

L^AT_EX: A Scientific Writing Tool

(A simple introduction)

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- Basic introduction of \LaTeX
 - Comparison of available writing softwares for Scientific writing
 - Advantages and disadvantages of \LaTeX usecase
- Basic commands in \LaTeX for:
 - Table formation
 - Figures control
 - Mathematical equations writing
 - Reference citation (Research articles)
 - Cross referencing (Figures, Equations, Tables, etc.)
- Learn the use case and efficacy of \LaTeX in scientific writing
 - Report
 - Research paper
 - Presentation (Beamer)
 - Thesis (Dissertation)

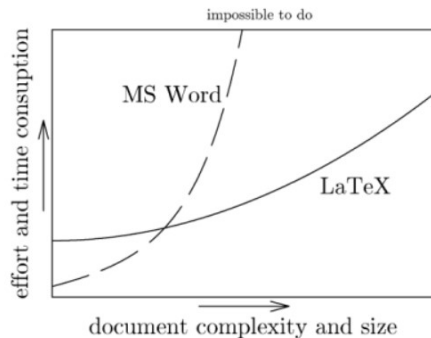
What is L^AT_EX?

Introduction:

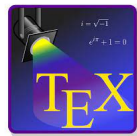
- L^AT_EX is a **Typesetting** software and not a **Word-processing** software
- Generate high-quality and less-size output based on the user's instruction and text
- It is particularly suited for the academic writing purposes than the general use cases
- Is a free, open source and highly stable Typesetting Software

Benefits:

- Professional typesetting.
- Superior handling of mathematical content.
- Automated cross-referencing and citations.
- Version control compatibility.
- Platform independence.
- Customization options and templates.
- Free & Open-source.
- Strong community support.



Installation of L^AT_EX and Text-Editor



Local compiler:

MikTeX Setup:- <https://miktex.org/>

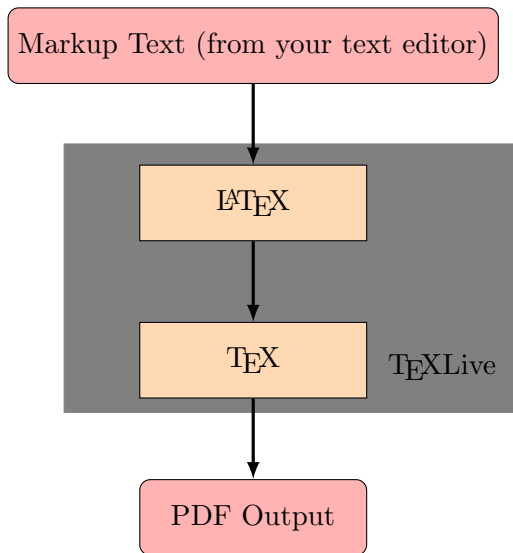
Tex Editor:- <https://www.texstudio.org/>



Online compiler:

Overleaf:- <https://www.overleaf.com/>

Work-flow of L^AT_EX Documents



Output files

Auxiliary files generated after compilation

The software diagram on slide 5 is a simplification. \LaTeX outputs a range of files depending on your input file and build profile. These include:

- **.log** — contains the transcript from the last \LaTeX run. Lists files loaded and packages used.
- **.aux** — contains information required for cross-referencing.
- **.bbl** — bibliography info created by Bib \TeX – subsequently inserted by \LaTeX into the document.
- **.blg** — Bib \TeX log file.
- **.synctex.gz** — contains information for jumping between source code and output file in your IDE (demo).

Minimal L^AT_EX Document

- The input for L^AT_EX is a plain text file with a **.tex** extension e.g. mypaper.tex.
- The file *must* have the following structure:

```
\documentclass[options]{class}  
<preamble>  
\begin{document}  
    content ...  
\end{document}
```

- Document classes examples:

```
\documentclass{book}  
\documentclass{report}  
\documentclass{article}  
\documentclass[a4paper, 11pt]{article}  
\documentclass[a4paper, 11pt, twocolumn]{article}
```

Preamble, Packages, and Sections

- Preamble lists **packages** for add-on functionality e.g.

```
\usepackage{hyperref}, \usepackage{amsmath},  
\usepackage{graphicx}, \usepackage{comments},  
\usepackage{natbib}, etc.
```

- Main Content of the

```
\begin{document}  
    \maketitle  
    \tableofcontents  
    \section{First}  
    \subsection{First Subsection}  
    \subsubsection{First SubsubSection}  
\end{document}
```


Some Fundamental Tips for Beginners

- Special characters are reserved in L^AT_EX::
\$ % ^ & _ { } ~ \
- if still it is required to be printed then type
`\# \$ \% \^{} \& _{} \{ \} \~{} \textbackslash` to get # \$ % ^ & _ { } ~ \
- An empty line creates a new paragraph;
- Consecutive empty lines are treated as one.
- **Commands** have this format `\command[optional parameters]{parameter}`
- Package documentation explains options
- Text following a % symbol is ignored by L^AT_EX
- **Various lists**
Commands

Structure of a research article

- ① Title
- ② Author's name
- ③ Affiliation of authors
- ④ Abstract
- ⑤ Section
 - subsection
 - subsubsection
- ⑥ Other contents
 - Creating lists
 - Graphical results
 - Tabular data
 - Mathematical equations
 - Referencing
 - Cross-referencing

Exercise 1

- ① Create a new L^AT_EX article, “Hello world!”
- ② Add a title in existing T_EX file
- ③ Add your Name and affiliation to the existing T_EX file
- ④ Add an abstract and write few words
- ⑤ Add a Section and write few words
- ⑥ Add a subsection and write few words
- ⑦ Add a subsection and write few words
- ⑧ Add a subsubsection and write few words
- ⑨ Add “\tableofcontents ” after \begin{document}

Latex-Exercise Various lists
Commands

Basic Command for Text Formatting

Handling with the font sizes:

`\Huge`: Largest size (use sparingly)
`\huge`: Very large size
`\LARGE`: Large size (often used for headings)
`\Large`: Slightly smaller than `LARGE`
`\normalsize`: Resets to the base size defined in the document class
`\small`: Smaller than normal size
`\footnotesize`: Even smaller size
`\scriptsize`: Very small size (use with caution)
`\tiny`: Tiniest size (use rarely)
`\fontsize{14pt}` : Used for specific size of font

Example:

```
{\Huge This is Huge text} % Sets text to Huge size  
{\normalsize This is normal text} % Resets to normal size  
{\fontsize{14pt}{16pt}\selectfont This text is 14pt with 16pt line s
```

Few more important commands for text formatting

- For getting the text style "*text*, text, *text*, **text**, *text*" can be get by commands `\emph{text}`, `\underline{text}`, `\textit{text}`, `\textbf{text}`, `\textsl{text}`
- Various lists
Commands

Exercises on Text Formatting

- Write your present address and align them to left, right, and center of the document by using environment `flushleft`, `flushright`, `center`
- Write your name, Dept, and Affiliation, and use the command `\hspace{10pt}` and `\vspace{10pt}` to see the result
- Use the environment "minipage" to split the page horizontally and vertically in equal part.
- Generate a footnote using "`\footnote{text}`" and write your email id there.
- Cross-referencing of section using `\label{key}` `\ref{label}`
- [More-Latex-Exercise](#)

Lists, Tables, and Cross-Referencing

Introducing some basic commands for lists and tables

- Unordered lists (`enumerate`, `itemize`, `description`)

```
\begin{itemize}
  \item First item
  \item Second item
\end{itemize}
```

- Ordered list

```
\begin{enumerate}
  \item First item
  \item Second item
\end{enumerate}
```

- List with description

```
\begin{description}
  \item[First] My desc ...
\end{description}
```

Exercise on lists and cross-referencing:

- Formation of tabular data

```
\begin{table}[optional placeholder]
  \caption{This is the caption of my Table}
  \begin{tabular}{ccc}
    1 & 2 & 3 \\
    4 & 5 & 6
  \end{tabular}
\end{table}
```


Exercise on Lists and Tabular data

- 1 List the name of all faculty members of your Dept.
- 2 Generate the tabular data with caption as mentioned

Table 1: Student Scores

Student Name	Math Score
John	85
Emily	92

- 3 More examples
- 4 Latex-Exercise

Arrangement of Figures

- A *float* is a container for something that cannot be broken over a page e.g. figures and tables
- To create a figure, use the **figure** environment.
- To display images, your **preamble** must include `\usepackage{graphicx}`, which gives access to the `\includegraphics{}` command

```
\begin{figure}  
    \centering  
    \includegraphics[options]{imagefile}  
    \label{fig:myfigure}  
\end{figure}
```

- Options can be replaced with keywords: `[scale=0.1]`, `[width=1cm, height=1cm]`, etc.

Float placement

- Generally \LaTeX does a good job of positioning floats, but you can pass specifiers to exercise more control over the placement of figures

```
\begin{figure}[htbp]  
...
```

- [More on figure and placement options](#)
- [How to put a float exactly where you want it](#)

Exercise on Figure Arrangements

- Display the DIAT logo in your report.
- Display the DIAT and DRDO logo in your report.
- Add a caption to the figure Environment
- Change the height, width, and scale of the figure
- [More on figure and placement options](#)
- [How to put a float exactly where you want it](#)



Figure 1: Three Figures with a Caption

Image with subcaptions: Add `subcaption` package in the preamble



Figure 2: Subcaption Example

```
\begin{figure}
  \subcaptionbox{DIAT-1}{\includegraphics[scale=0.2]{diat}}
  \subcaptionbox{DIAT-2}{\includegraphics[scale=0.2]{diat}}
  \subcaptionbox{DIAT-3}{\includegraphics[scale=0.2]{diat}}
  \caption{Subcaption Example}
\end{figure}
```



(a) First subfigure.



(b) Second subfigure.



(c) Third subfigure.

Figure 3: Creating Subfigures in L^AT_EX.

```
\begin{figure}
\centering
\begin{subfigure}{0.3\textwidth}
\centering
\includegraphics[scale=0.2]{diat}
\caption{First subfigure.}
\label{fig: first}
\end{subfigure}
\hfill
```

...

```
\caption{Creating Subfigures in LATEX.}
```

Mathematical Equations

How to typeset mathematical equations?

- 1 To enable the full access of mathematical environment, it is recommended to add `"\usepackage{amsmath}"` in preamble
- 2 Inline math mode: using dollar(\$) signs between equation:
e.g. `$e=mc^2$` for $e = mc^2$ describes mass-energy equivalence
- 3 The equation environment (the code below is typeset as equation 1)

```
\begin{equation}\label{eq:integraldemo}
```

$$y=\int_0^{\infty} f(x)dx$$

```
\end{equation}
```

It will show:

$$y = \int_0^{\infty} f(x)dx \quad (1)$$

Exercise on Mathematical Equations

Inline maths eq: Generate the following equation in inline maths expression



$$a + b = c$$

$$\frac{a}{b}$$

$$x^2 + y^3$$

$$\sqrt{x + y}$$

$$\int_a^b f(x) dx$$

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

$$f(x) = \left(\frac{x^2 + 1}{x - 1} \right)$$

Useful links: [Various lists](#) & [Commands](#)

Ans:

```
\[ a + b = c \]
\[ \frac{a}{b} \]
\[ x^2 + y^3 \]
\[ \sqrt{x + y} \]
\[ \int_a^b f(x) \, dx \]
\[ A = \begin{bmatrix}
1 & 2 \\
3 & 4 \end{bmatrix} \]
\[ f(x) = \left( \frac{x^2 + 1}{x-1} \right) \]
```

Equation environment: Get the following equations

❶ Simple Equation:

$$a + b = c \tag{2}$$

❷ Fraction:

$$\frac{a}{b} \tag{3}$$

❸ Exponents:

$$x^2 + y^3 \tag{4}$$

❹ Square Root:

$$\sqrt{x + y} \tag{5}$$

❺ Summation:

$$\sum_{i=1}^n x_i \tag{6}$$

❻ Integration:

$$\int_a^b f(x) \, dx \tag{7}$$

❼ Matrix:

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \tag{8}$$

① Equation with Brackets:

$$f(x) = \left(\frac{x^2 + 1}{x - 1} \right) \quad (9)$$

Multiple Equations

```
\begin{equation}
\begin{split}
x + y &= 5 \\
x + 10y &= 10
\end{split}
\end{equation}
```

Output is

$$\begin{aligned} x + y &= 5 \\ x + 10y &= 10 \end{aligned} \quad (10)$$

Generate the following coupled equation split environment

$$\begin{aligned}\frac{\partial \mathbf{u}}{\partial t} + (\mathbf{u} \cdot \nabla) \mathbf{u} &= -\frac{1}{\rho} \nabla p + \nu \nabla^2 \mathbf{u} + \mathbf{f}_{\text{ext}} \\ \nabla \cdot \mathbf{u} &= 0\end{aligned}\tag{11}$$

```
\begin{equation}
  \begin{split}
    \frac{\partial \mathbf{u}}{\partial t} + (\mathbf{u} \cdot \nabla) \mathbf{u} &= -\frac{1}{\rho} \nabla p + \nu \nabla^2 \mathbf{u} + \mathbf{f}_{\text{ext}} \\
    \nabla \cdot \mathbf{u} &= 0
  \end{split}
\end{equation}
```

Citations and References

Using the natbib package and BibT_EX program

- L^AT_EX is capable of numerical citations, with very limited formatting styles.
- Natbib is a popular package ”\usepackage{natbib}” for handling various citation styles
- Supporting files required citation purpose:
 - A .bib file containing BibT_EX-formatted references
 - \usepackage{natbib} in your preamble
 - \bibliography{mybibfile} makes your bibliography from the file mybibfile.bib.
 - Set the style using \bibliographystyle{style} Styles include: unsrt, srt, plain, apa, agu, dcu, plainnat, etc.
- Generate in-text citations using \cite{key1}, or \citet{key}

BibTeX Database and Citation Examples

- Step 1: Identify the research contents on [Google Scholar](#) and collect the BibTeX data.

```
@article{Key1,  
    title={Titel of the content},  
    author={Author's names},  
    journal={Name of journal},  
    volume={vol},  
    number={number etc},  
    pages={no of pages},  
    year={yr},  
    publisher={publication details}  
}
```

- Step 2: store it in **.bib** file type. For example say **myRef.bib**

Note: You can generate a BibTeX database using your reference manager (e.g. [JabRef](#), [Mendeley](#), etc.)

- Step 3: Add natbib, ref file, and citation style in the main T_EXfile

```
\documentclass{articles}
\usepackage[square,numbers]{natbib}

\begin{document}
    \section{My References}

    Here is the citation \cite{key1}

    \bibliographystyle{plain}
    \bibliography{myRef}
\end{document}
```

Note: The BibT_EX can handle citation for research articles, Book, proceedings, etc.

Step1: Collect the Bib \TeX data for following research articles:

- Book: **Fundamentals of Aerodynamics (SI units)**
- Research article: **M.K. Dewangan, SK Panigrahi, Finite element analysis of hybrid 3D orthogonal woven composite subjected to ballistic impact with multi-scale modeling, Polymers for Advanced Technologies 32 (3), 964-979 2021**
- Research article: **S. Tiwari, S. Chandel, Effect of stroke plane inclination on the hovering aerodynamic performance of tandem flapping foils, Bioinspiration & Biomimetics 19 (2), 026002, 2024**

Step 2: Cite the above book and article in your main \TeX file and observe the output.

Developing and Managing Large Document

Report/Synopsis/ Book writing

Organizing the contents of a Thesis

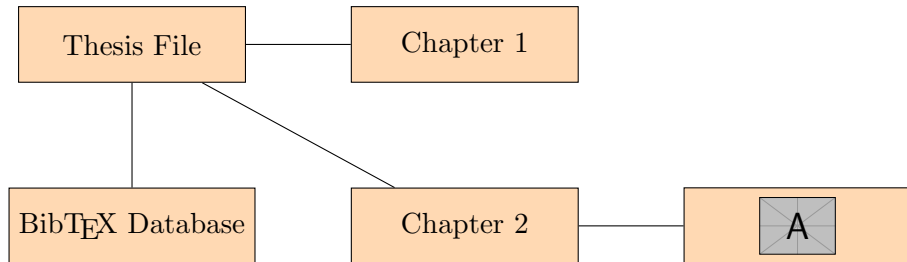
- ① Front matter
- ② Dedication, Declaration, approval, undertaking, certificates, etc.
- ③ Abstract
- ④ Nomenclature
- ⑤ List of Tables and Figures
- ⑥ Chapters
- ⑦ References

Thesis templates: [Overleaf Thesis Templates](#)

Thesis Guide: [A simple Guide to thesis writing](#)

Additional contents: [How to write a Thesis](#)

How do Files Link?



Thesis.tex is the document you compile.

The chapters are not complete \LaTeX documents; during compilation, the contents of each chapter file are inserted into the main thesis.tex file using the `\include{ file }` command.

Steps to Handle the Thesis Section

```
\documentclass[a4paper,12pt,oneside]{report}
\usepackage[utf8]{inputenc}
\usepackage{graphicx,ragged2e,comment,graphicx,subcaption,fancyh
\usepackage[square,numbers]{natbib}

\date{}

% % % % % % % % % % Rename the bibliography with References
\renewcommand{\bibname}{References}
\begin{document}
    \include{folder/file}
    % OR
    \input{folder/file}

    ...
\end{document}
```

```

...
\begin{document}
    %%%%%%%%%%%%%%% Title of the thesis
    \pagenumbering{roman}
    \setcounter{page}{0}
    \doublespacing \include{title/title}
    %%%%%%%%%%%%%%% Dedication page
    \doublespacing \include{approval/approval}
    %%%%%%%%%%%%%%% Abstract
    \singlespacing \include{abstract/abstract}
    %%%%%%%%%%%%%%% Table of contents
    \tableofcontents \listoffigures \listoftables
    %%%%%%%%%%%%%%% Chapter 1
    \singlespacing \pagenumbering{arabic} \setcounter{page}{1}
    \include{introduction/intro}
    %%%%%%%%%%%%%%% chapter 2
    \singlespacing \include{ch2/ch2}
    %%%%%%%%%%%%%%% References
    \clearpage \include{references/references}
\end{document}

```

Alternative format thesis

A collection of papers

- If you are submitting an alternative format thesis (including a collection of published papers) this is easily achieved using the `\includepdf{}` command
- The required package `pdfpages` is already in the preamble of the template

Structure of a Presentation

- ① Front Matter (Title, Author's details, Affiliation, Logo, etc)
- ② Main contents (Equations, Figures, Tables, etc)
- ③ End Slide (Thankful node, contacts, etc.)

Basic steps of building a presentation in L^AT_EX

Steps of building presentation

Step 1: Select the document class "beamer" `\documentclass[options]{beamer}`
and the theme of the presentation

Step 2: Create a frame environment for each slide with script
`\begin{frame} Contents of the frame \end{frame}`

Step 3: Give the frametitle and subtitles in each frame by
`\frametitle{title}\framesubtitle{title}`

Step 4: Fill the contents in each slides

Step 5: Repeat Step 2- 4

Resources:

[Beamer Theme](#)

[Beamer Theme Gallery](#)

[Templates and tutorials on Beamer](#)

Some Basic Commands

Build a block:

First block

Contents for block

Build another block:

Second block

Contents for block

Example with Pauses

- This is the first line.

Example with Pauses

- This is the first line.
- This is the second line, which appears after a pause.

Example with Pauses

- This is the first line.
- This is the second line, which appears after a pause.
- This is the third line

Exercise on Beamer Slide

- Create a new \TeX file with beamer as document class
- Add the relevant details of presenter (Author's Name, Affiliation, Logo etc.)
- Add a frame and include `\titlepage` in it and see the changes
- Add another frame and include `\tableofcontents`
- Add another frame with their title "My First Presentation in \LaTeX "
- Add a subtitle in the same frame " Here is the subtitle of this frame"
- Add the "pause " command after each item in a list

```
\begin{frame}\titlepage\end{frame}
```

```
\begin{frame}{Outline} \tableofcontents_\end{frame}
```

```
\section{Introduction}\begin{frame}{Introduction}\frametitle{Introduction}You
```

Resources

- Basic Commands and Cheat sheets for beginners
- Book: LaTeX Beginner's Guide - Second Edition by Stefan Kottwitz — 4 October 2021
- L^AT_EX in 24 Hours: A Practical Guide for Scientific Writing, Dilip Dutta
- Exercise Sheet1: & Exercise Sheet2:
- Exercise-Ref-Latex-Book
- PPT on Latex tutorials
- L^AT_EX Stack Exchange
- L^AT_EX Cheat Sheet
- The L^AT_EX Wikibook
- Excel to L^AT_EX Converter and L^AT_EX Table Maker
- T_EX users group FAQ
- The not so short introduction to L^AT_EX 2_ε
- Getting to grips with L^AT_EX (a series of tutorials)
- www.latex-tutorial.com



THANKS

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