

Basic LaTeX Tutorial

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1 INTRODUCTION

THIS tutorial is made to help you learn the basics of creating a good LaTeX document that is in IEEE format. IEEE format is the standard for writing technical documents in computer science and related fields which will come in handy for your later undergraduate engineering courses. Many professional jobs you may try to apply to after you graduate will require proficiency in LaTeX, so it's better to start learning now rather than later.

1.1 Getting Started: Creating an Environment to Write Text On

Generally, the first line of your code will be the command `\documentclass{}`. After that, you generally want to add a title, author, and date. Each is on its own line of code, written like `\title{}`, `\author{}`, and `date{}`. Additionally, don't forget to add a `\usepackage{}` which is like importing a library from python but on LaTeX. These parts all together is generally called the preamble [1]. In each of these commands, include the respective data inside of the curly brackets. Then, to start the main body of your .tex document, you will need to write: `\begin{}`. If you used the `\title` at the beginning of your code, please include a `\maketitle` command after your `\begin{}` command in order to properly display all of your preamble properties. This will be the very first line of your code after the previous steps. Once you are done writing your document, you will end your code with `\end{}`, but we'll get to that later.

2 RESERVED CHARACTERS

LaTeX has various characters that are "reserved" for specific manipulation purposes within your

LaTeX code that is not just normal text [2]. These include: `\`, `~`, `\\`, and `%`. To display these characters in your text without specifically utilizing their functions, you may use the `\verb` command along with the reserved character you want to display.

- The main function of the `\` character is to use a command in your code just like in `\begin{}` command and the rest of the commands that have this character.
- The `~` character is used to have a fixed space between text [3].
- The `\\` character is used to end a line that you are writing on and allow the next text to begin on a new line.
- Finally, the `%` character is used to write comments in your LaTeX code. Any text that is written after a `%` will not be compiled.

3 CREATING SECTIONS IN YOUR TEXT

- The sections in your text can also be treated as headings.
- To create sections in your text, you use the `\section` command at the top of your code along with the rest of your text below that command.
- To create subsections in your text, use the `\subsection{}` command after your `\section` command, along with the text you want to include in your subsection.

4 BODY TEXT: PARAGRAPHS AND CONTENT

To write paragraphs and normal text in your LaTeX document, just type in normal text without any commands between the starting commands `\begin{document}` and `\end{document}`. You can write normal text in between sections, subsections, etc. But, the main reason why we have these commands is to allow us to have different

environments where we can properly display things like tables, figures, bibliographies, and much more. We will be covering that all here in this tutorial.

5 TABLES

- 1) To start creating basic tables in LaTeX, you will first need to use the `\begin{table}[h]` command.
- 2) Then you want to enter a command like `\centering` on a single line to make your table appear on the center of your screen to make it pop.
- 3) To be able to enter content into a table, you then need to include the `\begin{tabular}` command, along with some symbols in the blank curly brackets. The symbols that you use are `l`, `c`, `r`, `\hline`, `\`, a vertical line (`\vline`) [4]. The letter `l` will align your text to the left and `r` will align your text to the right. [1]. Using `c` will center the text on each cell of your table. A vertical bar symbol will insert a dash into the cell which will look like this: `_`. Using `\` will begin a new row after you specify your rows in the table.
- 4) Use the `\hline` command on a single line of code to generate the top horizontal line of your table.
- 5) Enter the data you want to include in the cells of your table. For example, in a 2x3 table, you can write something like: `Yes & No \`. This will fill the first row of your table.
- 6) Add another `\hline` to add the horizontal line that goes in the middle of the table
- 7) On a separate line of code, write something like: `1 & 2 \` to fill the second row of your table. The `&` operand allows you to separate the two entries "1 and 2" to be placed on the left and right cells of your table.
- 8) Add a `\hline` to place the middle horizontal line of your table.
- 9) Add a final row by writing something like: `Go & Slugs \`
- 10) Add a final `\hline` to place the bottom horizontal line of your table.
- 11) Finally, on separate lines of code, write `\end{tabular}` and `\end{table}`.
- 12) If you'd like, you can label your tables by adding a `\caption{}` line with

the name of the table inside the curly brackets. This line should go after the `\begin{table}[h]` line.

- 13) Your table should then look something like this:

TABLE 1
Your Table Name

Yes	No
1	2
Go	Slugs

6 FIGURES

Creating figures in LaTeX is fairly straightforward. I will be showing you how to include a figure of a graph that was generated with a sample data table from a titration lab, which is a type of data collection for a chemistry experiment.

- 1) To make a graph of a table of data, you can use Google Sheets. You first need to have the data in the cells of the sheet, and using Google Sheet's graph-making features, make a graph which can then be downloaded into a pdf or image file.
- 2) First, make sure that an image file is present in the same directory. To begin including a figure in your document, first, enter the `\begin{figure}[h]` command.
- 3) Then, if you would like to center your image with the page, enter `\centering` on a separate line of code.
- 4) To insert the figure/image into your document, enter the `\includegraphics[width]{}` command on a separate line of code and write the width you would like of the image on the page. Then write the name of the figure file in the curly brackets.
- 5) Finally, end the figure process by including a `\end{figure}` command. You should have something like this:

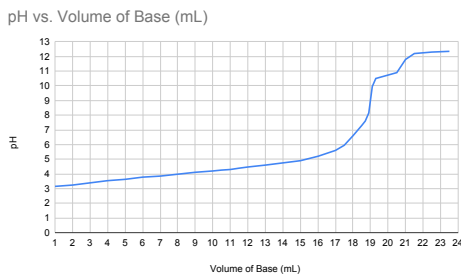


Fig. 1. Titration Plot

- From looking at figure 1, we can come to the conclusion that the pH increases when the volume of base increases.

7 MATH FORMULAS

7.1 In-line

- To make a math equation go along with your normal text, use the `$` command at the beginning and end of your formula [1]. For example, you can make the Pythagorean theorem formula by writing `$a^2 + b^2 = c^2$` which will look like: $a^2 + b^2 = c^2$.

7.2 Display

- To make your math equation show in display mode, place your equation in between these characters: `\[\]` [1]. If you place the slope-intercept formula in there it should look something like this:

$$y = mx + b$$

7.3 Symbols

- LaTeX can display all types of mathematical symbols. Aside from the ones that already exist in your keyboard like `+` or `-` [5], LaTeX can help you create sophisticated math formulas that are appropriate for an engineering setting. For example, to include the delta symbol in latex, simply type the command for the symbol in between the `$` signs [5]. For example, to show the greek letter "delta" (δ) in LaTeX, you would type it as: `δ` [5]. Other symbols like γ and θ can be shown by simply writing `γ` and `θ` [5].

7.4 Fractions

- To create fractions, use the `$\frac{}{}$` command, placing your numerator in the first curly bracket and your denominator in the second curly bracket [5]. To create a simple fraction like $\frac{1}{2}$, simply write `$\frac{1}{2}$` .

7.5 Superscript and Subscript

- To create superscripts (exponents) in your mathematical formulas, simply use `$^$` and place it in front of your text or number. For example, to write x^2 , simply type `x^2` .
- To create subscripts in your mathematical formulas, use the `$_$` command in front of your text or number and then type your additional numbers or text in the curly brackets [5]. For example, to show something like x_{n+1} , simply type `x_{n+1}` .

7.6 Sophisticated Formulas

- LaTeX allows you to create some pretty complex formulas as well. First, make sure you have the `\usepackage{amsmath}` command in the preamble section of your LaTeX code [5]. For example, to create the n choose k formula, you can use the fraction command along with the binomial command `\binom` [5]. To do this, type `$\frac{n!}{k!(n-k)!} = \binom{n}{k}$` and you should get something like this: $\frac{n!}{k!(n-k)!} = \binom{n}{k}$ [5].
- For the calculus experts, to create integrals in LaTeX you need to use the `\int_{}^{}` and place your limits of integration in the curly brackets, all along with your integrand function and your `dx` [6]. You can use all of the math commands we have discussed here in your integrals as well. For example, to make an integral with a fraction integrand, along with variables containing exponents, you can write something like `$\int_{}^{} \frac{}{} \, dx$` [6]. You can then place your respective numerator and denominator in the curly brackets found in the `\frac` function.
- For example, if we have an integral for $2x - 5/5x^2$ integrated from 0 to 10 it should look something like this:

$$\int_0^{10} \frac{2x - 5}{5x^2} dx$$

8 HOW TO CREATE ACKNOWLEDGEMENTS

Whenever you use outside resources to write up a document, you need to acknowledge the people, websites, or other entities that helped you write up your document. This is an extra step in making your document look more credible and to avoid plagiarism.

- 1) To begin, use the `\section*{}` where the star means that it will be an un-numbered section which makes it look separate from the rest of your document.
- 2) To write an acknowledgment, you can simply write something like: "I would like to acknowledge" along with a list of the people or entities who helped you with writing up this work.
- 3) To create a list, simply write the commands `\begin{itemize}` and `\end{itemize}` on separate lines of code [1].
- 4) Then, in between those two lines, include a `\item` line along with your text on the same line of code. You can have as many `\item` commands as you'd like [1].

9 HOW TO CREATE A REFERENCES SECTION

This is where your citations for the sources that you used in your document will go. As an engineering student, you are expected to format your citations in IEEE format.

- 1) To begin your references section, first include the command `\begin{thebibliography}{1}` in your code.
- 2) Then, create a label for your specific citation with `\bibitem{}`. Create a general name to place inside the curly brackets. Write your IEEE citation under this line of code.
- 3) To make an in-text citation, simply write `\cite{}` along with the same text you wrote in the `\bibitem` command's curly brackets. Then place this command in the location of your in-text citation in your document.
- 4) Finally, close out this section with the `\end{thebibliography}` command.

To be able to refer back to a figure that you included in your document, use the `\label{}` command and place it in between the `\caption{}` and `\end{figure}` commands where you wrote the code to include the figure in your document

[7]. Then, when referring to your figure in your sentence, use the `\ref{}` command and write the same name that you wrote inside the curly brackets of the `\label{}` command into the curly brackets of the `\ref{}` command [7]. A number should appear that refers to the figure in your document. If there is only one figure in your document, a 1 will appear. If there are more figures in your document, a different number will appear that corresponds to the specific figure that you are referring to.

CONCLUSION

This concludes the basic tutorial which includes everything that you will need to start learning the essentials of LaTeX to later use in your upper-division engineering classes and your careers!

ACKNOWLEDGEMENTS

I would like to thank the following people and websites for helping me write up this assignment...

- Professor Gerald Moulds, for teaching me many LaTeX commands and syntax with the comments in the code of his LaTeX IEEE Tutorial Template that he provided for his CSE 185S students. Also thanks to him for providing the sample data document for the titration lab experiment that we used to help us generate our graph.
- ChatGPT, which helped me debug some of my LaTeX code (I will document my use in separate documents).
- Overleaf.com, who helped me learn a lot of latex code and syntax with its various articles that I accessed when creating this document.
- latexref.xyz for helping me learn what reserved characters mean.
- Wikibooks.com for helping me learn what the tilde character meant and many LaTeX mathematical syntax and commands.
- Emerson.edu for helping me learn how to use the `\vline` command.
- Scribbr.com for helping me learn how to write my references in IEEE format.
- Google Sheets for helping me produce the titration graph using Professor Mould's titration data.
- The ZornScience YouTube channel for providing me with a video that helped me produce a graph for the titration data.

- Grammarly for helping me proofread my document and help fix some grammatical errors.

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