Introduction to LaTeX

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1. Introduction

LaTeX pronounced lay tech is a system for high quality Documents. It is most often used for technical or scientific documents but it can be used for almost any form of publishing. LaTeX uses a plain text markup language which is compiled into a PDF document. This results in professional looking documents. TeX is an abbreviation of $\tau\epsilon\chi\nu\eta$, Greek for both "art" and "craft"

To run LaTeX on your PC you need to download and install LaTeX Engine which is miktex which can be downloaded from the following link:

https://miktex.org/download

also it is helpful to download a graphical tool for LaTeX editing that run above miktex Engine, there are several options for example you can use texstudio or winedit which can be found on the following links:

https://www.texstudio.org

Or

http://www.winedt.com/download.html

for learning resources I recommend the following book and tutorial:

https://en.wikibooks.org/wiki/LaTeX

https://www.LaTeX-tutorial.com/tutorials/

2. LaTeX File Structure

LaTeX file begin with \documentclass{} command where the type of documents is specified. Document class is determined as following.

```
\documentclass[options]{class}
```

Classes of documents are:

Table 1: Classes of Documents in LaTeX

Article	For articles in scientific journals, presentations, short reports, program documentation, invitations, ...
IEEEtran	For articles with the IEEE Transactions format.
Proc	A class for proceedings based on the article class.
Report	For longer reports containing several chapters, small books, thesis,...
Book	For real books.
Slides	For slides. The class uses big sans serif letters.
Memoir	For changing sensibly the output of the document. It is based on the book class, but you can create any kind of document with it
Letter	For writing letters.
Beamer	For writing presentations.

Table 2: Options of Documents in LaTeX

10pt, 11pt, 12pt	Sets the size of the main font in the document. If no option is specified, 10pt is assumed.
a4paper, letterpaper	Defines the paper size. The default size is letterpaper; However, many European distributions of TeX now come pre-set for A4, not Letter, and this is also true of all distributions of pdfLaTeX. Besides that, a5paper, b5paper, executive paper, and legal paper can be specified.
Fleqn	Typesets displayed formulas left-aligned instead of centered.
Leqno	Places the numbering of formulas on the left hand side instead of the right.
titlepage, notitlepage	Specifies whether a new page should be started after the document title or not. The article class does not start a new page by default, while report and book do.
Twocolumn	Instructs LaTeX to typeset the document in two columns instead of one.
twoside, oneside	Specifies whether double or single sided output should be generated. The classes article and report are single sided and the book class is double sided by default. Note that this option concerns the style of the document only.
Landscape	Changes the layout of the document to print in landscape mode.
openright, openany	Makes chapters begin either only on right hand pages or on the next page available. This does not work with the article class, as it does not know about chapters. The report class by default starts chapters on the next page available and the book class starts them on right hand pages.
Draft	makes LaTeX indicate hyphenation and justification problems with a small square in the right-hand margin of the problem line so they can be located quickly by a human. It also suppresses the inclusion of images and shows only a frame where they would normally occur.

The structure of LaTeX file is defined below

\documentclass{...}

%Preamble(contains commands that affect the entire document.)

\begin{document}

\end{document}

Where the text is written between \begin{document}and \end{document} the preamble define commands that affect the entire document. No text is inserted in preamble

Example: \documentclass[12pt,a4paper,oneside]{article}

2.1. Defining Page Parameters

The size and parameters of page is defined using geometry package which need to be included in the document using \usepackage command \usepackage command structure as the following:
\usepackage[options]{geometry}
Examples:
\usepackage[legalpaper, landscape, margin=2in]{geometry}
\usepackage[a4paper, landscape, margin=1in]{geometry}
Or
\usepackage{geometry}
\geometry{legalpaper, margin=2in}
\usepackage[top=1in, bottom=1.25in, left=1.25in, right=1.25in]{geometry}
\usepackage[a4paper,margin=2.54cm]{geometry}

2.2. LaTeX Environment

The commands in LaTeX is performed be defining an environment the environment in LaTeX is defined and begins by command \begin{Env. Name} and terminated using command \end{Env. Name}.

2.3. Landscape View

To use Landscape view within the document the following command can be use where the text within \begin{landscape} \end{landscape} is displayed in landscape view the text outside \begin{landscape} \end{landscape} are portrait by default to use \begin{landscape} command the user should use lscape package as in the following example:
\usepackage{lscape} \begin{landscape} \end{landscape}

3. Page Numbering

by default LaTeX uses arabic numeral for page numbering. page numbering can be setting using \pagenumbering{num_style} command where num_style refer to number used in page numbering which are:

- arabic: for arabic numerals (1,2,3,...).

- roman: for lower case roman numerals (i,ii,iii,...)

- Roman: for upper case roman numerals (I,II,III,...)

- alph: for lower case alphabetical numbering (a,b,c,...)

- Alph: for upper case alphabetical numbering (A,B,C,...)

\pagenumbering is not environment its a command that affect the entire document so its location is in **preamble**.

4.   Text formatting

LaTeXuses the following commands to format the text which are:

4.1.   Spaces

All white spaces are ignored and will appear as a single space. To create tabs or new line or any spaces you need to use the following commands
\newpage will start new page in LaTeXdocument
\\or \newline will start new line
\hspace{50pt} for horizontal space with 50pt and \hspace{10cm} will create a spacxe with 10 cm.

4.2.   Text Alignment

Full justified is the Default setting in LaTeX. For left, right and center alignment use the following commads:
For left alignment use flushleft environment \begin{flushleft}this text will be aligned to left \end{flushleft}
For right alignment use flushright environment \begin{flushright} this text will be aligned to right \end{flushright}
For centering use center use environment \begin{center} this text will be centered aligned \end{center}

4.3.   Font Format

For italic text \emph{text} or \textit{this text is italic} *this text is italic*
For bold text \textbf{this text is Bold} **this text is Bold**
For normal text \textnormal{text}
For underline \underline{under line text} or
\usepackage{soul} then \ul{underlined text} underlined text
For strikethrough text \usepackage{soul} then \st{strikethrough text} ~~strikethrough text~~

4.4.   Line Spacing

To control line spacing the user need to use setspace package then use the command \doublespacing for double spacing text or \singlespacing for single spacing as in the following example:
\usepackage{setspace}
\doublespacing
\singlespacing

4.5.   Font Family

LaTeXprovide several font families as following:
\textrm{Roman text family}
\textsf{san serf family}

\texttt{teletypefont family}
\textsl{slanted shape}
\textsc{Small Capitals}
\uppercase{ UPPERCASE}
\lowercase{lowercase}

5.   Multicolumns

By default the LaTeXdocument is single column document but multiple column document can be defined. The text that is defined inside multicols environment is displayed as multi columns, and the text outside multicols environment is displayed in single columns format. To use multicols environment the multicol package must be used. The format of multicols environment is \begin{multicols}{number_of_columns} As in the following example:
\usepackage{multicol}
\begin{multicols}{2}
\end{multicols}
By default the columns in multicols environment are balanced, which means the columns in a page have the same length. If the user want to create unbalanced columns; asterisk can be added after multicols environment as following:
\begin{multicols*}{2}
for unbalanced columns.
To end the column at current location and begin new column for the remaining of the text the following command can be used
\columnbreak.
To control the properties of columns the following commands can be use in **preamble** to affect the property of columns.
\setlength{\columnsep}{30pt or cm or in} to set the space between columns.
\setlength{\columnseprule}{1pt} set a vertical line between columns.

6.   Document Title

The title object contains three parts: title, author and date which can be set as the following:
\title{this is a test of \LaTeX} \author{sultan M. Al-Rushdan \thanks{instructor at philadelphia university}} \date{date}
if the braces in date left empty then no date will display.
The title, author and date parameters are set in **preamble** so they are not displayed in document, to display these information in document the \maketitle command should be used in document environment. As shown in the following example:
\title{This is a test of LaTeX}
\author{Sultan M. Al-Rushdan \thanks{instructor at philadelphia university}}
\date{date}
\begin{document}
\maketitle
\enddocument
\thanks{note} command will add a note to page footer.

7. LATEXdocument structure

Documents in LATEXcan divided to the following levels note that in article you can only use section, sub section, sub sub section, paragraph and sub paragraph. Part and chapter are not applicable to articles.

Table 3: Documents Components in LATEX

Command	Level	Comment
\part{"part"}	-1	only books and reports
\chapter{"chapter"}	0	only books and reports
\section{"section"}	1	not in letters
\subsection{"subsection"}	2	not in letters
\subsubsection{"subsubsection"}	3	not in letters
\paragraph{"paragraph"}	4	not in letters
\subparagraph{"subparagraph"}	5	not in letters

For example if you are writing a book or report you can define the following structure:
\part{part introduction}
\chapter{chapter introduction}
\section{section introduction}
\subsection{subsection introduction}
\subsubsection{sub-subsection introduction}
\paragraph{paragraph introduction}
\subparagraph{sub-paragraph introduction}
Part name and number will appear as Part 1 in a separate page
Chapter name and number will appear chapter 1 then the name in separate line
Section will be numbered 1.1
Sub section will be numbered 1.1.1
Sub sub section , paragraph , sub paragraph will not be numbered by default All in new line.
All titles of the numbered components are added automatically to the table of contents.
Or
\section[table of content item]{section name} in this case "table of content item" is the text that will appear in table of content.
The table of content can be added to text using command
\tableofcontents
The following Example shows how to define deferent names for components in the table of contents
\part[p int]{part introduction}
\chapter[ch intro]{chapter introduction}
\section[sec intro]{section introduction}
\subsection[sub sec intro]{subsection introduction}
\subsubsection{sub-subsection introduction}
\paragraph{paragraph introduction}
\subparagraph{sub-paragraph introduction}
the default name for table of content is content to change the name of table of content

the following command is added in **preamble**

\renewcommand \contentsname{Summary}

Also LaTeXdefine list of figure and list of tables object that can be defined in LaTeXdocument like the following: \listoffigures

\listoftables

As in table of content to change the name of the list for tables and figures you can use the following commands in **preamble**

\renewcommand \listfigurename{fig(new name)}

\renewcommand \listtablename{tab(new name)}

Note the commands to change the list of contents, figures and tables are defined in **preamble** not in document environment. To control the depth of table of content \setcounter{tocdepth}{depth} where depth is a number that define the depth that will be numbered and hence appear in table of contents, the default is 1 which means only the sections will appear. But the depth can be changed to a deeper level for example 3 means that the subsubsection will be numbered and added to table of contents.

To unnumber the heading of components (parts, chapter,sections, ,...) asterisk symbol can be added as in the following example in this case the component will not be numbered and will not appear in table of contetnt \part*{part tow}

\chapter*{chapter two}

\section*{section two}

\subsection*{subsection two}

\subsubsection*{sub-subsection tow}

\paragraph*{paragraph tow}

\subparagraph*{sub-paragraph two}

To control the numbering format of components the following commands are added to **preamble**:

\renewcommand \thesection\arabic{section}--}

which means the section numbering will be in Arabic numerals followed by --

\renewcommand \thesubsection{\thesection \arabic{subsection}--}

which means the numbering of sub section will begin with the number of section followed by the number of subsection using Arabic numerals followed by -- and so on as shown in the following two example. Note these command are inserted in **preamble** not in document environment.

\renewcommand \thesubsubsection{\thesubsection \arabic{subsubsection}--}

\renewcommand \theparagraph{\thesubsubsection \arabic{paragraph}--}

The following table shows example how to define numbering systems.

Table 4: Examples of Numbering System

Command	Format
\renewcommand\thesection{\arabic{section}--}	1- , 2- , 3- , ...
\renewcommand\thesection{\roman{section}--}	i- , ii- , iii- , iv- , v- , vi- , vii-,
\renewcommand\thesection{\Roman{section}.}	I. , II. , III. , IV. , V. , VI. , VII.,
\renewcommand\thesection{(\alph{section}).}	(a). , (b). , (c). , (d).
\renewcommand\thesection{\Alph{section}--}	A- , B- , C- , D-

To control the size of part headers font the following command can be used:

\usepackage{titlesec} \titleformat*{\section}{\LARGE\bf} the font is large and bold
\titleformat*{\subsection}{\Large\it} the font is large and italic
\titleformat*{\subsubsection}{\normalsize\bf} the font is normal size and bold
\titleformat*{\paragraph}{\large\bf}
\titleformat*{\subparagraph}{\large\bf}
\bf for bold font
\it for italic font.

8. List and Enumeration

List and Enumeration in LaTeXconcern with ordered and non ordered list as following:

8.1. Items

Non ordered List Items in LaTeX(usually bullet or star , dash) which is defined in itemize environment. the following example shows how to define a list

```
\begin{itemize}
        \item first
        \item second
        \item third
        \item  fourth
\end{itemize}
```

the result of the above is:

- first

- second

- third

- fourth

for Multilevel item list:

```
\begin{itemize}
        \item first
        \begin{itemize}
                \item first first
                \item first second
        \end{itemize}
        \item second
        \item third
        \begin{itemize}
                \item third first
                \item third second
```

```
            \begin{itemize}
                 \item third second first
                 \item third second second
            \end{itemize}
        \end{itemize}
        \item  fourth
        \begin{itemize}
                 \item fourth first
                 \item fourth second
        \end{itemize}
    \end{itemize}
\end{itemize}
```

the result of thy above is:

- first

  – first first

  – first second

- second

- third

  – third first

  – third second

    * third second first
    * third second second

- fourth

  – fourth first

  – fourth second

To control the itemized numbering

```
\renewcommand{\labelitemi}{$\circ$} the item numbering will be circles
\renewcommand{\labelitemii}{$\bullet$}
\renewcommand{\labelitemiii}{$\ast$}
```

8.2.   Enumeration

Enumeration are Ordered list or the list that are numbered in ascending order using numbers or letters like 1,2,3 or a,b,c or i,ii,iii this can be defined using enumerate environment

```
\begin{enumerate}
        \item first
        \item second
        \item third
        \item fourth
\end{enumerate}
```

The result will be ordered list numbered 1,2,3,4, … as following:

1. first

2. second

3. third

4. fourth

for multilevel enumeration:

```
\begin{enumerate}
    \item first
    \begin{enumerate}
        \item first first
        \begin{enumerate}
            \item first first first
            \begin{enumerate}
                \item first first first first
                \item first first first second
            \end{enumerate}
            \item first first second
        \end{enumerate}
        \item first second
        \item first third
    \end{enumerate}
    \item second
    \begin{enumerate}
        \item second first
        \item second second
    \end{enumerate}
    \item third
    \item fourth
\end{enumerate}
```

the result of the above code is:

1. first
   (a) first first
      i. first first first
         A. first first first first
         B. first first first second
      ii. first first second
   (b) first second
   (c) first third

2. second

      (a) second first

      (b) second second

3. third

4. fourth

Up to 4 level of enumeration is available in latex.
The default numbering 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.

To change the numbering of enumeration the user can use the following commands. Where i , ii , iii , iv indicate the level that is being numbered.

```
\renewcommand\labelenumi{\roman{enumi}}
\renewcommand\labelenumii{\Alph{enumii}}
\renewcommand\labelenumiii{\alph{enumiii}}
\renewcommand\labelenumiv{\arabic{enumiv}}
```

9. Figures

To insert figures in LaTeXthree packages must be included which are float, graphicx and caption as following:

```
\usepackage{float}
\usepackage{graphicx}
\usepackage{caption}
```

The figure can be added using figure environment as following:

```
\begin{figure}[option]
\includegraphics[option]{figure file name}
\caption{the caption of figure}
\end{figure}
```

Figure options concern with where figure will appear in the document, the following table shows what options are available:

Table 5: Figure Options

Specifier	Action
H	Place exactly at spot in source text
h	Place approximately at spot in source test
t	Place at top of page
b	Place at bottom of page
!	Override internal LaTeXparameters for determining float position

Includegraphics option are all about the size and scaling of the figure which will be explained later.

for example the following code will display philadelpia logo form philadelphia_logo file in the document:

```
\begin{figure}[H]
\centering
\includegraphics{philadelphia_logo}
\caption{Philadelphai University}
\end{figure}
```


Figure 1: Philadelphai University

By defult the figure is justified left but the caption is justified center so to justify the caption to left the following command must be added to preamble

```
\captionsetup[figure]{justification=raggedright,singlelinecheck=false}
```

9.1.   Scaling of figures

the following examples shows how to use includegraphics options to control the size of figure in LaTeX:

```
\includegraphics[width=1\textwidth]{pu.png}
```

the figure width is the same as the text width (the width of the whole text area in page not just the column width)

```
\includegraphics[width=5cm]{pu.png} figure width is 5 cm
\includegraphics[width=0.5\textwidth]{pu.png}
\includegraphics[width=200pt]{pu.png}
\includegraphics[height=7cm, width=5cm]{pu.png}
```

Unless otherwise specified the ratio between height and width is preserved. As in the previous examples except the last one.

9.2. Naming and numbering

The default naming and numbering of figures is "Figure" followed by the sequence number of figure in the document, to change the numbering so that the section number is included in the figure the following command must be used in **preamble**.

```
\renewcommand{\thefigure}{\arabic{section}.\arabic{figure}}
```

Where the figure number is defined as the section number in arabic numerals followed by the figure number in Arabic numerals. Example:

```
\renewcommand{\thefigure}{\arabic{chapter}.\Roman{section}.\Alph{subsection}.
\setcounter{figure}{1}\arabic{figure}}
```

The figure number consist of chapter number in arabic numerals followed by section number in roman numerals followed by subsection number in capital letters numbering followed by figure number in arabic numerals. By default the figure numbering in continuous across the entire document. The command \setcounter{figure}{1} reset the figure counter in every subsection to 1. To change the figure name the following command can be used to change figure name form "figure" to "Fig." for example. \renewcommand{\figurename}{Fig.}

9.3. Wrapping Text

To wrap text around figure the wrapfig package must be used, then wrapfigure environment must be used in LaTeXdocument, the format of the environment is:

```
\usepackage{wrapfig}
...
...
...
\begin{wrapfigure}{position}{resizing}
\includegraphics[scale]{figure file name}
\caption{figure caption}
\end{wrapfigure}
```

The position parameter determine the position of figure in the text there are eight options described in the following table:

Table 6: Wrapfigure Positions in LaTeX

r	R	right side of the text
l	L	left side of the text
i	I	inside edge–near the binding (in a twoside document)
o	O	outside edge–far from the binding

The uppercase-character allows the figure to float, while the lowercase version means "exactly here". See The following example:

```
\usepackage{wrapfig}
...
...
...
\begin{wrapfigure}{r}{0.3\textwidth}
\centering
\includegraphics[scale=0.5]{pu}
\caption{philadelphia university}
\end{wrapfigure}
```

the following example shows how wrapfigure looks like.

As a distinguished academic institution, Philadelphia University commits itself to becoming a full partner in the development of both Jordanian society and other societies at the regional and global levels. The role of science, technology, information and means of communication is becoming absolutely vital to the well-being of humanity. In the coming few years, this role is bound to become a decisive engine of growth. Relevant high–quality education, supported by problem–oriented, inter-disciplinary and inter-institutional research, is the only means of leading any society to become an active partner in the development of human civilization. The speed of globalization and the collapse of cultural and economic barriers require modern education, e-learning and interactive systems rooted in democratic interaction, human rights, complete freedom of thought and greater creativity by the younger sectors of society. As the rapid development of knowledge, science and technology could widen the cultural divide between generations and society, modern approaches to education and lifelong interactive learning will become indispensable in alleviating effects of this trend. Carrying a revered name, with deep roots in history, of a major city of

Figure 2: philadelphia university

the Decapolis on the King's Road linking old civilizations, Philadelphia is committed to moving forward along the information highway through the twin engines of quality and modernity. It hopes to make a strong bond between knowledge, learning and modern civilization. The keynote here is the provision of proper, fast-developing and morally informed education. Young men and women are the vehicle that launches societies into a future propelled by quality education to prosperity and innovation. Philadelphia University and its sister institutions will be instrumental in bringing this about.

9.4. Sub figures

Sometimes figure can contain several figures related to each other that need to be grouped in one figure, LATEXallow user to define sub figure environment inside figure environment, subcaption package must be used. The following example shows how to use sub figure:

```
\usepackage{subcaption}
...
...
...
```

```
\begin{figure}[H]
    \begin{subfigure}{0.3\textheight}
    \centering
    \includegraphics[scale=0.5]{pu}
    \caption{philadelphia}
    \end{subfigure}
\hspace{20pt}
    \begin{subfigure}{0.3\textwidth}
    \centering
    \includegraphics[scale=0.5]{jea}
    \caption{Jea}
    \end{subfigure}
\caption{institutes}
\end{figure}
```

\hspace{20pt or 2cm or 1in} define the distance between sub figures if not defined the sub figures will be listed vertically. the result of the above code is:

(a) philadelphia

(b) Jea

Figure 3: institutes

10.   Tables

Table can be defined in LaTeXusing tabular environment as following:

```
\begin{tabular}{l c l r c }
\end{tabular}
```

Which will define five columns table the first one aligned to left the second on centered the third one left the fourth one right and the last one is centered. The following table contain the parameters for table alignment:

Table 7: Table Alignment Parameters

L	left-justified column
C	centered column
R	right-justified column
p'width'	paragraph column with text vertically aligned at the top
m'width'	paragraph column with text vertically aligned in the middle (requires array package)
b'width'	paragraph column with text vertically aligned at the bottom (requires array package)
		vertical line
||	double vertical line

To control the content of table the following commands are used:

Table 8: Table content Control commands

&	column separator
\\	start new row
\hline	horizontal line
\newline	start a new line within a cell (in a paragraph column)
\cline{i-j}	partial horizontal line beginning in column i and ending in column j

the following example shows how to build a tabular:

```
\begin{tabular}{|l|c|l r c}
\hline
first & second & third & fourth & fifth \\
\hline
11 & 12 & 13 & 14 & 15 \\
\cline{3-5}
21 & 22 & 23 & 24 & 25\\
\hline
\end{tabular}
```

the result of the above code is:

first	second	third	fourth	fifth
11	12	13	14	15
21	22	23	24	25

another Example:

```
\begin{tabular}{r|c|c|p{5cm}|}
day & max temp & min temp & summery \\
\hline
sunday & 21 & 10 & A clear day with lots of sunshine. However, the strong breeze
will bring down the temperatures.\\ \hline
monday & 19 & 9 &  cloudy with rain, across many northern regions.
Clear spells across most south, but rain reaching the far east \\ \hline
tuesday & 21 & 10 & Rain will still linger for the morning. Conditions
will improve by early afternoon and continue throughout the evening. \\
\end{tabular}
```

P5cm will define a paragraph cell with 5 cm width. the result of the above code is:

day	max temp	min temp	summery
sunday	21	10	A clear day with lots of sunshine. However, the strong breeze will bring down the temperatures.
monday	19	9	cloudy with rain, across many northern regions. Clear spells across most south, but rain reaching the far east
tuesday	21	10	Rain will still linger for the morning. Conditions will improve by early afternoon and continue throughout the evening.

10.1.   Multirow and multicolumns

Sometime user needs To define a table where multiple columns or multiple rows are merged in to a single cell. In this case user need to use \multicolumn and \multirow commands. To use these commands user need to use multicol and multirow packages. The following example shows how to use \multicolumn and \multirow commands.

\multicolumnnum of columnscell alignment and bordertext Example:
\multicolumn{3}{—R}{A} 3 columns are merged with right justification and border on left side only and letter A is displayed in the cell.

\multirow{num of rows}{width} Example:
\multirow{3}{*}{X} 3 rows are merged together with default text width and letter X is displayed in the cell.

The following example shows how to use \multicolumn and \multirow commands. Note \multicolumn{1}{—c—} command is used only to define cell border.

```
\usepackage{multicol}
\usepackage{multirow}
...
...
...
\begin{tabular}{cc|c|c|c|c|}
\cline{3-6}
 & & \multicolumn{2}{|c|}{MC1}&\multicolumn{2}{|c|}{MC2} \\
 \cline{3-6}
  & & C1 & C2 & C3 & C4 \\
  \hline
  \multicolumn{1}{|c|}{\multirow{2}{*}{MR1}}& \multicolumn{1}{|c|}{R1}
  & A & B & C & D \\
  \cline{2-6}
\multicolumn{1}{|c|}{} & \multicolumn{1}{|c|}{R2} & E & F & G & H \\
  \hline
  \multicolumn{1}{|c|}{\multirow{2}{*}{MR2}}& \multicolumn{1}{|c|}{R3}
```

```
  & I & G & K & L\\
  \cline{2-6}
\multicolumn{1}{|c|}{}& \multicolumn{1}{|c|}{R4} & M & N & O & P \\ \hline
\end{tabular}
```

the result of the above text is:

		MC1		MC2	
		C1	C2	C3	C4
MR1	R1	A	B	C	D
	R2	E	F	G	H
MR2	R3	I	G	K	L
	R4	M	N	O	P

10.2.   Table environment

Table environment is used to encapsulate tabular environment and to add control to tabular. Caption can be added to a tabular using the following format:

```
\begin{table}
\caption{}
\begin{tabulure}
\end{tabulure}
\end{table}
```

Table floating can be used as the following:

```
\begin{table}[option]
\caption{}
\begin{tabulure}
\end{tabulure}
\end{table}
```

where floating Options can be defined as in the following table:

Table 9: Table floating options

h	where the table is declared (here)
t	at the top of the page
b	at the bottom of the page
p	on a dedicated page of floats

also Table environment can be used to resize the tabular environment the format of resizing is as following:

```
\begin{table}
\resizebox{width}{height}{
\\begin{tabulure}
\end{tabulure}
}
```

Where the value of width and height can be specified to resize tabular to desired value. However the user may specify one of the values and the other can be set to ! which means maintain width/height ratio

To renew the table name

```
\renewcommand{\tablename}{tab}
Reset the counter and number of table
\renewcommand{\thetable}{\arabic{section}.\setcounter{table}{1}\arabic{table}}
```

11. Mathematical equations

To write math equations user need to use package amsmath. \usepackage{amsmath}
Then the user may choose math or equation environments

```
\begin{math}  \end{math}    OR      \begin{equation}  \end{equation}
```

The differences between math and equation are:

1. Math displayed within text but equation displayed in dedicated line.

2. Equations are numbered but math are not.

The mathematics formula can be written as following:

1. Superscript and Subscript. xˆ3 means x^3 and x_2 means x_2 , xˆ2_i means x_i^2 , x_{n+1} means x_{n+1} , xˆ{i+3} means x^{i+3}

2. Math Operations: + - for addition and subtraction, \times (for multiplication symbol) \div (for division symbol).

3. Fraction \frac{numerator}{Denominator} for example y=\frac{xˆ5+3}{4x} means $\frac{x^5+3}{4x}$.

4. Square root: \sqrt{\frac{a}{b+1}} means $\sqrt{\frac{a}{b+1}}$.

5. Roots: \sqrt[n]{\frac{k+1}{L}} means $\sqrt[n]{\frac{k+1}{L}}$.

6. Sum: y=\sum_{i=1}ˆ{n}xˆ{i+1} means $y = \sum_{i=1}^{n} x^{i+1}$.

7. Integrations is formated by \int_{min}ˆ{max} function. for example
   \int_{0}ˆ{\infty}eˆ{-x}dx mean
   $\int_0^\infty e^{-x}dx$.
   Or \int\limits_aˆb f(x)dx means
   $\int\limits_a^b f(x)dx$.

8. Matrix can be defined using matrix environment in which & separate elements of the matrix and\\start new line.

\begin{matrix} A & B & C \\ D & E & F \\ G & H & I \end{matrix}	$\begin{matrix} A & B & C \\ D & E & F \\ G & H & I \end{matrix}$
\begin{bmatrix} A & B & C \\ D & E & F \\ G & H & I \end{bmatrix}	$\begin{bmatrix} A & B & C \\ D & E & F \\ G & H & I \end{bmatrix}$

the following table shows how to change the surrounding delimiter for matrix by using appropriate environment

Table 10: Surrounding delimiter of matrix

Environment name	Surrounding delimiter
Pmatrix	()
bmatrix	[]
Bmatrix	{}
vmatrix	| |
Vmatrix	‖ ‖

12. Bibliography

Bibliography can be created using \thebibliography environment which can be defined as following:

```
\begin{thebibliography}{99}

\end{ thebibliography}
```

The number 99 means that the user want two digit counter for bibliography which means he can write up to 99 references. If the user write 9 then he can write up to 9 references. If the number was 999 then the user can write up to 999 references. The reference items can be defined as following:

```
\begin{thebibliography}{99}
\bibitem{citekey}

\end{ thebibliography}
```

Bibitem represent a reference element citekey is a textual value that should be unique for each reference. The bibitems will be numbered automatically starting from [1] to the number of references. To cite a reference user can use the command \citecitekey where the citekey is a value that was defined previously in bibliography.