LaTeX

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What is LaTeX

- LaTeX is a document preparation system to produce articles, research papers, book etc. of high typographical quality.
- It is based on TeX, a low-level markup and programming language.
- It is developed by *Lesile Lamport* in 1982.

Advantages of LaTeX

- It produces documents of high typographical quality.
- It saves time and effort by automating common tasks like page layout, equation numbering, table of contents, list of figures etc.
- It supports the typesetting of mathematical formulae in a professional way.
- It easily creates footnotes, index and bibliography etc.
- It is free and portable across different operating systems.

How to Install LaTeX?

- First install its engine Miktex: `https://miktex.org/download`.
- Always check your operating system's bits support: **32-bit OS or 64-bit OS**.
- Next install the Editor TexMaker/WinEdt/TexStudio: `https://www.xm1math.net/texmaker`.
- Now you are ready to execute your files in LaTeX by clicking **Quick Build**

Basic Structure

The LaTeX source file, say **myDoc.tex** has the following basic structure:

```
\documentclass[options]{class}
\usepackage{packageName}
\begin{document}
Put your text here.
\end{document}
```

class: `article`, `report`, `book`, `letter`, `beamer`.
options: `11pt`, `12pt`, `landscape`, `a4paper`, `twocolumn`, `twoside`, etc.

A Simple Example

```
\documentclass[12pt]{book}
\begin{document}
This is my first document.
\end{document}
```

This is my first document.

Setting Font Size

Command	10pt	11pt	12pt	Result
\tiny{Any Text}	5	6	6	Any Text
\scriptsize{Any Text}	7	8	8	Any Text
\footnotesize{Any Text}	8	9	10	Any Text
\small{Any Text}	9	10	11	Any Text
\normalsize{Any Text}	10	11	12	Any Text
\large{Any Text}	12	12	14	Any Text
\Large{Any Text}	14	14	17	Any Text
\LARGE{Any Text}	17	17	20	Any Text
\huge{Any Text}	21	21	25	Any Text
\Huge{Any Text}	25	25	25	Any Text

Setting Font Size

```
\large{Text with font size large}.

\begin{LARGE}
Text with font size LARGE.
\end{LARGE}
```

Text with font size large.

Text with font size LARGE.

Formatting Text

Command	Environment	Purpose	Result
`\textrm{Any Text}`	`\begin{rmfamily}` ... `\end{rmfamily}`	For Roman style	Any Text
`\textbf{Any Text}`	`\begin{bfseries}` ... `\end{bfseries}`	For Boldface	**Any Text**
`\textsf{Any Text}`	`\begin{sffamily}` ... `\end{sffamily}`	For sans serif	Any Text
`\textit{Any Text}`	`\begin{itshape}` ... `\end{itshape}`	For Italic style	*Any Text*
`\underline{Any Text}`		To underline text	Any Text

Formatting Text

```
\textit{This text is italic}.

\begin{itshape}
This text is also italic.
\end{itshape}

\textbf{This text is bold}

\begin{bfseries}
This text is also bold.
\end{bfseries}

Some of the greatest discoveries are
made by \underline{accident}.
```

This text is italic.
This text is also italic.
This text is bold
This text is also bold.
Some of the greatest discoveries are made by accident.

Exercise 1: Format the following:

Dr Bhim Rao Ambedkar, popularly known as **Babasaheb Ambedkar**, is a celebrated leader, who flagged the Constitution of India. He was a well-known statesman who fought for the *rights of the Dalits* and other **socially backward classes**.

Answer

```
Dr Bhim Rao Ambedkar, popularly known as
\textbf{Babasaheb Ambedkar}, is a celebrated leader,
who flagged the \underline{Constitution of India}.
He was a well-known statesman who fought for
the \textit{rights of the Dalits} and other
\underline{\textbf{socially backward classes}}.
```

Spacing, Line Breaking and Page Breaking

Command	Purpose
\newpage	Start a new page at that point.
\newline or \\	End a line without justifying it.
\linebreak	End a line and justifies it.
\hspace{unit}	Produce a horizontal space of defined size.
\vspace{unit}	Produce vertical space of defined size.

- One or more than one blank space will be treated as single blank space.
- A single *Enter* (from keyboard) is also treated as a single blank space.
- More than one *Enter* (from keyboard) marks the beginning of a new paragraph.

Example: Spacing, Line Breaking and Page Breaking

```
Single blank space.
Multiple    blank     spaces.

Use of hspace \hspace{0.5 cm} for fixed horizontal spacing.\\

Effect of Multiple Enter. \linebreak
Observe effect of linebreak.
```

Single blank space. Multiple blank spaces.
Use of hspace for fixed horizontal spacing.

Effect of Multiple Enter.
Observe effect of linebreak.

Text color and Background color

Include the package 'color' by inserting the command '\usepackage{color}' in the preamble of LaTeX document (before the command '\begin{document}').

The syntax to set text color is:

```
\textcolor{color_name}{text}
```

The syntax to set background color is:

```
\colorbox{color_name}{text}
```

```
\textcolor{red}{text with red color}

\colorbox{yellow}{Notice yellow background color}
```

text with red color

Notice yellow background color

Exercise 2: Format the following:

Research Methodology and Research Ethics are the two compulsory subjects for M.Phil./Ph.D. students to enhance their research activity

and produce quality research works.

Answer

```
\textcolor{red}{Research Methodology} and
\textcolor{blue}{Research Ethics} are the two
compulsory subjects for M.Phil./Ph.D. students
to \colorbox{yellow}{enhance their research activity} \\
\vspace{0.3in}
and \colorbox{green}{produce quality research works}.
```

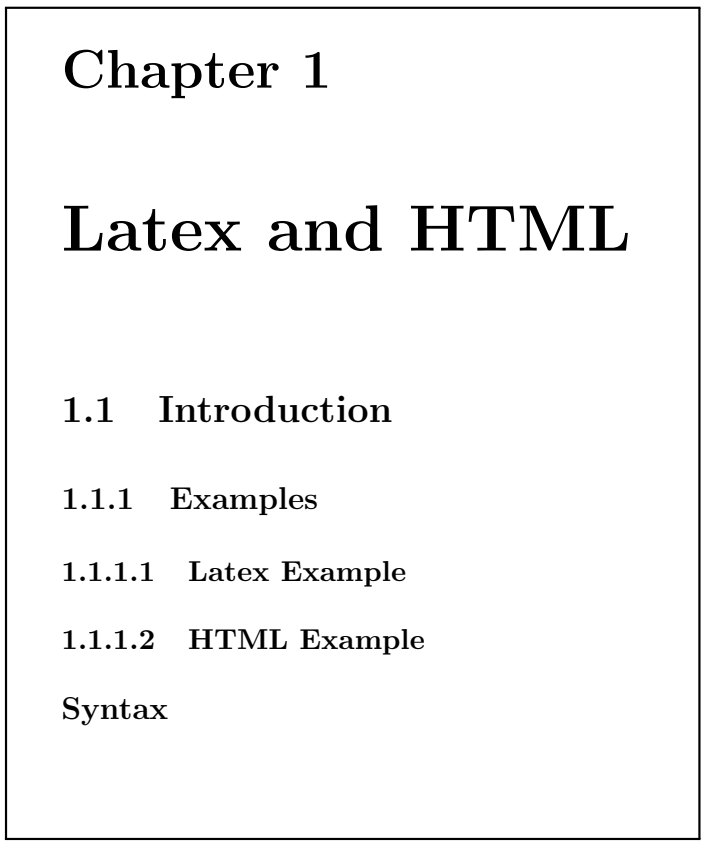
Making Sections, Subsections, ...

Command	Purpose
\chapter	Starts a new chapter, applicable only in report and book, not in article.
\part	Divide the whole document into the parts.
\section	Starts a new section.
\section*	Section with no numbering.
\subsection	Starts a new subsection.
\subsubsection	Starts a new subsubsection.

LaTeX automatically generates the numbering for chapters, sections, subsections and so on. If no section numbering is required then just append the command with an asterisk (*).

Making Sections, Subsections, ...

```
\documentclass[12pt]{book}
\setcounter{secnumdepth}{3}
\begin{document}
\chapter{Latex and HTML}
\section{Introduction}
\subsection{Examples}
\subsubsection{Latex Example}
\subsubsection{HTML Example}
\subsection*{Syntax}
\end{document}
```



Environments

Environment Name	Purpose
itemize	An unordered list with bullets.
enumerate	An ordered list with numbered labels.
tabular	To create table.
table	Insert a table with caption.
eqnarray	Display aligned math formulae.
equation	Centered math formula with equation number.
figure	Insert a figure with caption.
flushleft	Text is aligned on the left, lines end with \\.
flushright	Text is aligned on the right, lines end with \\.
theorem	Make a numbered theorem.
thebiblipgraphy	The bibliography or reference section.
titlepage	Making a separate title page of your choice.
array	Produce arrays in math environment.

A general syntax for an environment is:

```
\begin{environment_name}
...
\end{environment_name}
```

Listing: Ordered List

LaTeX provides the environment ‘enumerate’ to create an ordered list. It can be nested up to four levels.
The default labeling scheme is:

- Arabic number (1, 2, 3, ...) for Level 1
- Lowercase letter (a, b, c, ...) for Level 2
- Lowercase Roman numeral (i, ii, iii, ...) for Level 3
- Uppercase letter (A, B, C, ...) for Level 4.

The command ‘\item’ is used to define a list item.

Simple Ordered List

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

\item Second item

\item Third item
\end{enumerate}
```

1. First item
2. Second item
3. Third item

Nested ordered List

```
\begin{enumerate}
  \item The first item.
  \begin{enumerate}
    \item First nested list.
    \begin{enumerate}
       \item Second nested list.
       \begin{enumerate}
          \item Third nested list.
       \end{enumerate}
    \end{enumerate}
 \end{enumerate}
 \item The second item.
\end{enumerate}
```

1. The first item.
   (a) First nested list
      i. Second nested list
         A. Third nested list
2. The second item.

Unordered List

LaTeX provides the environment `'itemize'` to create an unordered list. Like ordered list, it can be nested up to four levels.
The default labeling scheme is:

- • for Level 1.
- – for Level 2.
- ∗ for Level 3.
- · for Level 4.

Simple Unordered List

```
\begin{itemize}
\item item 1

\item item 2

\item item 3
\end{itemize}
```

- item 1
- item 2
- item 3

Nested Unordered List

```
\begin{itemize}
   \item The first item.
   \begin{itemize}
      \item First nested list
      \begin{itemize}
         \item Second nested list
         \begin{itemize}
            \item Third nested list
         \end{itemize}
      \end{itemize}
 \end{itemize}
 \item The second item.
\end{itemize}
```

- The first item.
  - First nested list
    - Second nested list
      - Third nested list
- The second item.

Exercise 3: Format the following:

Chapter 1

Mathematics

1.1 Compulsory Papers

1.1.1 Core Papers

1. Analysis 1
2. Calculus 1

1.1.2 Elective Papers

1. History of India
2. Micro Economics

1.2 Optional Papers

- Number Theory
- Bio Mathematics

Answer

```
\documentclass[11pt]{book}
\begin{document}
\chapter{Mathematics}
\section{Compulsory Papers}
\subsection{Core Papers}
\begin{enumerate}
\item Analysis 1
\item Calculus 1
\end{enumerate}

\subsection{Elective Papers}
\begin{enumerate}
\item History of India
\item Micro Economics
\end{enumerate}

\section{Optional Papers}
\begin{itemize}
\item Number Theory
\item Bio Mathematics
\end{itemize}

\end{document}
```

Chapter 1

Mathematics

1.1 Compulsory Papers

1.1.1 Core Papers

1. Analysis 1
2. Calculus 1

1.1.2 Elective Papers

1. History of India
2. Micro Economics

1.2 Optional Papers

- Number Theory
- Bio Mathematics

Table of Contents

Use command '\tableofcontents' after the command '\begin{document}' to create table of contents.

```
\documentclass[11pt]{book}
\begin{document}
\tableofcontents
\chapter{Mathematics}
\section{Compulsory Papers}
\subsection{Core Papers}
\begin{enumerate}
\item Analysis 1
\item Calculus 1
\end{enumerate}

\subsection{Elective Papers}
\begin{enumerate}
\item History of India
\item Micro Economics
\end{enumerate}

\section{Optional Papers}
\begin{itemize}
\item Number Theory
\item Bio Mathematics
\end{itemize}
```

Table of Contents

Contents

Creating Table

LaTeX provides the environment 'tabular' to create a table.

The general syntax is:

```
\begin{tabular}{parameters}
r11 & r12 & ... & r1m \\
\hline
r21 & r22 & ... & r2m \\
\hline
....
\hline
\rm1 & rm2 & ... & rmn \\
\hline
\end{tabular}
```

Parameters can take following values:

- The parameters **l, c** and **r** are used for a column of *left, center* and *right* aligned text respectively.
- To put vertical line between columns, use '|' in options.
- The column entries are separated by & symbol.
- \hline to put horizontal line between rows.

Creating Table

```
\begin{tabular}{|r|c|}
  \hline
   \textbf{Student Name} & \textbf{Marks} \\
    \hline
    Pawan & 90 \\
    \hline
    Naveen & 89 \\
    \hline
    Deepak & 80 \\
    \hline
\end{tabular}
```

Student Name	**Marks**
Pawan	90
Naveen	89
Deepak	80

Table with Caption

```
\begin{table}
\centering
\begin{tabular}{|r|c|}
  \hline
   \textbf{Student Name} & \textbf{Marks} \\
    \hline
    Pawan & 90 \\
    \hline
    Naveen & 89 \\
    \hline
    Deepak & 80 \\
    \hline
\end{tabular}
\caption{Marks Details}

\end{table}
```

Student Name	**Marks**
Pawan	90
Naveen	89
Deepak	80

Table 1: Marks Details

Exercise 4: Create the following table:

Student Name	**Algebra Marks**	**Analysis Marks**
Pawan	90	95
Naveen	89	88
Deepak	80	87

Inserting Images

To insert images or pdf files, include the package ‘graphicx’ in the preamble of the LaTeX document.

To assign a caption, include the package ‘caption’.

Ensure that the image or pdf file lies in the same folder where the LaTeX file lies otherwise specify the complete path.

The general structure of the *figure* environment is:

```
\begin{figure}[float]
  \includegraphics[options]{image/file}
  \caption{captionText}
  \label{labelText}
\end{figure}
```

Figure Options and Settings

The parameter '`float`' can takes following values:

Float	Purpose
h (here)	Same location
t (top)	Top of the page
b (bottom)	Bottom of the page
! (override)	Force the specified location
H (precised)	Placed at precised location

The command '`\includegraphics`' can take the following options:

option	Purpose
width	To set width (in cm., inches or fraction of line width)
height (top)	To set height
trim	To crop image/file (trim = l b r t)
rotate	to rotate at specified angle

Inserting Figure

```
\documentclass{book}
\usepackage{graphicx}
\usepackage{caption}
\begin{document}
\begin{figure}[h]
\includegraphics[width=3cm, height=3cm]{bird.jpg}
\caption{Birds}
\label{mark1}
\end{figure}


Consider the picture shown in figure \ref{mark1}.
\end{document}
```

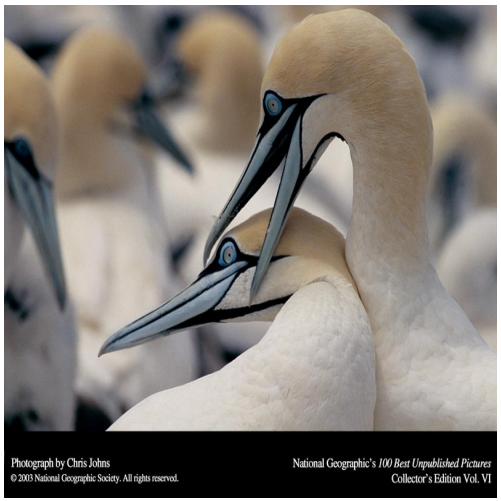


Figure 1: Birds

Consider the picture shown in figure 1.

Cropping and Rotating Figure

```
\documentclass{book}
\usepackage{graphicx}
\usepackage{caption}
\begin{document}
\begin{figure}[h]
\includegraphics[trim=0in 1in 0in 0in,clip=true,
 width= 3.5cm, height = 3.5cm, angle = 30]{bird.jpg}
\caption{Birds}
\label{mark2}
\end{figure}


Consider the picture shown in figure \ref{mark2}.
\end{document}
```

Figure 2: Birds

Consider the picture shown in figure 2.

Cross-Reference

In LaTeX, you can cross-refer almost everything that is numbered (like chapter, section, subsection, figure, table etc.).

The required commands for references and cross-references are:

- `\label{mark}`

  Put the command `\label` after the declaration of object, you want to label. But in case of environments, it should be placed inside the environment.

- `\ref{mark}`

  The command `\ref` is used for referencing the object that has been labeled earlier with label '`mark`'. This prints the number that was assigned to the object.

Cross-Reference

```
\section{Introduction} \label{mark3}
This section is introductory.

\subsection{Examples} \label{mark5}

\begin{figure}[!h]
\centering
\includegraphics[width=3cm]{bird}
  \caption{Birds}
  \label{mark4}
\end{figure}

This is a subsection of section
\ref{mark3}. Refer to figure \ref{mark4}.
```

1.1 Introduction

This section is introductory.

1.1.1 Examples

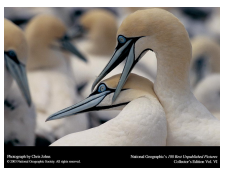


Figure 1.1: Birds

This is a subsection of section 1.1.
Refer to figure 1.1.

Mathematical Typesetting

For mathematical typesetting, include the package ‘amsmath’ in the preamble of the LaTeX document.

- When the mathematical expression appears in the running text, surround the formula with the dollar sign $.
- When the mathematical expression appear in a separate paragraph, surround the formula with the double dollar sign $$ or within \[and \].

```
Equation $x+y=1$ and $$x^2 + y^2=2$$

Another way \[ x + y = 1 \]
```

Equation $x + y = 1$ and

$$x^2 + y^2 = 2$$

Another way

$$x + y = 1$$

Mathematical Equation

LaTeX provides the environment \begin{equation} to insert mathematical equation.

- This environment automatically number each equation. If no equation numbering is required use the environment \begin{equation*}.
- \label command can be used to give a unique label to the equation.
- Use the command \ref to refer a labeled equation.

```
\begin{equation}\label{mark6}
   x^{2}+y^{2} = 1.
\end{equation}
\begin{equation*}
   x/4+y/9 = 1.
\end{equation*}
The equation \ref{mark6} represents a circle
 center at (0,0) with radius 1.
```

$$x^2 + y^2 = 1. \tag{1}$$

$$x/4 + y/9 = 1.$$

The equation 1 represents a circle center at (0,0) with radius 1.

Mathematical Equations

To write a sequence of equations or inequalities, use the environment \begin{eqnarray}.

```
\begin{eqnarray}
   x + 3y = 2. \label{mark7} \\
    x \leq 3 + 4x + 5y. \nonumber
\end{eqnarray}
\begin{eqnarray}
   x + 3y &=& 2.\label{mark8} \\
    x &\leq& 3 + 4x + 5y. \nonumber
\end{eqnarray}
```

$$x + 3y = 2. \tag{2}$$
$$x \leq 3 + 4x + 5y.$$

$$\begin{aligned} x + 3y &= 2. \qquad (3)\\ x &\leq 3 + 4x + 5y. \end{aligned}$$

- Consecutive equations are separated by \\ and to align left and right hand side of equations use &.
- Terminate an equation with command \nonumber, if no equation number required.

Creating Matrix

The 'array' environment is used to create array. The general syntax is:

`\begin{array}{options}`.

The options consist of **l, r** or **c** for left, right and center aligned text.

Separate each column entry by & and end each row with \\.

```
$\begin{array}{ccc}
  1 & 3 & 2\\
  3 & 4 & 1\\
  2 & 8 & 2
\end{array}$

$\left( \begin{array}{ccc}
  1 & 3 & 2\\
  3 & 4 & 1\\
  2 & 8 & 2
\end{array}\right)$
```

$$\begin{array}{ccc} 1 & 3 & 2 \\ 3 & 4 & 1 \\ 2 & 8 & 2 \end{array}$$

$$\left(\begin{array}{ccc} 1 & 3 & 2 \\ 3 & 4 & 1 \\ 2 & 8 & 2 \end{array} \right)$$

Greek Symbols

\alpha	α	\omega	ω	\Gamma	Γ
\beta	β	\mu	μ	\Delta	Δ
\gamma	γ	\nu	ν	\Theta	Θ
\delta	δ	\xi	ξ	\Lambda	Λ
\psi	ψ	\pi	π	\Xi	Ξ
\zeta	ζ	\rho	σ	\Pi	Π
\eta	η	\tau	τ	\Sigma	Σ
\theta	θ	\upsilon	υ	\Phi	Φ
\chi	χ	\phi	ϕ	\Psi	Ψ
\iota	ι	\varphi	φ	\Omega	Ω
\kappa	κ	\varsigma	ς	\epsilon	ϵ

Mathematical Operators

Command	Example	Result
^{}	x^{2}	x^2
_{}	x_{2}	x_2
\frac{}{}	\frac{1}{2}	$\frac{1}{2}$
\sqrt{}	\sqrt{2}	$\sqrt{2}$
\sqrt[n]{}	\sqrt[3]{2}	$\sqrt[3]{2}$
\sum_{}^{}	\sum_{x = 0}^{\infty}e^{x}	$\sum_{x=0}^{\infty} e^x$
\prod_{}^{}	\prod_{k=1}^{n} k	$\prod_{k=1}^{n} k$
\int_{}^{}	\int_{0}^{1}x dx	$\int_0^1 x dx$

Mathematical Functions

Command	Display	Command	Display	Command	Display
\arg	arg	\hom	hom	\sinh	sinh
\cos	cos	\inf	inf	\sup	sup
\cosh	cosh	\ker	ker	\tan	tan
\cot	cot	\lg	lg	\tanh	tanh
\coth	coth	\ln	ln	\arccos	arccos
\csc	csc	\log	log	\arcsin	arcsin
\det	det	\max	max	\arctan	arctan
\dim	dim	\min	min	\lim	lim
\exp	exp	\sec	sec	\liminf	lim inf
\gcd	gcd	\sin	sin	\limsup	lim sup

Brackets, Braces and Delimiters

Command	Result	Command	Result	Command	Result	Command	Result
(	(	)	)	[	[	]	]
\{	{	\}	}	\lfloor	$\lfloor$	\rfloor	$\rfloor$
\lceil	$\lceil$	\rceil	$\rceil$	\langle	$\langle$	\rangle	$\rangle$
/	/	\backslash	\	\underbrace{x}	$\underbrace{x}$	\\|	$\|\|$

```
$$( \frac{n^2+3 n + 2}{n(n+1)} ) = (\frac{n+1}{n})$$.

$$\left ( \frac{n^2+3 n + 2}{n(n+1)} \right ) = \left (\frac{n+1}{n} \right)$$.
```

$$(\frac{n^2+3n+2}{n(n+1)}) = (\frac{n+1}{n})$$

.

$$\left(\frac{n^2+3n+2}{n(n+1)}\right) = \left(\frac{n+1}{n}\right)$$

.

Relation Operators, Symbols

Command	Relation	Command	Relation	Command	Relation
`<`	$<$	`>`	$>$	`\equiv`	$\equiv$
`\leq`	$\leq$	`\geq`	$\geq$	`\sim`	$\sim$
`\prec`	$\prec$	`\succ`	$\succ$	`\simeq`	$\simeq$
`\preceq`	$\preceq$	`\succeq`	$\succeq$	`\approx`	$\approx$
`\cup`	$\cup$	`\cap`	$\cap$	`\neq`	$\neq$
`\subset`	$\subset$	`\supset`	$\supset$	`\cong`	$\cong$
`\subseteq`	$\subseteq$	`\supseteq`	$\supseteq$	`\infty`	∞
`\in`	$\in$	`\pi`	π	`\propto`	$\propto$

Arrows

Command	Result	Command	Result	Command	Result
\leftarrow	$\leftarrow$	\rightleftharpoons	$\rightleftharpoons$	\leftleftarrows	$\leftleftarrows$
\leftarrowtail	$\leftarrowtail$	\Leftarrow	$\Leftarrow$	\hookrightarrow	$\hookrightarrow$
\rightrightarrows	$\rightrightarrows$	\rightarrowtail	$\rightarrowtail$	\rightarrow	$\rightarrow$
\rightharpoonup	$\rightharpoonup$	\leftrightarrows	$\leftrightarrows$	\looparrowleft	$\looparrowleft$
\Rightarrow	$\Rightarrow$	\rightharpoondown	$\rightharpoondown$	\rightleftarrows	$\rightleftarrows$
\looparrowright	$\looparrowright$	\leftrightarrow	$\leftrightarrow$	\uparrow	$\uparrow$
\Lleftarrow	$\Lleftarrow$	\curvearrowleft	$\curvearrowleft$	\Leftrightarrow	$\Leftrightarrow$
\Uparrow	$\Uparrow$	\Rrightarrow	$\Rrightarrow$	\curvearrowright	$\curvearrowright$
\mapsto	$\mapsto$	\downarrow	$\downarrow$	\leftrightharpoons	$\leftrightharpoons$
\nleftarrow	$\nleftarrow$	\hookleftarrow	$\hookleftarrow$	\Downarrow	$\Downarrow$
\rightleftharpoons	$\rightleftharpoons$	\nrightarrow	$\nrightarrow$	\leftharpoonup	$\leftharpoonup$
\upharpoonleft	$\upharpoonleft$	\upharpoonright	$\upharpoonright$	\downharpoonleft	$\downharpoonleft$
\downharpoonright	$\downharpoonright$	\downharpoonright	$\downharpoonright$	\Lsh	$\Lsh$
\Rsh	$\Rsh$	\upuparrows	$\upuparrows$	\downdownarrows	$\downdownarrows$
\updownarrow	$\updownarrow$	\twoheadleftarrow	$\twoheadleftarrow$	\nLeftarrow	$\nLeftarrow$
\leftharpoondown	$\leftharpoondown$	\Updownarrow	$\Updownarrow$	\twoheadrightarrow	$\twoheadrightarrow$
\nRightarrow	$\nRightarrow$	\to	$\to$	\nLeftrightarrow	$\nLeftrightarrow$

Mathematical Formatting

```
If $n=4$, then $n^2 + 4 = 20$.

$\lfloor 4.2 \rfloor = 4.$

The nth term of the sequence is $a_n = n^2 + 1$.

Let $\alpha = 3, \beta = 4$ and $\gamma=5$.

If $\sin \theta = 0$, then $\theta = n \pi$ where $n \in \mathbb{N}$.
```

If $n = 4$, then $n^2 + 4 = 20$.
$\lfloor 4.2 \rfloor = 4$.
The nth term of the sequence is $a_n = n^2 + 1$.
Let $\alpha = 3, \beta = 4$ and $\gamma = 5$.
If $\sin\theta = 0$, then $\theta = n\pi$ where $n \in \mathbb{N}$.

Mathematical Formatting

```
It is not always true that $$\frac{a+b}{c+d} = \frac{a}{c} + \frac{b}{d}$$.

Triangular Inequality: $|a+b| \leq |a| + |b|$.

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots$$

Use of brackets $2^{xy} \neq 2^xy$.
```

It is not always true that

$$\frac{a+b}{c+d} = \frac{a}{c} + \frac{b}{d}$$

.

Triangular Inequality: $|a+b| \leq |a| + |b|$.

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots$$

Use of brackets $2^{xy} \neq 2^xy$.

Mathematical Formatting

```
 $$ \sum_{k=1}^{n} k^3 = \left( \frac{n(n+1)}{2}\right )^2$$

$$ 1 + \frac{1}{2} + \underbrace{\frac{1}{3} + \frac{1}{4}} +
\underbrace{\frac{1}{5}+\frac{1}{6}+\frac{1}{7}+\frac{1}{8}} + \cdots $$
```

$$\sum_{k=1}^{n} k^3 = \left(\frac{n(n+1)}{2}\right)^2$$

$$1 + \frac{1}{2} + \underbrace{\frac{1}{3} + \frac{1}{4}} + \underbrace{\frac{1}{5} + \frac{1}{6} + \frac{1}{7} + \frac{1}{8}} + \cdots$$

Mathematical Formatting

```
$$A_{m,n} =
 \left[\begin{array}{cccc}
  a_{1,1} & a_{1,2} & \cdots & a_{1,n} \\
  a_{2,1} & a_{2,2} & \cdots & a_{2,n} \\
  \vdots & \vdots & \ddots & \vdots \\
  a_{m,1} & a_{m,2} & \cdots & a_{m,n}
 \end{array}
 \right]$$
```

$$A_{m,n} = \left[\begin{array}{cccc} a_{1,1} & a_{1,2} & \cdots & a_{1,n} \\ a_{2,1} & a_{2,2} & \cdots & a_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m,1} & a_{m,2} & \cdots & a_{m,n} \end{array} \right]$$

Mathematical Formatting

```
$$\frac{d}{dx}\left( \int_{0}^{x} f(u) du \right)=f(x)$$.

$$\lim_{x \to \infty} \exp(-x) = 0$$.
```

$$\frac{d}{dx}\left(\int_{0}^{x} f(u) du \right)=f(x)$$.

$$\lim_{x \to \infty} \exp(-x) = 0$$.

Exercise 4: Format the following

(1.) $x^3 + \sqrt[5]{10}$

(2.) $(a+b)^2 = a^2 + b^2 + c^2$

(3.) $\sqrt{2} \approx 1.414$

(4.) $A \setminus (B \cup C) = (A \setminus B) \cap (A \setminus C)$

(5.)

$$1^2 + 2^2 + \cdots + n^2 = \frac{n(n+1)(2n+1)}{2}$$

(6.)

$$(a_1 a_2 \cdots a_n)^{1/n} \leq \frac{a_1 + a_2 + \cdots + a_n}{n}$$

.

Answer 4: Format the following

```
(1.)   $x^3 + \sqrt[5]{10}$
(2.)  $(a+b)^2 = a^2 + b^2 + c^2$4

(3.)  $\sqrt{2} \approx 1.414$

(4.)  $A \setminus (B \cup C) = (A \setminus B) \cap
      (A \setminus C)$

(5.)  $$ 1^2 + 2^2 + \cdots +n^2 = \frac{n(n+1)(2n+1)}{2} $$

(6.)  $$(a_1 a_2 \cdots a_n)^{1/n} \leq \frac{a_1 + a_2 +
      \cdots +a_n}{n}$$.
```

Exercise 4: Format the following

(8.)

$$\begin{aligned} x &= r\cos\theta\sin\phi \\ y &= r\sin\theta\sin\phi \\ z &= r\cos\theta \end{aligned}$$

(9.)

$$e^{i\theta} = \cos\theta + i\sin\theta$$

(10.)

$$\frac{d}{dx}\left(\frac{1}{x}\right) = -\frac{1}{x^2}$$

(11.)

$$\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n = e$$

Answer 4: Format the following

```
(8.) \begin{eqnarray}
     x  &=& r \cos \theta \sin \phi \nonumber \\
      y &=& r \sin \theta \sin \phi \nonumber \\
      z & =& r \cos \theta \nonumber
    \end{eqnarray}

(9.) $$e^{i \theta} = \cos \theta + i \sin \theta$$

(10.) $$\frac{d}{dx} \left ( \frac{1}{x} \right ) =
       - \frac{1}{x^2}$$


(11.) $$\lim_{n \to \infty} \left (1 + \frac{1}{n}
       \right )^{n} = e$$
```

Creating Block

A ‘block’ environment can be used to create any kind of named block. A block can be of theorem, lemma, corollary or example.

Include the package ‘amsthm’ in the preamble of the document before using this environment. The general syntax for defining a new block is:

```
\newtheorem{key}{blockName}
```

where *key* is used to reference the new block and *blockName* is the name of this block.

```
\newtheorem{myDef}{Definition}
\begin{myDef}
Write definition here.
\end{myDef}
\begin{myDef}
Write another definition here.
\end{myDef}
```

Definition 1

Write definition here.

Definition 2

Write another definition here.

Creating Block

To number blocks according to chapter or section or subsection, use the following:

`\newtheorem{key}{blockName}[numberBy]`

```
\documentclass[a4paper,11pt]{book}
\usepackage{amsthm}
\newtheorem{thm}{Theorem}[chapter]
\newtheorem{examp}{Example}[section]

\begin{document}

\chapter{Introduction}

\section{Section 1}
\begin{thm} First theorem. \end{thm}
\begin{examp} First example. \end{examp}

\section{Section 2}
\begin{thm} Second theorem. \end{thm}
\begin{examp}Second example.\end{examp}

\end{document}
```

Chapter 1

Introduction

1.1 Section 1

Theorem 1.1. *First theorem.*

Example 1.1.1. *First example.*

1.2 Section 2

Theorem 1.2. *Second theorem.*

Example 1.2.1. *Second example.*

Comments

The symbol % is used to put a comment line.

For multiple line comment, use the environment ‘comment’. To use this environment include the package ‘verbatim’ in the preamble of the document.

```
%This line will not appear in output.
Or you can leave a note for yourself.
%Complete this section later.

Here is multiple line comment.
\begin{comment}
These lines will not appear
on the final output.
If a portion of code gives error
one can comment sub portion
to locate the error
\end{comment}
```

Or you can leave a note for yourself.
Here is multiple line comment.

Footnote

Footnote can be produced with command, `\footnote`. The syntax of this command is:

`\footnote[number]{text}`

The optional argument *number* is used to change the default footnote number.

```
Delhi \footnote[1]{The capital of country}
is a historical city of India.

DU \footnote[3]{University of Delhi} is
a premier university.
```

Delhi [1] is a historical city of India.

DU [3] is a premier university.

[1]The capital of country

[3]University of Delhi

Computer Code

LaTeX provides the environment `lslisting` to include computer code in the document.

The required package for this environment is '`listings`'.

```
\begin{lstlisting}[backgroundcolor=\color{yellow}]
\documentclass{article}
\begin{document}
This is my first document.
\end{document}
\end{lstlisting}
```

```
\documentclass{article}
\begin{document}
This is my first document.
\end{document}
```

The Bibliography

The environment, ‘thebibliography’ can be used to create bibliography. The structure is:

```
\begin{thebibliography}{noOfRef}
\bibitem{citationKey} ...
\bibitem{citationKey} ...
\end{thebibliography}
```

The Bibliography

```
\begin{minipage}[t]{0.8\columnwidth}
\begin{thebibliography}{9}
\bibitem{bm1}Sachin Kumar, Brij Mohan 2022 A novel and efficient method for
obtaining Hirota's bilinear form for the nonlinear evolution equation in (n+1)-dim.
\bibitem{bm2}Sachin Kumar, Brij Mohan, Amit Kumar 2022 Generalized fifth-order
nonlinear evolution equation for the Sawada-Kotera, Lax, and
Caudrey-Dodd-Gibbon equations in plasma physics.
\end{thebibliography}
\end{minipage}
```


[1] Sachin Kumar, Brij Mohan 2022 A novel and efficient method for obtaining Hirota's bilinear form for the nonlinear evolution equation in (n+1)-dim.

[2] Sachin Kumar, Brij Mohan, Amit Kumar 2022 Generalized fifth-order nonlinear evolution equation for the Sawada-Kotera, Lax, and Caudrey-Dodd-Gibbon equations in plasma physics.

Citation

‘\cite{key1}’ command is used to cite any bibliography reference with citation key ‘key1’.

To cite multiple references, include all the citation keys within the curly brackets separated by comma, for example, \cite{key1, key2, key3}

```
For single citation \cite{bm1}.

For multiple citations \cite{bm1,bm2}.
```

For single citation [1].
For multiple citations [1, 2].

To be continued with Beamer...