

DEPARTMENT OF ELECTRICAL ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY MADRAS
CHENNAI – 600036

My Thesis Title



A Thesis

Submitted by

MYFIRSTNAME MYLASTNAME

For the award of the degree

Of

DOCTOR OF PHILOSOPHY

July 2022



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A quotable quote that is quoted by the quoter

– Quote Author

*To whoever, whatever, wherever or whenever, or all of those, or
none at all*

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This is to undertake that the Thesis titled **MY THESIS TITLE**, submitted by me to the Indian Institute of Technology Madras, for the award of **Doctor of Philosophy**, is a bona fide record of the research work done by me under the supervision of **Dr. Firstname Lastname**. The contents of this Thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

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Chennai 600036

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LIST OF PUBLICATIONS

I. REFEREED JOURNALS BASED ON THESIS

whatever

II. REFEREED JOURNALS (OTHERS)

whatever

III. PRESENTATIONS IN CONFERENCES

whatever

IV. PUBLICATIONS IN CONFERENCE PROCEEDINGS

whatever

ACKNOWLEDGEMENTS

Here is where one would thank others for their assistance with the thesis, in whatever shape or form. While, this section is optional, almost all theses contain it.

ABSTRACT

KEYWORDS L^AT_EX; template; dissertation; thesis; synopsis; here; is; a; long; list;
of; keywords; one; can; have; as; many; as; desired

This is a minimal template to get one started. The abstract typically contains a brief gist of the thesis. Common guidelines to effective abstract writing are available on the internet.

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GLOSSARY

L^AT_EX	L ^A T _E X is a popular macro package for document preparation.
Computer Science and Programming	An art form that is commonly associated with bringing silicon to life.
Engineering	A popular scientific discipline.
Mathematics	A very versatile language.
Physics	Trying to understand the world by describing it using mathematics.

ABBREVIATIONS

DC Doctoral Committee.

GTC General Test Committee.

IITM IIT Madras.

MS Master of Science.

Ph.D Doctor of Philosophy.

NOTATION

- ϵ_0 the dielectric constant of free space
- π ratio of the circumference of a circle to its diameter
- τ ratio of the circumference of a circle to its radius
- c the speed of light in vacuum

CHAPTER 1

INTRODUCTION CHAPTER NAME

This is a generic introduction chapter. Some people might call it an overview. You can give it any name of your choice really. However, it is the first chapter of this thesis, so it deserves a decent name.

1.1 THE FIRST SECTION

This, as you can see is the first section inside this chapter. A chapter rarely, if ever, starts with a section. Instead, some material setting the context for the material in this section should precede it. Quite often, one wants to treat material in further detail. Subsections might be used for this purpose.

1.1.1 A subsection

Here we are in a subsection. The third level of the document's sectioning structure. This is the deepest sectioning level allowed. Levels deeper than this are not recommended. Very often one can rid documents of deep, nested levels by some thoughtful restructuring of the material. A good exercise, indeed, and one that makes for a better dissertation.

1.2 THIS IS AN EXAMPLE OF A VERY LONG SECTION HEADER, HIGHLY DISCOURAGED, BUT IT WORKS NONETHELESS

Here are some references to terms in the glossary: \LaTeX Mathematics Physics

CHAPTER 2

ITEMIZED LISTS AND QUOTES

Itemized lists work as one would expect. They are properly line-spaced. Refer to the tutorial for more details. In general, it is better to start a new paragraph (i.e. place a blank line in the source file) at the start of a new enumerate block. This ensures that the line-spacing options are activated correctly.

Line spacing of items in the list and the spacing of the list with respect to the surrounding textual matter is set as per the institute guidelines.

2.1 UNNUMBERED LISTS

These are the standard “bulleted” lists that one is familiar with.

- this
- is
- a bulleted
- list

this is the next paragraph

- ◇ this
- ◇ is
- ◇ a dashed
- ◇ list

and this is the next paragraph

- this
- is

- a mixed

– list

and this is the next paragraph

★ this

★ is

- a mixed

★ list

and this is the next paragraph

□ this

□ is

□ square

□ list

and this is the next paragraph

■ this

■ is

■ square

■ list

2.2 NUMBERED LISTS

These are the standard numbered lists that one might be familiar with.

1. this
2. is a
3. numbered
4. list

this is the next paragraph

- i. this
- ii. is a
- iii. roman-numbered
- iv. list

this is the next paragraph

- I] this
- II] is a
- III] capitalized roman-numbered
- IV] list

this is the next paragraph

- a) this
- b) is an
- c) alphabetical
- d) list

this is the next paragraph

- A} this
- B} is the
- C} last
- D} This is what that author said and it is rather important. That is the reason I am quoting the entire passage here for reference and completeness
 - a) This is what that author said and it is rather important. That is the reason I am quoting the entire passage here for reference and completeness
 - b) This is what that author said and it is rather important. That is the reason I am quoting the entire passage here for reference and completeness

Note that one can nest lists as well as shown above

2.3 MORE COMPLEX LISTS MADE EASY

Step i] reflect over the research done

Step ii] review ones notes, writings, lab journal and research articles

Step iii] stop overthinking and/or procrastinating

Step iv] start writing

Step v] realize that there is much to do

i} fear not

★ persevere

ii} continue writing

Step vi] success!

2.4 QUOTES

Very useful for quoting text from other works. See the tutorial for more details and references.

An inline-quote, one that is along with the main material is placed like this “this is a quote”. Sometimes we want to mention the author as well “this is what that author wrote”
(Author of the quote)

Sometimes, it is better to quote larger passages of text in the display mode like this

This is what that author said and it is rather important. That is the reason I am quoting the entire passage here for reference and completeness

this is the next paragraph. By specifying the optional argumnet, the author name can be set as well:

[Authorname] This is what that author said and it is rather important. That is the reason I am quoting the entire passage here for reference and completeness

2.5 FOOTNOTES

One might find the need to include some relevant contextual information in the material but find it unnecessarily intrusive to do so in the running text matter itself. In such cases, or whenever else the author feels the need to do so, a footnote may be deployed thus ¹

¹see, this is the footnote I was talking about. It is spaced appropriately. Best to use these sparingly since they detract from the general flow of the document. Some thoughtful restructuring of the material can help reduce the need for footnotes

CHAPTER 3

MATHEMATICS

\TeX is unmatched when it comes to the precise rendering of complex mathematical material. Several handy tools and packages are available to the author from various packages offering mathematic facilities. Some of these are bundled-in by default. Refer to the relevant chapter of the tutorial for more details.

3.1 EQUATIONS

What follows below is an equation

$$e^{i\pi} + 1 = 0 \tag{3.1}$$

Notice that it is appropriately numbered. Notice that in the case of mathematics, appropriate spacing of the textual matter surrounding the equation (i.e., those portions of the material above and below the equation) are appropriately spaced only when there is no paragraph break before and after environment block. Therefore, the user must ensure that there are no blank line(s) before or after the mathematics block so that excess unwanted space is avoided. Shown below is a piece of display math, which are unnumbered by default. Therefore if equation numbering is desired, the equation environment is recommended

$$\lim_{x \rightarrow 0} \frac{\sin x}{x} = 1.$$

This is the next paragraph. Very often, one needs to write several equations in a sequence of steps aligned properly, one below the other. This is also easily achieved using the `align` environment:

$$\mathbb{P} \left[\limsup_{n \rightarrow \infty} E_n \right] = \mathbb{P}[\{E_n \text{ i.o.}\}^c] \tag{3.2}$$

$$= \mathbb{P} \left[\bigcup_{n \in \mathbb{N}} \bigcap_{m \geq n} E_m^c \right] \quad (3.3)$$

$$= \lim_{n \rightarrow \infty} \mathbb{P} \left[\bigcap_{m \geq n} E_m^c \right] \quad (3.4)$$

$$= \lim_{n \rightarrow \infty} \prod_{m \geq n} \mathbb{P} [E_m^c] \quad (3.5)$$

$$= \lim_{n \rightarrow \infty} \prod_{m \geq n} (1 - \mathbb{P} [E_m])$$

$$\leq \lim_{n \rightarrow \infty} \prod_{m \geq n} \exp(-\mathbb{P} [E_m]) \quad (3.6)$$

$$= 0. \quad (3.7)$$

If equation numbers for certain steps are not required they may be avoided by using the `\nonumber` directive as has been done above.

Notice that the equations are line-spaced correctly as well. The surrounding text too is appropriately spaced from the `align` block. Here too, as with the equation environment, here too it is recommended to avoid blank lines (paragraph breaks) before and after the `align` environment so that unsightly white space before and after the block is avoided.

3.2 CONVENIENCES

Various other essential and convenient mathematical facilities are bundled with the package. For instance, automatically sized delimiters, common theorem and theorem-like environments, configured proof blocks and commonly used operators are all provided.

Refer to the tutorial for more information regarding these.

Theorem 3.1. *This is an insightful theorem.*

Proof. Here is the proof. ■

CHAPTER 4

FIGURES AND TABLES

Figures and tables are referred to as floats in the $\text{T}_{\text{E}}\text{X}$ world. These are elements which cannot be broken across pages. For more details on these, refer to the relevant chapter of the tutorial.

4.1 FIGURES

A simple figure is shown below:



Figure 4.1: This is a photo of Tux. He is a very friendly penguin. We will meet his friends shortly.

As with almost all other elements in $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ figures too can be cross-referenced using the labels. Make sure to provide these for all figures and choose a descriptive tag while doing so. That way, later on if one needs to refer to the figure, there is no need for hunting around to find where the image is. Instead, Overleaf will automatically suggest a list of tags to choose from while invoking the `\ref` command.

Since floats are complex, one does not have very fine-grained control over the location of its placement relative to surrounding text. While preparing a document, the author should not be too concerned about the placement unless it is severely out of place. Instead,



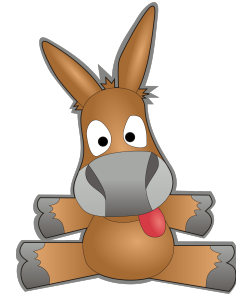
(a) Tux



(b) Adiumy



(c) GNU Head



(d) Emule



(e) Konqi



(f) Katie



(g) Wiber



(h) Camelia

Figure 4.2: Tux with his various friends. Notice that captions of figures are placed below the figure and are properly line spaced as per the guidelines

once the document is near-complete, fine tuning can be done to precise measurements if desired/possible. Otherwise, some fine-tuning might go to waste as significant changes to the document (and hence the layout of the material) occurs.

The recommended way to place multiple figures is by use of the `subcaption` package. Make sure to include this. An example is shown in figure 4.2.

4.2 TABLES

Please refer to the tutorial for a slightly detailed note about tables. A simple table is shown below. Table captions are placed above the table. They are line-spaced as per the guidelines. It is not recommended to break paragraphs after a table unless absolutely necessary. Note that `\captionabove` (not `\caption`), is used to place captions in tables. Only then will the spacing around the captions of tables be appropriate. Make

Table 4.1: Shown below is a simple elegant table with a very long caption. Tables are quite helpful in organizing information in a presentable manner.

Table	Head
stuff	stuff
stuff	stuff
stuff	stuff
stuff	stuff
stuff	stuff

Table 4.2: A complex table is shown here. Careful use of the column specifiers along with thoughtful (re)organization of the material can yield great results

Aspect	Value		Profit	
	Before 2019	After 2019	Before 2020	After 2020
Whatever	30	40	20	2
Aspect	33	45	10	5
Entries	37	51	90	600
Here	33	67	97	52

note of this fact.

Far more complex table layouts are possible using `multicolumn` and/or specifying different column types for the `tabular` block. Refer to the tutorial for more details. An example is shown below:

Further, the `multirow` functionality offered by the `multirow` package is sometimes useful. The same example as above is repeated below with a slight change using the `multirow` functionality

Bear in mind that as in the case of figures, the tables too cannot always be precisely positioned as desired. Fine-tuning of the positioning by the use of position specifiers is best left to the final stages of the document preparation.

Finally, vertical rules in tables are not only unsightly, but also largely unnecessary (for

Table 4.3: A complex table is shown here. Sometimes, one might need to have cell entries which span more than a single row; this too is possible as shown below

Aspect	Value		Profit	
	Before 2019	After 2019	Before 2020	After 2020
Whatever	30	40	20	2
Aspect	33	45	10	5
Entries	37	51	90	600
Here	33	67	97	52

most cases). If one still wants properly positioned vertical rules in tables, refer to the tutorial file for more information.

4.3 BIBLIOGRAPHY REFERENCES

Bib_TE_X is the only supported mechanism to manage bibliography and citations. For those unfamiliar with Bib_TE_X, several useful tutorials are available on the internet.

In nutshell, one requires a `references.bib` file containing all the relevant details of the material to be referenced in the Bib_TE_X format. Make sure to the `references.bib` file is free of any errors to ensure that the bibliography is typeset correctly. Many popular reference management tools support Bib_TE_X export of libraries.

With that in place one simply uses the `\cite` command along with the tag of the entry to be referenced. For instance, this is a very nice paper Stroock and Varadhan (1971). While we are on the topic, let me recommend another classic: Nash (1951). Or perhaps, some other favorites might interest you if you work in related fields: see Chernoff (1972), Wald (2004), Zhang (2014) or Shannon (1948) for a nice selection. It is also worth mentioning that the work of Polyanskiy *et al.* (2010) is well regarded.

APPENDIX A

GENERAL NOTES

For any package, always consult the official package manual and/or reference for specific instructions on how to load them and the range of options available. If you run into strange issues, feel free to ask for send me an email or ask on the PhD or MS mailing lists.

Note: As is the case for many other programming languages, there are lot of \LaTeX code snippets floating around at various forums on the internet. While using these code snippets may (or may not) alleviate issues, it is highly plausible that such code can have undesirable side effects, just from being placed in a document. Further, a single code snippet can, in general, have different effects depending on where it is placed in the document. Therefore, the user is urged to inspect an official manual and/or reference before inserting arbitrary code into the document. The code of `iitmdissertation` largely conforms to the best practices and strictly abides by the documentation of the packages that it loads.

A.1 SOURCE FILES

The user must avoid editing the source files as far as possible. Commands do not always do what one expects of them unless of course they are invoked in the right context (and/or situation). `iitmdissertation` has been extensively tested in many scenarios. However, it is very much possible that bugs exist. Most errors in compilation arise from incorrect use of packages and/or their facilities. Take care to ensure that you follow best practices while using external packages. If you encounter an insurmountable issue despite your best efforts, you are most welcome to contact the author for help.

Ensure that these files are not tampered with at any cost. The accompanying template will not compile (and produce a PDF) if even one of these is missing. These are as follows: `iitm.bst`, `iitmdissertation.cls`, `iitmdissertation.sty` and the folder `zz-imp`.

A.2 SOME USEFUL PACKAGES

Quite a few packages are loaded by `iitmdissertation` which are very commonplace in a standard document. In the event that certain customization of one or more of the facilities offered by these packages is required, the user is urged to look at the respective package's documentation.

We hope this helps users to produce nicely formatted theses and simplifies his/her writing experience. Happy writing!

Table A.1: A list of commonly required (some of which are pre-loaded) packages along with links to their documentation

Package(s)	Note(s)
<code>enumitem</code>	handles all itemized lists and descriptions [López (2019)]
<code>booktabs</code> & <code>array</code>	handle all facilities related to tables [Els (2020); Team and Mittelbach (2021)] Caution: Although, there are many table-related packages for \LaTeX , use of <code>booktabs</code> and <code>array</code> is the recommended way to handle tabulation
<code>xcolor</code>	handles all color related facilities. This package is loaded with the <code>usenames,svgnames</code> option for a total of 170 color options. Consult page 43 of the <code>xcolor</code> manual for these color names [Team and Kern (2021)] Caution: Trying to load <code>xcolor</code> with other options might cause issues (i.e, option clashes in \LaTeX parlance). If you really must have new color(s) you can define it using the <code>definecolor</code> command.
<code>subcaption</code>	This is the recommended package for handling sub-figures and sub-captions. This is not loaded by default but is highly recommended if the need for multiple figures with sub-captions arises [Sommerfeldt (2020)]
<code>multirow</code>	This is the recommended package for handling tabular-cells spanning multiple rows. This is not loaded by default, since it is not essential.[van Oostrum (2020)]
<code>glossaries</code>	This is the default package used to handle glossaries and the abbreviations in the pre-matter. <code>iitmdissertation</code> provides defaults for a simple glossary customized to match the official guidelines of the institute as can be seen in the template. [Talbot (2021)]
<code>nomenc1</code>	This is the default package used to handle the notation chapter in the pre-matter. <code>iitmdissertation</code> provides defaults for a simple notations chapter conforming to the guidelines. [Veytsman <i>et al.</i> (2021)]

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CURRICULUM VITAE

NAME Myfirstname Mylastname

DATE OF BIRTH 01 January 2022

EDUCATION QUALIFICATIONS

1970 **The first degree**
 Institution Wherever
 Specialization Whatever

2038 **The previous degree**
 Institution Wherever
 Specialization Whatever

Doctor of Philosophy
 Institution Wherever
 Specialization Whatever
 Registration Date Whenever

DOCTORAL COMMITTEE

Chairperson

Dr. Name
Whatever
Wherever

Guide(s)

Dr. Name
Whatever
Wherever

Dr. Name
Whatever
Wherever

Member(s)

Dr. Name
Whatever
Wherever

Dr. Name
Whatever
Wherever

Dr. Name
Whatever
Wherever