

SUPERVISOR’S DECLARATION

I/We* hereby declare that I/We* have checked this thesis/project* and in my/our* opinion, this thesis/project* is adequate in terms of scope and quality for the award of the degree of *Doctor of Philosophy/Master of Engineering/Master of Science in ... ... ... ... ... ... ... ... (specialisation) or Bachelor of ... ... ... ... ... ... ... ... (Specialisation).

Signature
Name of Supervisor: 
Position: 
Date: 

Signature
Name of Co-supervisor: 
Position: 
Date:

*Delete if unnecessary
APPENDIX A7
SAMPLE OF STUDENT'S DECLARATION

STUDENT'S DECLARATION

I hereby declare that the work in this thesis/project* is my own except for quotations and summaries which have been duly acknowledged. The thesis/project* has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature : 
Name : 
ID Number :  Upper case, no bold face
Date : 

*Delete if unnecessary

3 × ENTER (1.5 line spacing)
APPENDIX A8
SAMPLE OF DEDICATION

Dedicated to my parents
ACKNOWLEDGEMENTS

I am grateful and would like to express my sincere gratitude to my supervisor, Professor X for his/her germinal ideas, invaluable guidance, continuous encouragement and constant support in making this research possible. He has always impressed me with his outstanding professional conduct, his strong conviction for science, and his belief that a PhD program is only a start of a life-long learning experience. I appreciate his consistent support from the first day I applied to graduate program to these concluding moments. I am truly grateful for his progressive vision about my training in science, his tolerance of my naïve mistakes, and his commitment to my future career. I also would like to express very special thanks to my co-supervisor Professor Y for his/her suggestions and co-operation throughout the study. I also sincerely thanks for the time spent proofreading and correcting my many mistakes.

My sincere thanks go to all my labmates and members of the staff of the Mechanical Engineering Department, UMP, who helped me in many ways and made my stay at UMP pleasant and unforgettable. Many special thanks go to member engine research group for their excellent co-operation, inspirations and supports during this study.

I acknowledge my sincere indebtedness and gratitude to my parents for their love, dream and sacrifice throughout my life. I acknowledge the sincerity of my parents-in-law, who consistently encouraged me to carry on my higher studies in Malaysia. I am also grateful to my wife, daughter and son for their sacrifice, patience, and understanding that were inevitable to make this work possible. I cannot find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to attain my goals. Special thanks should be given to my committee members. I would like to acknowledge their comments and suggestions, which was crucial for the successful completion of this study.
APPENDIX A10
SAMPLE OF ABSTRACT

ABSTRACT

This thesis deals with durability assessment for new two-stroke free piston linear engine components using variable amplitude loadings. The objective of this thesis is to develop the general procedures for durability assessment and optimization of safety-critical free piston engine components. The thesis describes the finite element analysis techniques to predict the fatigue life and identify the critical locations of the components. Forged steel, cast iron, and a set of aluminium alloys materials were studied in this thesis which commonly used in industry. The structural three-dimensional solid modeling of free piston engine was developed using the computer-aided drawing software. The strategy of validation of finite element model was developed. The finite element analysis was then performed using MSC.NASTRAN code. The finite element model of the components was analyzed using the linear elastic and frequency response approaches. Finally, the stress-strain state of the components and frequency of the stresses obtained previously are employed as input for the fatigue life. From the results, it is observed that the analysis using Goodman mean stress correction method yields more conservative life prediction. The acquired results utilizing the strain-life method indicate that when the loading sequences is predominantly tensile in nature, the SWT and the Morrow models give shorter life than that the results obtained using the Coffin-Manson model. However, the Coffin-Manson method gives conservative prediction when the time histories are predominantly compressive, and zero mean stress loadings. The obtained results indicate that the nitride treatment produces the longest life. The results concluded that the polished surface finish conditions give the highest life. Therefore, the nitriding process is the promising surface treatments for the aluminium alloy parts to increase the fatigue life of the linear engine components. The durability assessment results are significant to improve the component design at the early developing stage. The results can also significantly reduce the cost and time to market, and improve product reliability and customer confidence.
ABSTRAK

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APPENDIX A15
SAMPLE OF LIST OF SYMBOLS

LIST OF SYMBOLS

\( \omega \) Natural frequency
\( \varepsilon \) Total strain, Bandwidth parameter
\( \varepsilon_a \) Strain amplitude
\( \varepsilon_f \) True fracture ductility
\( \varepsilon'_f \) Fatigue ductility coefficient
\( \sigma \) True stress, local stress
\( \Delta \sigma \) Stress range
\( \sigma_a \) Local stress amplitude
\( \sigma_m \) Local mean stress
\( \sigma_{max} \) Local maximum stress
\( \sigma_f \) True fracture strength
\( S_f \) Fatigue strength
\( S'_f \) Fatigue strength coefficient
## APPENDIX A16
### SAMPLE OF LIST OF ABBREVIATIONS

#### LIST OF ABBREVIATIONS

<table>
<thead>
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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AA</td>
<td>Aluminum alloy</td>
</tr>
<tr>
<td>A-A</td>
<td>ASTM air to air typical fighter loading</td>
</tr>
<tr>
<td>Al</td>
<td>Aluminium</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>CAD</td>
<td>Computer-aided drafting</td>
</tr>
<tr>
<td>CAE</td>
<td>Computer-aided engineering</td>
</tr>
<tr>
<td>DOF</td>
<td>Degree-of-freedom</td>
</tr>
<tr>
<td>DTP</td>
<td>Discretized turning point</td>
</tr>
<tr>
<td>FE</td>
<td>Finite element</td>
</tr>
<tr>
<td>FFT</td>
<td>Fast Fourier transform</td>
</tr>
<tr>
<td>FRF</td>
<td>Frequency response function</td>
</tr>
<tr>
<td>IC</td>
<td>Internal combustion</td>
</tr>
<tr>
<td>LG</td>
<td>Linear generator</td>
</tr>
<tr>
<td>MBD</td>
<td>Multibody dynamics</td>
</tr>
<tr>
<td>PDF</td>
<td>Probability density function</td>
</tr>
<tr>
<td>PSD</td>
<td>Power spectral density</td>
</tr>
<tr>
<td>SAE</td>
<td>Society of Automotive Engineers</td>
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</table>
2.1 INTRODUCTION

The purpose of this chapter is to provide a review of past research efforts related to internal combustion engine, free piston engine, finite element analysis, durability assessment models and surface treatment on the fatigue life. A review of other relevant research studies is also provided. Substantial literature has been studied on stress history computation, fatigue life prediction, and durability analysis of components of two-stroke free piston engine. The review is organized chronologically to offer insight to how past research efforts have laid the groundwork for subsequent studies, including the present research effort. The review is detailed so that the present research effort can be properly tailored to add to the present body of literature as well as to justify the scope and direction of the present research effort.

2.2 INTERNAL COMBUSTION ENGINE (Main title: Upper case and bold)

2.2.1 Historical Perspective (sub-title: Title case and bold)

The IC engine was first realized in its modern form by Nikolaus Otto in 1867 (Heywood, 1988; Stone, 1999). The technology spread quickly, and by World War I, the internal combustion engine was ubiquitous in both the mobile and stationary applications.
With the advent of mass production, automobiles actuated by the chemical power plant entered the garages of middle class America. Around the world, fortunes were made and lost by those who made automobiles, fuels, tires, and all the other things necessary for peoples’ new found mobility. In the manufacturing and power generation, these sources of mechanical energy were also common. Such uses include air compressors, power equipment, electrical generators, and, of course, all types of transport vehicles. The remarkable versatility of the IC engine has been due to its inherent simplicity, favorable power-to-weight ratio, and exceptional ruggedness (Heywood 1988). Figure 2.1 presents an illustration of one of these crankshaft driven machines.

![Crankshaft Driven IC Engine](image)

**Figure 2.1:** An illustration of a conventional crankshaft driven IC engine

Source: Heywood 1988

**2.2.2 Classification of Internal Combustion Engines**

There are many ways in which internal combustion engines may be classified (Heywood, 1988; Dawson, 1998). However, if the limit of the scope to geometries involving reciprocating pistons, two broad distinctions are of special importance.
The force balance to the crank engine piston in the x direction is expressed as in Eq. (2.3)

\[
\sum F_x = m \frac{d^2 x}{dt^2} - P_c A_c - F_f \cos \beta
\]

(2.3)

Table 2.1 are listed the materials properties of the materials used in this study

<table>
<thead>
<tr>
<th>Materials properties</th>
<th>MANTEN</th>
<th>RQC100</th>
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</thead>
<tbody>
<tr>
<td><strong>Monotonic Properties</strong></td>
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<td></td>
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<tr>
<td>Young’s modulus, E, GPa</td>
<td>203.4</td>
<td>203.4</td>
</tr>
<tr>
<td>Ultimate tensile strength, ( S_u ), MPa</td>
<td>552</td>
<td>863</td>
</tr>
<tr>
<td><strong>Cyclic and Fatigue Properties</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatigue strength coefficient, ( \sigma_f' ), MPa</td>
<td>917</td>
<td>1158</td>
</tr>
<tr>
<td>Fatigue strength exponent, ( b )</td>
<td>-0.095</td>
<td>-0.075</td>
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<tr>
<td>Fatigue ductility coefficient, ( \varepsilon_f' )</td>
<td>0.26</td>
<td>1.06</td>
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<tr>
<td>Fatigue ductility exponent, ( c )</td>
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<td>Fatigue strength, ( S_f @ 10^8 ) cycles, MPa</td>
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<tr>
<td>Cyclic strength coefficient, ( K' ), MPa</td>
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<tr>
<td>Cyclic strain hardening exponent, ( n' )</td>
<td>0.19</td>
<td>0.10</td>
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</table>

Source: Rahman (2007)

The SAE keyhole was modeled using the MSC.PATRAN and analyzed utilizing the MSC.NASTRAN, the finite element analysis code.
### APPENDIX C1

#### SAMPLE OF TABLE

Table 6.5: Monotonic and cyclic properties of the MANTEN and RQC100 materials

<table>
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<td>863</td>
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<tr>
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<td>Cyclic strain hardening exponent, $n'$</td>
<td>0.19</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Source: Juvinall and Marshak (2000)
### APPENDIX C2

**SAMPLE OF LANDSCAPE TABLE**

**Table 6.12:** Predicted fatigue life using the biaxiality correction method

<table>
<thead>
<tr>
<th>Loading conditions</th>
<th>Predicted Life in seconds at critical location (at node 49360) (\times 10^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2014-T6</td>
</tr>
<tr>
<td>SAETRN</td>
<td>42.7</td>
</tr>
<tr>
<td>SAESUS</td>
<td>50.1(\times 10^3)</td>
</tr>
<tr>
<td>SAEBKT</td>
<td>496</td>
</tr>
<tr>
<td>I-N</td>
<td>264</td>
</tr>
<tr>
<td>A-A</td>
<td>59.9</td>
</tr>
</tbody>
</table>
### APPENDIX C3

SAMPLE OF CONTINUOUS TABLE

**Table 6.5**: Continued

<table>
<thead>
<tr>
<th>Materials properties</th>
<th>MANTEN</th>
<th>RQC100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress range intercept, SRII, MPa</td>
<td>3162</td>
<td>4680</td>
</tr>
<tr>
<td>Slope, b1</td>
<td>-0.2</td>
<td>-0.216</td>
</tr>
<tr>
<td>Transition life, NC1, cycles</td>
<td>$2 \times 10^8$</td>
<td>$2 \times 10^8$</td>
</tr>
<tr>
<td>Slope, b2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Standard error, SE</td>
<td>0.137</td>
<td>0.433</td>
</tr>
</tbody>
</table>
## APPENDIX C4

### SAMPLE OF LANDSCAPE CONTINUOUS TABLE

**Table 6.12:** Continued

<table>
<thead>
<tr>
<th>Loading conditions</th>
<th>Predicted Life in seconds at critical location (at node 49360) (\times 10^6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2014-T6</td>
</tr>
<tr>
<td>A-G</td>
<td>16.6</td>
</tr>
<tr>
<td>R-C</td>
<td>31.9</td>
</tr>
<tr>
<td>TRANSP</td>
<td>(19.5\times10^2)</td>
</tr>
</tbody>
</table>
Figure 6.8: SAE keyhole specimen in millimeters

Source: Bannantine et al. (1990)
APPENDIX D2
SAMPLE OF LANDSCAPE FIGURE

Figure 5.3: Time-loading histories of narrow and wide band signals
APPENDIX D3
SAMPLE OF CONTINUOUS FIGURE

Figure 6.8: Continued