

**THESIS MANUAL FOR THE M.TECH. PROGRAM**

Indian Institute of Technology Patna

**CONTENTS**

1. [GUIDELINES FOR PREPARING AND SUBMITTING M. TECH.](#_bookmark0) [THESIS 3](#_bookmark0)
   1. [General Instructions 3](#_bookmark1)
   2. [Title of the THESIS and Title page format 3](#_bookmark2)
   3. [Statement of THESIS Approval Page 4](#_bookmark3)
   4. [BODY OF THE THESIS 6](#_bookmark4)
      1. [References 6](#_bookmark5)
   5. [Tables and Figures 6](#_bookmark6)
      1. [Order of Tables and Figures 6](#_bookmark7)
      2. [Table and Figure Placement 7](#_bookmark8)
   6. [Page Numbering 7](#_bookmark9)
   7. [Tips for Good Writing 7](#_bookmark10)
      1. [Continuity of Ideas 7](#_bookmark11)
      2. [Proper Usage of Verbs and Tenses 7](#_bookmark12)
      3. [Mathematical Symbols 8](#_bookmark13)
      4. [Units of Measurement 8](#_bookmark14)
      5. [A Sample of Common Mistakes 10](#_bookmark15)
      6. [Common Errors in Writing 10](#_bookmark16)
   8. [The Overriding Rule 12](#_bookmark17)
2. [GENERAL INFORMATION AND INSTITUTE REGULATIONS 13](#_bookmark18)
   1. [Objectives 13](#_bookmark19)
   2. [Features 13](#_bookmark20)
   3. [Institute Regulations 14](#_bookmark21)
   4. [Topic approval 14](#_bookmark22)
   5. [Publication of thesis involving Publication, Patents and](#_bookmark23) [restricted data 14](#_bookmark23)
   6. [Approval requirement 14](#_bookmark24)
   7. [Copyright 14](#_bookmark25)
   8. [Avoiding infringement 15](#_bookmark26)
   9. [Citation of Web-accessed Information 15](#_bookmark27)
3. [CONTENT AND ORGANIZATION OF THESIS TEXT 16](#_bookmark28)
   1. [Thesis size 16](#_bookmark29)
   2. [Paper Quality 16](#_bookmark30)
   3. [Paper size 16](#_bookmark31)
   4. [Double-sided printing 17](#_bookmark32)
   5. [Non paper material 17](#_bookmark33)
   6. [Page numbering 17](#_bookmark34)
   7. [Binding 18](#_bookmark35)
   8. [FONT 18](#_bookmark36)
   9. [Margins 18](#_bookmark37)
   10. [Line Spacing 18](#_bookmark38)
   11. [EQUATIONS 18](#_bookmark39)
   12. [Headers and Footers 19](#_bookmark40)
   13. [The Appendix or Appendices 19](#_bookmark41)
4. [THESIS TEMPLATE: DOCUMENTATION AND WRITING STYLE](#_bookmark42)

[20](#_bookmark42)

|  |  |  |  |
| --- | --- | --- | --- |
| [4.1.](#_bookmark43) | [ABOUT THE DOCUMENT THAT FOLLOWS](#_bookmark43) |  | [20](#_bookmark43) |
|  | Template for Thesis Title |  | 21 |
|  | Template for Dedication page |  | 22 |
|  | Template for Acknowledgements |  | 23 |
|  | Template for Certificate |  | 24 |
|  | Template for Declaration |  | 25 |
|  | Template for Table of Contents |  | 26 |
|  | Template for List of Tables |  | 28 |
|  | Template for List of Figures |  | 29 |
|  | Template for List of Symbols and Abbreviations |  | 30 |
|  | Template for Abstract | 31 |  |
|  | Template for first page of Chapter 1 |  | 32 |
|  | Template for first page of Chapter 2 |  | 33 |
|  | Style for References | 35 |  |
|  | List of Publication(s) of M. Tech. student |  | 36 |

1. [**PREPARATION AND SUBMISSION OF THESIS 37**](#_bookmark44)
   1. [Supervisory Committee and Final Reading Approval Forms 37](#_bookmark45)
   2. [Curriculum vitae 37](#_bookmark46)
   3. [Checklist before submitting the final copies of your thesis 37](#_bookmark47)
2. [**INDEX 39**](#_bookmark48)
3. **SUGGESTIVE GUIDELINES 41**

Chapter 1

# Guidelines for Preparing and Submitting M. Tech. Thesis

## General Instructions

1. The thesis must be printed on A4-size paper for distribution. The total number of pages of the thesis should not exceed 60-70 pages. This excludes the title page.
2. Hardcopy of the thesis must be submitted to the department at least a week prior to the probable date of examination. Softcopy and Hardcopy both are to be sent to the external examiner as well as the examiner internals within the same time frame.
3. After incorporating the suggestions made by the examiners on the day of examination, a copy of the modified thesis must be submitted with a certification from the advisor. This final copy of the thesis must be submitted to CET OFFICE through the M. Tech. program Coordinator/Advisor. A soft copy of the thesis must also be submitted on moodle portal along with the hard copy of the thesis.

## Title of the Thesis and Title page format

1. The title of a thesis should be a meaningful and a concise description of the research done by the student.
2. The title should be short (word limit - 10-15 words, in no case exceeding 20 words) and typed in block letters (All Caps). If title is longer than four inches, then title should be arranged in an inverted pyramid with double line spacing.
3. Formatting:

Font style : Times New Roman/Arial Font size : As indicated in sample page

Margin : 1.5 inches (from top, bottom, left and right) Justification : Centre

1. Thesis title should not contain symbols (including Greek symbols such as π, α, etc.), initials, formulas (including chemical formulas), subscripts, superscripts, numerical characters, acronyms or even abbreviations in brackets. Redundant words, such as "An investigation of .....", "A Study of .....", "Theory of ....", "Some ", "An

Experimental Investigation of ...", and "Toward a ”, should be avoided.

*Examples*

"The Effects of Ion Implantation and Annealing on the Properties of GeSi2 Films on Silicon Wafer Substrates" should be written as "The Effects of Ion Implantation and Annealing on the Properties of Germanium Silicide Films on Silicon Wafer Substrates."

"TEM" should be written as "Transmission Electron Microscopy" and should not be written as "Transmission Electron Microscopy (TEM)."

## Statement of Thesis Approval Page:

This page indicates that thesis has been approved by all DPPC members, who sign above their full legal name. The template for this is available in subsequent pages (pg – 5).

##### INDIAN INSTITUTE OF TECHNOLOGY PATNA

**Evaluation Committee Approval**

##### of a Thesis submitted by

Name of the student (in All CAPS)

The thesis of has been read, found satisfactory and approved by the following DPPC committee members.

Name : 1 , Supervisor Date :

Name : 2 , Co-Supervisor Date :

Name : 3 , Member Date :

Name : 4 , Member Date :

Name : 5 , Member Date :

Name : 6 , Member Date :

Name : 7 , Member Date :

## Body of the Thesis

The student is responsible for the way the text is organized. However, it should have title of all sections (e.g. Introduction, Review of Literature, Objectives and Scope, Results, Discussion of result, Conclusion, Contributions made by the scholar, and References) in capital letters and center justified. The text (in each section) begins after a triple space.

If the thesis contains text that is a reprint of a previously published report, a credit line “Reprinted with permission from” followed by source must be placed on the page.

Use MS Word Times New Roman/Arial (or LaTeX) with font size 12 and 1.5 line spacing for the text.

#### References

Use number reference citation system where numbers in the text are in superscript only. If several references are cited at once, then numbers are separated by comma. If reference number is to be mentioned at the end of a sentence, then the superscript number is placed outside the punctuation marks.

e.g. Many researchers6, 7, 11-19 disagree with the conclusions drawn by Feynman.20

The reference list is compiled (under reference section) in numerical order. No spacing between lines within a particular entry is present. However, a double space separates two references.

## Tables and Figures

When data are compiled in rows and columns, these are referred to as a “Table”. Tables should be used only when absolutely necessary. Figures include the diagrams, schemes (including chemical reactions), photos, maps, plots or other schematic/graphical representation.

The guideline for ordering, placement, numbering and assigning title (for tables) or caption (for figures) is same as that mentioned in the same as that for thesis. For reference, please consult the “Guidelines on the Preparation of a Thesis”.

#### Order of Tables and Figures

Tables and figures also must be referenced in order (i.e., Table 1, Table 2, Table 3, not Table 1, Table 3, Table 2). It is not acceptable to refer to Table 3 in the text before referring to Table 2. However, once a table has been referred to in the main text, it can

be mentioned again out of its sequential order. Each figure or table appears only once and cannot be repeated.

#### Table and Figure Placement

A large table or figure is placed by itself on the page, centered within the thesis margins. Although it is not necessary for large tables or figures to be centered precisely between the top and bottom margins of the page, tables and figures should be placed so that they look balanced on the page. Full-page tables or figures must be placed on the page immediately following the textual reference. Other guidelines pertaining to placement of tables and figures are same as that mentioned for writing the thesis manuscript (refer to pg 34 of this document).

## Page Numbering

The title page should not have a number printed on it. The page next to the title page should bear the page number 1. Page numbers should be printed centered at the bottom of each page.

## Tips for Good Writing

#### Continuity of Ideas

It is very important that there is a continuity of idea in your thesis. Few suggestions in this regard are mentioned below:

A particular paragraph should elaborate only one theme/idea. If there is a need to emphasize multiple themes, then it is suggested to name them in a single paragraph and subsequently discuss them in separate paragraphs.

There should be a smooth transition from one paragraph to the next paragraph. In order to do so, the first paragraph mentions the theme of the next paragraph.

#### Proper Usage of Verbs and Tenses

In order to have continuity, it is essential to use verb tenses judiciously and properly. Following suggestions may be useful in this context:

* + - 1. Past tense (e.g., "Bergman showed ... ") or present tense (e.g., "Newton has shown . . .") is appropriate for the literature review. This usage of verb tense may be applied for discussion on the past events.
      2. Results are best described by using past tense. e.g., "Expenditure increased at the rate of 10% per year.").
      3. Inorder to discuss results and draw conclusions, it is apt to use present tense. e.g., “The results of the experiment indicate ...”

#### Mathematical Symbols

Mathematical expressions must italicize all symbols used in them. A distinct look (to the mathematical expression) may be imparted by separating them from the text (both preceding and following it) by larger line spacing and an indentation should be given. Each equation must appear only after it has been referenced in the text.

#### Units of Measurement

Always use [International System of Units](http://en.wikipedia.org/wiki/International_System_of_Units) (SI) units. Follow the guidelines given below while using the SI units

* Symbols for units do not have an appended period/full stop (.) unless they appear at the end of a sentence. e.g., The length of the cube is 500 m and the breadth is only 0.01 m.
* Symbols for units are written in upright Roman type (m for meter, g for gram), so as to differentiate them from the italic type used for mathematical variables (*m* for mass, *g* for acceleration due to gravity).
* Symbols for units are *generally* written in lower case, except for symbols derived from the name of a person. e.g., the SI unit of frequency is named after [Heinrich Hertz](http://en.wikipedia.org/wiki/Heinrich_Hertz), so its symbol is "Hz" whereas its unit is "Hertz". Another common example is SI [unit of measurement](http://en.wikipedia.org/wiki/Units_of_measurement) for [temperature](http://en.wikipedia.org/wiki/Temperature) - Kelvin named after Lord Kelvin. It is denoted by unit symbol K. Other exceptions include petametre (1015 m; symbol = Pm) where the symbol has the first alphabet in upper case to differentiate it from [picometre](http://en.wikipedia.org/wiki/Picometre) (10−12 m; symbol = pm).
* The SI rule for pluralizing units is that symbols of units are not pluralized, for example "600 kg" (not "600 kgs").
* The number and the symbol of the SI unit are separated by a space (e.g., "32.451 kg", "9.3x104 m3”, "22 K"). Some notable exceptions are the symbols for plane angular degrees, minutes and seconds (o, ‘, and "), which are placed immediately after the number with no intervening space.
* Spaces (or commas) may be used as a thousands separator (*1 000 000* or *1,000,000*). Spaces are preferred to avoid confusion resulting from the different convention used in different countries.
* Symbols for derived units that are obtained from multiple units by multiplication are joined with a space or center dot (·) (e.g. "N m" or "N·m ").
* Symbols for derived units obtained by division of two units are joined with a solidus (/), or given as a negative exponent. For example, the "meter per second" can be written "m/s", "m s-1", or "m·s-1". A solidus should not be used if the result is ambiguous, i.e. "kg·m-1·s-2" is preferred to "kg/m·s2" to avoid misinterpretation.

Many units in everyday and scientific use are not derived from the seven SI base units (meter, kilogram, second, ampere, Kelvin, mole, and candela). Some examples which can be used are as follows:

* Many units of time ― minute (min), hour (h), day (d) ― in use, besides the SI unit “second” are specifically accepted for usage.
* The "year" is specifically not included in SI units, but its use is accepted.
* Electrical energy is often billed in kilowatt-hours instead of megajoules.
* The nautical mile and knot (nautical mile per hour) are used to measure travel distance and speed of ships and aircraft. In addition to these, convention on International Civil Aviation permits the "temporary use" of foot for altitude.
* Astronomical distances are measured in astronomical units, parsecs (an abbreviated form of a **par**allax of one **sec**ond; symbol: pc), and light-years (symbol: ly) instead of, say, petametres (1 petametre = 1015 m; symbol = Pm).
* Atomic scale units used in Science and Engineering are: ångström, electronvolt, atomic mass unit, and barn.
* A [sphygmomanometer](http://en.wikipedia.org/wiki/Sphygmomanometer) measures and reports blood pressure in in mmHg instead of Pa.

**See the following website for details of Rules and style conventions, as far as SI Units are concerned.**

<http://physics.nist.gov/cuu/Units/rules.html>

***Indian Units of Measurement***

"Lakh or Lac" is not understood by many non-Indian examiners. There are two ways to deal with this problem. Avoid using it; instead express it as 1 00 000.

Example: The sentence "The car was sold to 5 lakh persons last year" could be written instead as "The car was sold to 5 00 000 persons last year".

Alternatively, when "Lakh/Lac" is used for the first time, explain its equivalence to "1 00 000" in a footnote.

#### A Sample of Common Mistakes

Some words and expressions, commonly misspelled by the scholars, are the following:

|  |  |  |
| --- | --- | --- |
| **Correct** | **Incorrect** |  |
| et al. | etal, et. al, et al | (The word is "et alia") |
| whereas | where as |  |
| Literature | Literatures |  |
| Equipment | Equipments |  |
| kWh | KWH, KWh | (K stands for Kelvin.) |
| million tons (106) | MT | (M stands for Mega.) |
| 10 kg | 10kg | (A space separates the value from the  unit of measurement.) |

#### Common Errors in Writing

Writing a dissertation could be tiring process. This may lead to loss of attention that may lead you to common errors in writing. The following write up gives you an idea about some of these common errors. Keeping them in mind will make your work impressive.

In most writing, common mistakes include:

1. Incorrect use of punctuation, including commas, semicolons, colons, and dashes, etc.
2. Misusing articles and prepositions
3. Mistaking one word for another (envelope and envelop, stationary and stationery, affect and effect, complement and compliment). The spell-checker won't detect these errors.
4. You may want to keep your sentences small.
5. Confusing "then" and "than," "its" and "it's," "affect" and "effect," and "lay" and "lie"
6. Advice versus Advise:

Advice is a noun, something that you give. It is a thing. Say, "Please give me some advice."

Advise is a verb, something that you do. It is some action. Say, "Please advise me."

1. Affect and Effect:
2. As verbs, they differ. To affect some thing is to have some influence upon it. To effect some action is to cause it to happen. As nouns, they also differ. Affect is like affection, related to emotion. Effect is a result.
3. Apart and a Part:

One is a single word; the other includes two words. "Apart" means two things are separate or away from each other. A "part" means one thing is a portion or an element of another.

A wall is usually seen as a "part" of a house, for example, while a fence is seen as "apart" from the house.

1. Complement and Compliment:

The change from an "e" to an "i" makes a big difference in these two words. The word "complement" is related to the word "complete." If one thing complements another, then the two together make a whole.

In contrast, the word "compliment" is an observation of some good quality in a person. It is considered more sincere than flattery.

1. In Spite: There is no such word as "inspite." Make sure you use the two words separately, "in" and "spite."
2. Isn't it?

When you make a statement, then immediately ask if it is not true, you can use "isn't it" only if the question used the verb "to be" (ie "is" or one of its forms),

the original question was positive, and if the subject of the sentence is third person singular (it). It is correct to say, for example, "It is coming, isn't it?"

1. Loose and Lose: The two words, "loose" and "lose," look similar, especially to those who speak English as a second language. It is easy to mix them up. The word, "loose," means something is not tight or securely fastened down. It might easily fall apart or fall off. The word "lose," in contrast, means to have something go away and become lost.
2. Passive Voice: Using the passive voice is a common way to say less than people want to read or hear. In the passive voice you say, "The orange was eaten." That way you hide the subject and so do not reveal who ate the orange. If you use the active voice, you must reveal the subject. "Aziz ate the orange." The active voice is simpler, and it always identifies the subject, i.e. who did the action. Nothing is hidden.

Always use the active voice in writing an academic paper or dissertation. (This is compiled from various sources).

## The Overriding Rule

The text in the thesis should be clear in its meaning. To ensure the clarity of presentation, the best method is to ask your friend, who is not in your area of work, to read through your thesis. If he ( or she) is confused with your writing, it means that the sentence/paragraph/ should be rewritten for clarity.

# CHAPTER 2

**General Information and Institute Regulations**

This handbook is prepared by Indian Institute of Technology Patna to aid the students in writing M. Tech. thesis. This handbook must be used in conjunction with the student’s department for references, figure and table format and other stylistic considerations. It is the student’s responsibility to be familiar with the rules and regulations governing thesis submission and subsequent requirements for graduation. The following is a general outline for preparing a thesis for approval by the student’s department and the Institute.

## Objectives

For all M. Tech. students, completing a research thesis is a mandatory requirement.

A thesis is documentation of a research of a student- a record of the original research done by the student during his M. Tech. program. It provides information on the student’s research work to future researchers. The Institute is committed to preserve a paper copy of the student’s thesis for archiving and cataloging it in the central library, making it available to others for academic purposes.

The objective of this document is to provide a set of guidelines for research students to prepare a thesis to satisfy the above mentioned criteria for M. Tech. research.

## Features

The main criteria for M. Tech. research is that it should provide a useful educational experience for the student emphasizing creativity, independent action and learning, research methodology, and scholarly approach. The research should possess the major characteristics of the scientific method, namely objectivity and reproducibility. Assumptions should be clearly stated in both experimental and theoretical research. The thesis should reflect a level of competence indicative of significant achievement beyond the master's level. Thus, the research is expected to draw directly upon

advanced learning in the student's major field and demonstrate mastery of that knowledge.

## Institute Regulations

Guidelines for “*Evaluation of M. Tech. Project/Thesis*” is mentioned in M. Tech. ordinance of IIT Patna.

## Topic approval

The advisor approves the topic/title of the thesis.

## Publication of thesis involving Publication, Patents and restricted data

Written permission (hardcopy, facsimile or electronically signatured) has to be obtained from Journal for reproducing data published in the journal. An article or articles that are accepted by journals but have not yet been published may be used as part of a thesis or dissertation. The student should check with the specific journals if there is any requirement regarding obtaining permission for such unpublished yet accepted manuscripts. In case of sponsored projects, funding agency has to be mentioned and the data usage should be in accordance with the guidelines of the funding agency. Data from patents can be incorporated in thesis only after relevant permission and adherence to the patent guidelines.

## Approval requirement

The student has to make sure whether all requirements have been fulfilled as mentioned in the Ordinance.

## Copyright

Copyright protection is obtained by placing notice of copyright on the thesis . The copyright notice should be placed in the Thesis Title page and no separate page is required. The copyright notice shall consist of the following:

* + 1. The encircled symbol “C” ©
    2. The year of the award of the degree
    3. The name of the owner of the copyright
    4. The words “ All rights reserved”

Example

Copyright © Your Name 2011 All Rights Reserved

## Avoiding infringement

Obtaining permission to quote copyrighted material is Government law. Students should obtain written permission (hard copy, facsimile, or electronic signature) for any figure or table in its entirety. Students should also use the credit line specified by the copyright owner and place it where required by the owner.

All sources must be cited whenever use is made of the material of others, even if the use is limited and no copyright permission is necessary. Direct use of the work of others without citing the source is plagiarism considered as a severe academic offence.

## Citation of Web-accessed Information

Web citations must include name of author, title of publication, and date of publication. These items are formatted according to the style guide selected. In addition, the Uniform Resource Locator (URL) must be provided in the following form:

* protocol or access-mode identifier (i.e., http, https), followed by a colon and two forward slashes (e.g., http://)
* host name, always typed in lower case (e.g., <http://www.ieee.org/)>
* pathway to the document, including file name, typed exactly as it appears, including upper and lower case and punctuation
* A sample URL is: <http://www.ieee.org/Policy/Submis/Abstract/pabs587.cfm>

URLs may be broken only after a slash or double slash or after a period. Never insert a hyphen, and never break a URL at a hyphen.

# Chapter 3

**Content and Organization of Thesis Text**

Proper organization of the thesis is extremely important that enable the readers to view and understand the contents of the thesis. In this chapter, each component of the thesis is listed to help the students in organizing their thesis properly.

## Thesis size

A thesis should not exceed 60-70 pages (excluding prefacing material of the thesis). Some tips to reduce the size of a thesis are given below.

1. Do not unnecessarily repeat definitions and texts.
2. Proper referencing may save writing details of literature surveyed.
3. Be precise in your description, conclusions and interpretations.
4. Do not leave blank space on a page after a table or a figure.
5. Students might consider including a CD for details computer program listing and just include the flow of the logic and its other distinguishing features in the text of the thesis.

## Paper Quality

The copy of the thesis to be submitted to the central library should be durable. To ensure durability, paper should be acid neutral or acid-free as mentioned in the packet. Thesis-quality paper (Acid free Bond Paper) is available in the market and typically weighs greater than 85 GSM (gram per square meter).

## Paper size

The standard size of paper of a thesis is 21.5 cm (8.5 inches) wide and 28 (11 inches) long, commonly known as A4 sized paper.

Oversized figures and tables if any should be reduced appropriately to fit with the size of the paper. Care should be taken not to compromise the clarity of the contents while reducing. If required, you may consider folding oversized papers to fit with the thesis size.

## Double-sided printing

The copies of the thesis at the time of submission should be printed double sided. The final copy of the thesis to be submitted to the central library only may be either single sided or double sided. In case of double sided printing, care must be taken to choose paper quality so as to ensure opaqueness of the paper and good readability under normal lighting conditions.

In a double sided thesis, new chapters always starts on an odd numbered page. If a chapter ends on an odd numbered page, the next even numbered page is to be kept blank to ensure start of the next chapter on an odd numbered page.

## Non paper material

Digital or magnetic materials, such as CDs and DVDs, may be included in the thesis as a supporting material. They have to be given in closed packet in the back cover page of the thesis. Proper label should be given to non paper material that should include name of student, date of submission and copyright notice. However, preservation and use of such material is not guaranteed from the central Library, since rapid technology changes may render the format obsolete.

Students can also include important samples they have produced, e.g., Polymer films and others provided they are non toxic and clearly labelled and packeted at the back cover page.

## Page numbering

Page numbers for the prefacing materials of the thesis should be in Roman numerals and should be centered or right cornered at the bottom of the pages.

Page numbers of the body of the thesis should be in Arabic numerals and start with the page of Chapter 1. It should continue throughout the thesis and same trend of centering or right cornering the numbers as the Roman numerals be followed.

In double sided thesis, the odd numbered pages are always on the right and even numbered pages are on the left.

## Binding

Initial copies of the thesis submitted for examination have to be softbound and printed on both sides. Final copies of the thesis, after incorporating the changes, corrections and modifications suggested by the doctoral committee members, have to be hardbound and preferably printed on one side.

## Font

Preferred font size of normal text in the thesis is 12 point. However, minimum acceptable font size of material within a table/figure/pictorial representation is 8 point. The font type should be Times New Roman or Arial.

## Margins

A margin of 3.75 cm (1.5 inch) is to be given on the binding edge while on the other side it is to be 2.5 cm (1inch). The text of the thesis, including headings, figures, tables, and notes, but excluding page numbers, must be accommodated within the page area.

## Line Spacing

The line spacing in the main text should be one and a half (1.5). Single line spacing should be given for abstract, declaration, thesis approval, figure captions, table titles, figure legends, foot notes and references.

Two consecutive paragraphs should either be separated by spacing larger than the line spacing adopted for the text or the paragraph is started with an initial tab space.

## Equations

Format of equations is dictated by the style guide the student is following. Short equations are centered within the thesis margins. All equations are set off from preceding and following text by a triple space. Spacing must be uniform and consistent. In general, equations should be numbered at the right margin of the thesis

manuscript with the number either in brackets or parentheses. Equations may be numbered consecutively or locally. If figures and tables are numbered locally, equations also must be numbered locally. If they are locally numbered, the main divisions of the manuscript must be numbered with Arabic numerals. Local numbering of equations never exceeds one decimal place (i.e., equations are never numbered according to the number assigned to a subheading). Equation numbers must be aligned with each other throughout the manuscript.

## Headers and Footers

Headers and footers may be used to provide chapter name/number or any other relevant information. However, author should be consistent in the use of header/footers throughout the entire thesis.

## The Appendix or Appendices

If used, an appendix follows the text but precedes the references or bibliography. The pages of the appendix are numbered consecutively with the rest of the text. There is considerable flexibility in the kind of material that may be placed in appendices: computer programs, tables of raw data, questionnaires, letters, original historical source material, etc. Each appendix should be sequenced with upper-case letters of the alphabet (APPENDIX A, APPENDIX B). If there is only one appendix, no letter is used; one appendix may or may not have an explanatory title. If there is more than one appendix, each has an explanatory title. The appendix title(s) must be listed in the table of contents in all upper-case letters. Subheadings in an appendix, however, are not listed in the table of contents. Subheads in an appendix follow the same subhead scheme selected for the text.

# Chapter 4

**Thesis Template: Documentation and Writing Style**

## ABOUT THE DOCUMENT THAT FOLLOWS

This “template” is a very basic “starter kit” for formatting your thesis in Microsoft WORD. It does not incorporate WORD’s Autogenerate capability for the Table of Contents, List of Tables, Figures etc.

It has the margins and page numbering set up, the formatting of the front pages (often the area with the greatest number of formatting errors) correctly set up, chapter and section headings in acceptable formats and heading and subheading styles set up through subheading level 4.

It also offers some tips, usually in blue text boxes that can be easily deleted before you print. IMPORTANT: you must be in the Page Layout View (under the View menu) to see or delete these blue text boxes (also called “help boxes” or “instructional text boxes” herein).

It is our intention to develop a template that allows the user to take advantage of WORD’s auto-generation of Table of Contents, Lists of Tables and Figures, etc.

[THESIS TITLE GOES HERE]

This TEMPLATE is very basic. On this page and the next few pages, where you see greyed-in text surrounded by brackets, selecting the grey text will open a Text Form Field dialogue box where you can enter your text. DELETE THIS HELP TEXT BOX AND ALL OTHER INSTRUCTIONAL TEXT BOXES BEFORE

PRINTING. The text will disappear along with the box.

A Thesis Presented to

The Academic Faculty

by

[Student Name Goes Here]

In Partial Fulfillment

of the Requirements for the M. Tech. Degree



# Indian Institute of Technology Patna

[MONTH YEAR of VIVA VOCE]

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[To my beloved parents]

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### TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS iv

LIST OF TABLES #

LIST OF FIGURES #

LIST OF SYMBOLS AND ABBREVIATIONS #

SUMMARY/ABSTRACT #

CHAPTERS

* 1. [Click here and type CHAPTER 1 TITLE] 1

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|  |  |
| --- | --- |
| [Click here and type Subheading] | # |
| 2 [Click here and type CHAPTER 2 TITLE] | # |
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| 3 [Click here and type CHAPTER 3 TITLE] | # |
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| 4 [Click here and type CHAPTER 4 TITLE] | # |
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| [Click here and type Subheading] | # |
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| 6 [Click here and type CHAPTER 6 TITLE] | # |
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| 7 [Click here and type CHAPTER 7 TITLE] | # |
| APPENDIX A: [Click here and type APPENDIX A TITLE] | # |
| APPENDIX B: [Click here and type APPENDIX B TITLE] | # |
| REFERENCES | # |

|  |  |
| --- | --- |
| **LIST OF TABLES** |  |
| Page |
| Table 1.1: [Click here and type table title.] | # |
| Table 2.1: [Click here and type table title.] | # |
| Table 2.2: [Click here and type table title.] | # |
| Table A.1: [Click here and type table title.] | # |
| Table A.2: [Click here and type table title.] | # |
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### LIST OF FIGURES

Page

Figure 1.1: [Click here and type figure title.] #

Figure 2.1: [Click here and type figure title.] #

Figure 2.2: [Click here and type figure title.] #

Figure A.1: [Click here and type figure title.] #

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Symbol-2 What it means

Abbrev1 What it means

Abbrev2 What it means

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### ABSTRACT

The rapid digitization of textual information has led to a vast accumulation of knowledge in the form of PDF documents. This project introduces a robust PDF Knowledge Extraction System that integrates Retrieval-Augmented Generation (RAG) and Cache-Augmented Generation (CAG) models for intelligent and scalable document querying. The system allows users to upload PDF files, which are then automatically parsed and segmented into content chunks. Two parallel embedding pipelines are employed: one using Google’s Gemini 1.5 Flash API to generate high-quality embeddings for the RAG model, and another using HuggingFace models for efficient caching in the CAG framework.

Embeddings from both pipelines are stored in separate vector stores using ChromaDB—enabling rapid retrieval and response generation. When a query is submitted, the system first checks the cache for existing results. On a cache hit, the relevant answer is instantly returned, minimizing latency. If a cache miss occurs, the query is processed via the RAG model, and the generated response is cached for future requests. This hybrid approach ensures optimized performance by combining the context-awareness of RAG with the efficiency of CAG, making it ideal for knowledge-intensive applications across domains.

Submitted by:

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Under the guidance of:

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### CHAPTER 1 INTRODUCTION

**1.1. Background and Motivation**

**Overview of the Research Domain**

The domain of **knowledge extraction** from unstructured documents has gained considerable attention in recent years due to the rapid expansion of data, particularly in the form of PDF files. PDFs, often the preferred format for storing documents, reports, manuals, and academic papers, present a challenge in terms of accessibility and processing. Traditional methods of information retrieval from such documents are often limited, as they typically rely on manual indexing or basic keyword search mechanisms. These techniques fail to capture the full contextual richness of the documents, limiting their ability to provide accurate and insightful responses to user queries.

Recent advancements in **Natural Language Processing (NLP)** and **Machine Learning (ML)** have revolutionized the field by enabling automated and intelligent document processing. **Retrieval-Augmented Generation (RAG)** and **Cache-Augmented Generation (CAG)** are two powerful models that have significantly enhanced the ability to query large document databases with high accuracy. These models integrate external knowledge retrieval mechanisms with generative algorithms, facilitating context-aware, efficient, and scalable document querying. The integration of these advanced techniques with modern embeddings, such as those generated by **Google's Gemini 1.5 Flash API**, has made it possible to achieve state-of-the-art performance in knowledge extraction tasks.

**Importance and Relevance of the Topic**

The importance of effective knowledge extraction systems cannot be overstated, particularly in today’s data-driven world. With the explosion of digital content, businesses, academic institutions, and various industries are increasingly reliant on automated systems that can quickly and accurately retrieve valuable insights from vast pools of unstructured data. The ability to process and query large sets of documents with ease is vital in fields such as **legal research**, **medical documentation**, **business intelligence**, and **academic research**.

As more organizations and sectors digitize their archives, the need for intelligent systems that can **automatically interpret and extract meaningful information** from complex document formats grows. Traditional document management and query methods are often not equipped to handle the volume and complexity of modern datasets. As such, leveraging the capabilities of deep learning models, generative AI, and efficient embedding systems offers a scalable solution to meet these growing demands.

Moreover, the integration of **cache systems** (CAG) alongside **retrieval-based models** (RAG) ensures that the knowledge extraction process is both **time-efficient** and **resource-effective**, enabling systems to respond to user queries faster and more accurately. This makes the topic of document knowledge extraction both timely and relevant, with far-reaching applications in fields that require real-time, intelligent decision-making from large sets of information.

**Motivation Behind the Study**

The primary motivation for undertaking this study stems from the increasing necessity for efficient and **context-aware knowledge extraction systems** that can handle diverse and large-scale datasets. Despite recent advances in AI, many existing document extraction systems still face limitations in dealing with **complex queries** or providing **contextually relevant responses** from a wide variety of document types.

The growing reliance on PDFs as a standard for document exchange, combined with the complexity and richness of the data contained within them, presents an opportunity for further innovation in the field of knowledge extraction. By combining **RAG** and **CAG** models with **Gemini 1.5 Flash embeddings**, this study aims to enhance the accuracy, efficiency, and scalability of document querying systems. Additionally, the use of **ChromaDB** to store embeddings further contributes to the **optimization of query responses** by enabling intelligent caching mechanisms, reducing response times, and improving overall system performance.

Ultimately, the study seeks to create a **robust and scalable PDF knowledge extraction framework** that can be applied across industries, aiding users in obtaining valuable insights from documents quickly and effectively. This will support not only academic research but also practical applications in sectors that require efficient handling of large-scale document data.

### CHAPTER 2

**TITLE OF THE CHAPTER GOES HERE**

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* + - 1. Go to the end of a chapter. That means put your cursor after the very last character of that chapter.
      2. Hit **Return** to move to a new paragraph.
      3. From the **Insert** menu, choose **Break**. Click the button **Page Break**, and click **OK**.

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**Figure and table Placement**

It is highly recommended that figures and tables be placed in the same page as much as practicable wherever they are mentioned in the text for the first time. Tables and figures may be landscaped or placed broadside. For a landscaped table or figure, the title or caption is also landscaped the title or caption is on the same page as the table or figure. Few examples are shown below.

See Figure 4

5

Figure 4: Bar Graphs

6

in Table 3

Table 3: Variation of size

7

See Figure 5

in Table 4

Figure 5: Absorbances Table 4: Conductivity values

8

See Figure 6

9

Figure 6: Design

See Figure 7

Figure 7: Title

10

#### Style for References

**The following style should be used since citations in the text are numbered sequentially and the “References” list is ordered numerically. This is the only acceptable format.**

(Note the style: Full surname followed by abbreviated first and middle name, separated by semicolons, The abbreviated Journal Name in italics, the year of publication in bold followed by the volume and starting page of the article.)

The following is the list of various type of references that you might cite. The format for a particular reference type is shown as an example below.

* **Citation of Journal article/communication/letter/note/review**

1. Shah, S.; Rangarajan, S.; Friedman, S. H. *Angew. Chem., Int. Ed.* **2005**, 44, 1328−1332.
   * **Citation of Books**

(52) Austin, G. T. *Shreve’s Chemical Process Industries*; McGraw−Hill: New York, 1984; Vol. 5.

* **Citation of Patents**

(25) Cramm, N.T., A Device to Simplify the Conversion of Bibliographic Information into Citation Format. U.S. Patent 7,005,423, Sep 13, 2005.

* **Citation of Conference Publication**

(13) Zhao, H.; Yuman, C. Energy Analysis of a Steam Power Plant with Direct Air- Cooling System in China. In *Asia-Pacific Power and Energy Engineering Conference 2009 (APPEEC 2009)*; IEEE Press: Piscataway, NJ, 2009; pp 1−4.

* **Citation of Web-accessed Information**

For citing websites please see page 15.

**List of Publication(s) from M. Tech. research work**

* **Papers Published in Peer Reviewed Journals 1.**

**2.**

**3.**

* **Papers Published in Conferences 1.**

**2.**

**3.**

* **Book chapter 1.**

**2.**

**3.**

* **Patents**

**1.**

**2.**

**3.**

Format should be as mentioned in Reference section.

# Preparation and Submission of Thesis

## Supervisory Committee and Final Approval Forms

Some forms are included in this document. Other forms are available in the intranet of IIT Patna website. Updated forms are to be used only. Some important forms are available in this manual also. You may also contact CET OFFICE in this regard.

## Curriculum vitae

This is optional. The student might wish to add his/her curriculum vitae limited strictly to one page and without any photographs. This can be incorporated at the end of the thesis.

## CHECKLIST before submitting the final copies of your thesis (NOT TO BE INCLUDED IN THESIS)

Is the author’s full name on the title page and the abstract?

Are the correct names and titles of the thesis supervisor(s) and program head(s) on the title page?

Does the title on the title and abstract pages agree with the title given to the Program Coordinator?

Is the publication date correct on the title page?

Does the title page carry the appropriate copyright notice (or separate copyright page whatever applicable) and, in cases where the student owns copyright, the appropriate copyright permission statement?

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Ensure that the thesis is completely free of plagiarism.

IPR declaration in case part of the thesis work carried out at the industry.

# INDEX

* + 1. Good Writing 9

|  |  |
| --- | --- |
| Abbreviations | 31, 35 |
| Academic Section | 3 |
| Acknowledgement | 27 |
| Appendix | 7, 22 |
| Approval Page | 4 |
| Approval Requirement | 17 |

Guidelines for Preparing and Submitting the

Thesis of a Thesis 3

Guidelines on the Preparation of a Thesis 3, 8

##### H

Handbook 15

Hard Copy 3, 15, 17

* + 1. Headers and Footers 22

|  |  |  |
| --- | --- | --- |
| Binding |  | 21 |
| Body of the Thesis |  | 7 |
|  | C |  |
| Caption |  | 8, 39 |
| CD |  | 3, 20 |
| Certificate |  | 28 |
| Checklist |  | 41 |
| Citation |  | 7, 8, 18, 40 |
| Common Errors |  | 12 |
| Common Mistakes |  | 13 |
| Content and Organization of Thesis Text 19 | | |
| Contents |  | 31 |
| Continuity of Ideas |  | 9 |
| Coordinator |  | 3, 41 |
| Copyright |  | 5, 17, 24 |
| Curriculum Vitae |  | 41 |
|  | D |  |

##### I

|  |  |
| --- | --- |
| Infringement | 17 |
| Institute Regulations | 15, 16 |
| International System of Units | 10 |
| Introduction | 37 |

L

Line Spacing 3, 7, 10, 21

##### M

Margin 21, 22

Mathematical Expressions 10

##### O

|  |  |
| --- | --- |
| DC | 3, 4 |
| Declaration | 29 |
| Dissertation | 12, 14, 16, 17 |
| Evaluation Committee | 3, 4, 5, 6, 16, 21, 25 |
| Documentation | 23 |
| DVD | 20 |

|  |  |  |
| --- | --- | --- |
| Objectives |  | 7, 15 |
| Overriding Rule |  | 14 |
|  | P |  |
| Page Numbering |  | 9, 20 |
| Paper Quality |  | 19 |
| Paragraph |  | 9, 14, 21, 27, 38 |
| Printing |  | 20, 42 |

##### E

Equations 22

Examiner 3, 16

##### F

|  |  |
| --- | --- |
| Features | 15 |
| Figure | 9, 15, 17, 19, 21, 34, 37, 39 |
| Font | 7, 21, 37 |
| Foreign Examiner | 3 |
| Formatting | 3 |
| Forms | 41 |

G

General Information 15

Publication of Thesis Involving Publication, Patents and Restricted Data 16

Publications 17, 30

##### R

Reference 3, 7, 8, 9, 15, 21, 22, 29, 30, 37, 40

##### S

|  |  |
| --- | --- |
| SI unit | 10, 11, 12 |
| Size | 3, 4, 7, 19, 21, 37 |
| Soft Copy | 3 |
| Abstract | 31, 36 |
| Supervisory Committee | 41 |
| Symbols | 4, 10, 11, 31, 35 |

T

Table 8, 9, 15, 17, 19, 21, 22, 23, 33, 37, 39

Tables and Figures 8, 9, 23

Template 4, 23, 37, 38

Tenses 10

Thesis Template 23

Title 3, 4, 7, 8, 9, 16, 18, 21, 22, 37, 39, 41, 42

Title of the Thesis 3

Title Page 3, 4, 17

Topic Approval 16

##### V

Verb 10

##### W

Website 12, 41

Writing Style 23

**Suggestive Guidelines (NOT TO BE INCLUDED IN THESIS)**

M.Tech. students are expected to adhere to the following suggestive guidelines:

1. Introduction (Chapter 1)

The introduction must contain a general overview about the topic of interest citing all important breakthroughs in the field, describing them adequately keeping in view the scopes and limitations. This will be a preamble to the scopes and objectives of the study.

1. General Experimental/Theoretical Techniques and Instrumentation

The general experimental (instruments, parameters, etc.) and theoretical (published methods, programs etc.) methods must be mentioned and justified. This should be followed by adequate description of the necessary instrumentation involved to carry out the present investigation.

1. This chapter shall describe the actual work in the present study. The chapter must outline the current related literature about the subject of interest along with a specific objective, description of results, discussions derived from them, conclusions derived, experimental procedure and references. Like this chapter, there may be others needed to meet the general objectives described in the introduction. The extent of work is solely the prerogative of the advisor.
2. An executive conclusion based on the results that justify all the objectives described in the introduction.
3. Glossary