

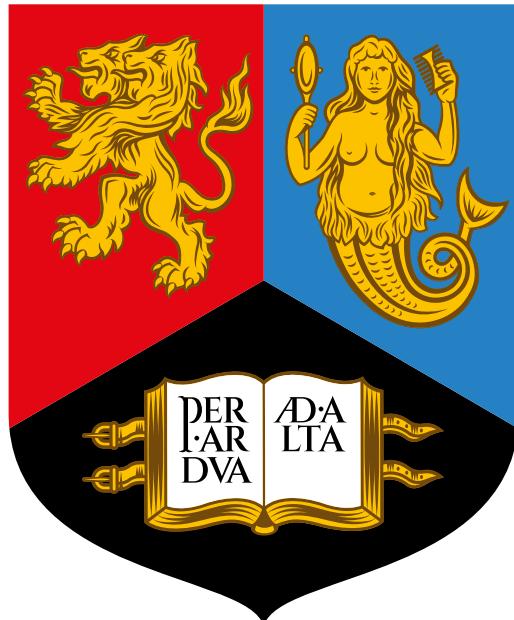
University of Birmingham

College of Engineering and Physical Sciences

School of Engineering

Birmingham Centre for Railway Research and Education

MSc in Railway Systems Engineering and Integration



Assignment Title

Module Code: 04

Student ID Number: Student ID Number

Date Submitted: Date Submitted

Abstract & Keywords

Abstract

This should be no more than 10 sentences.

Suggested areas to be covered include:

- A problem statement;
- Aims & research question;
- Method;
- Results;
- Take home message.

Keywords

Key words are used to help in searching for a paper using a search engine. These should not be keywords from the title, however synonyms may be appropriate.

1 How to get the most out of this template

This section is aimed to help you using this template. It does not aim to teach you how to use \LaTeX as there are plenty of resources that would do a far more effective job. Some places to start are included in section 1.2.

Instead the aim here is to help a relatively inexperienced \LaTeX user navigate the template, point them to places they can learn more, give some helpful hints and examples of cool stuff you can do.

1.1 Setting up this template

1.1.1 Template

You can use the code behind this project as your starting point, however, you will have to go through the process of removing all the guidance text. It may therefore be more advisable to use the blank template to start and then use this as your reference.

If you do choose to use this document as your starting point you can remove this chapter (no. 1) by taking out the input command in `main.tex` that refers to this file and the `guidance-example-section` folder.

1.1.2 Metadata

Your first steps upon starting working with this template should be to edit lines 6 to 11 in `main.tex`. They should currently read as:

```
% Document metadata
% fill these in to update header, footer and titlepage
\def\modulename{Module Name}
\def\assignmenttitle{Assignment Title}
\def\studentidnumber{Student ID Number}
\def\datesubmitted{Date Submitted}
```

Replace the text in black in the squigly brackets {} with your details and the details of your assignment and they will be updated on the title page, header and footer through the document.

1.1.3 Style

This template has been set up to best match the university style and uses appropriate fonts, logos, etc.

The University also has a published house style guide (University of Birmingham 2024) that may prove useful. For example the following guidance is given for headings:

Headings should always be in sentence case and without a full stop. This is an initial capital followed by all lower case (unless a proper noun appears in the heading). This includes left-hand navigation bars on the web. Use sentence case for events. Do not use initial capitals for emphasis anywhere.

1.2 \LaTeX resources

You are obviously free to use any service or setup to edit and compile your \LaTeX documents but we would recommend Overleaf (as of Nov. 2024). It is web based so you don't need to install software and you should be able to access it from any computer. There is also a professional license for all

students and staff in EPS (College of Engineering and Physical Sciences) accessed through UoB single sign-on.

Here are some handy starting points for getting started with \LaTeX for you to explore.

- Overleaf Documentation (Overleaf 2024)
 - As well as being a good option for managing your \LaTeX projects, the documentation and guidance provided by Overleaf is rather good.
 - A good starting point may be the learn \LaTeX in 30 minutes guide www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes
- ShareLaTeX YouTube Guides (ShareLaTeX 2024)
 - A youtube channel recommended by the University library service that provides a number of guides.
 - <https://www.youtube.com/@ShareLaTeX/videos>
- University resources
 - There are often events through the year that are useful for getting started with LaTeX. There is a planned lecture as an introduction in the Engineering Department.
 - The University Computer Science Society (CSS) and Hacking Society (AFNOM) run a series of lunchtime lectures through the year called the missing semester (CSS and AFNOM 2024), this included a session on \LaTeX the notes for which can be found at: <https://missingsemester.afnom.net/2024/latex/>

1.3 Some interesting examples of things \LaTeX can do

1.3.1 Referencing

For documents produced for the MSc it is a requirement to use Harvard style referencing (Author-Date), luckily \LaTeX can handle remove most of the headache normally associated with managing references. This document template is setup to cite and produce a bibliography inline with these requirements.

It may be a good idea to manage your references with a reference manager, some examples of these are Zotero, EndNote or Mendeley. All will export your references in a `.bib` file which \LaTeX can read. If you are using Overleaf then at the time of writing there are integrations for both Zotero and Mendeley which enable library syncing which may be a nice feature for you.

Once you have a `bib` file it is very simple to create a citation, for Harvard style `\parencite` cites in brackets, `\textcite` is inline text, `\autocite` tries to make the choice based on context.

The references section at the end of the document is created through the `\printbibliography` command at the end of the document and will include only the citations made in the document.

1.3.2 Numbers and units

`siunitx` is a package that allows for better number and unit typesetting. The full documentation gives an excellent guide (Wright 2024) but here are a few examples as a starting point.

Here are some examples of typesetting numbers:

- 125
- 12 345
- 1.2×10^{34}

- 1.2×10^{-3}
- 12.34°
- 1, 23 and 4567
- 90 to 125

Here are some examples of typesetting units, they can either be input in math style or interpreted:

- km/hr
- kg m/s²
- m/s
- m s⁻¹
- V² lm³ F⁻¹

Units and numbers can then be combined together in qty:

- Speed of light (*c*):
 - $299\,792\,458\,\text{m}\,\text{s}^{-1}$
 - $3.0 \times 10^8\,\text{m}\,\text{s}^{-1}$
- Planck constant (*h*):
 - $6.63 \times 10^{-34}\,\text{J}\,\text{Hz}^{-1}$
- Newtonian constant of gravitation (*G*):
 - $6.67 \times 10^{-11}\,\text{m}^3\,\text{kg}^{-1}\,\text{s}^{-2}$
- 90 mph to 125 mph
- 30 km h⁻¹, 45 km h⁻¹, 70 km h⁻¹, 90 km h⁻¹ and 150 km h⁻¹

1.3.3 Figures



Figure 1: University of Birmingham Logo

This template uses the `graphicx` package for figures. Figure 1 is a example of a basic image as a figure.



(a) Circle line (Rathbone 2017a)



(b) DLR (Rathbone 2017b)



© Northern line (Rathbone 2017c)



(d) Piccadilly line (Rathbone 2017d)

Figure 2: 4 examples of Transport for London seat cover patterns or "Moquettes". Courtesy of Loughborough University, accessed 10 October, 2024, https://repository.lboro.ac.uk/projects/Transport_for_London_seat_cover_patterns/24400

Figure 2 is a slightly more complicated figure. It is a single figure that contains the sub figures 2a, 2b, 2c and 2d. For more complex sections of code for large figures like this is can be useful to store that section in a seperate `.tex` file as has been done here and in subsequent plots.

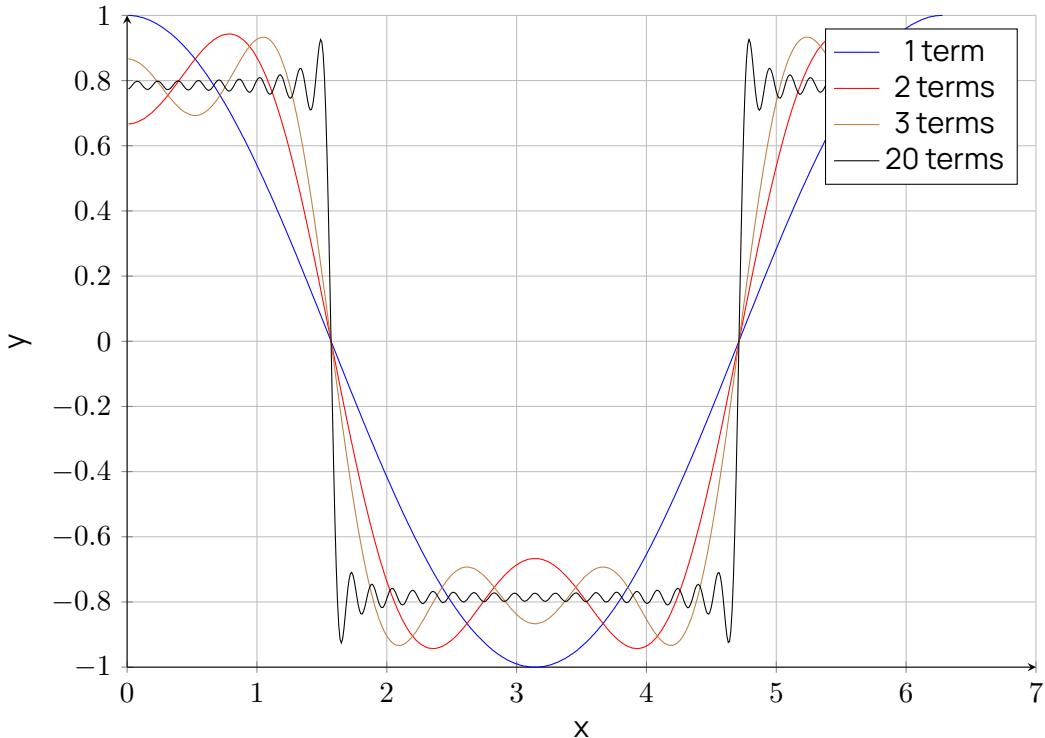


Figure 3: Fourier series approximation of a square wave with varying number of cosine terms. Plotted with pgfplots from stored csv data

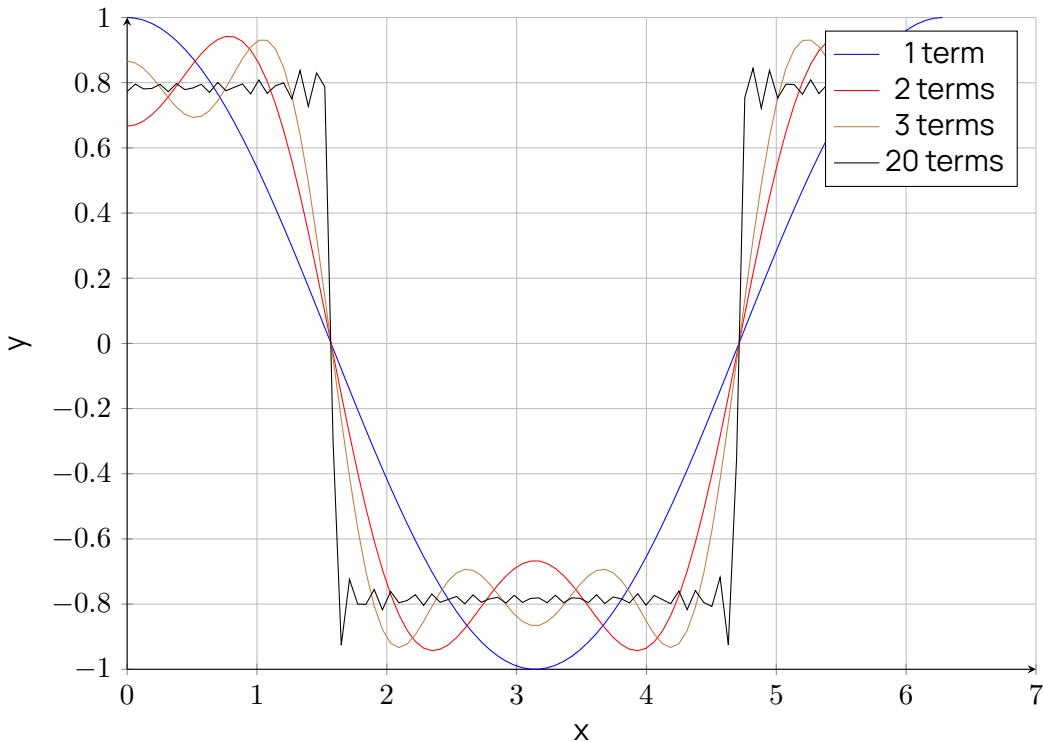


Figure 4: Fourier series approximation of a square wave with varying number of cosine terms. Plotted with pgfplots from functions

Figures 3 and 3 both show figures plotted with the pgfplots package. Figure 3 is plotted from data stored in a csv file, while Figure 4 is plotted directly from a set of functions.

This can be a very useful as if you want to change the way your data is plotted (or the data that is plotted), you can change it directly in Latex without having to re-export from your tool every time.

Image Formats As a rule of thumb vector images are preferable over rasterized images. \LaTeX 's preferred format for vector images is .pdf files. There are other vector formats including .svg and .eps which you can convert between with a bit of google assistance.

For raster images (.png, .jpg, etc.) the usual guidance applies, try where possible to use high quality images, especially high resolution. It is worth noting that \LaTeX allows the use of the scale command when specifying an image size which would allow the natural size or integer scaling of the natural size to maximise image quality.

If you want to learn more about image types then Adobe have produced an article that covers the difference between raster and vector images [Adobe 2024](#).

1.3.4 Equations

\LaTeX allows you to do inline equations, i.e. $y = mx + c$, or set on their own line, such as equations 1, 2 and 3.

$$f(x) = 2[H\frac{x}{L} - H(\frac{x}{L} - 1)] - 1 \quad (1)$$

$$\begin{aligned} b_n &= \frac{1}{L} \int_0^{2L} f(x) \sin\left(\frac{n\pi x}{L}\right) dx \\ &= \frac{4}{n\pi} \begin{cases} 0 & n \text{ even} \\ 1 & n \text{ odd} \end{cases} \end{aligned} \quad (2)$$

$$f(x) = \frac{4}{\pi} \sum_{n=1,3,5,\dots}^{\infty} \frac{1}{n} \sin\left(\frac{n\pi x}{L}\right) \quad (3)$$

1.3.5 Tables

Table 1: Example simple table

Name	Age
Adam	30
Eve	30

Table 1 is an example of a very simple table, but there is the possibility of making them more complex, table 3 has a little more data, includes some cell shading and has been placed on it's own separate page, printed in landscape.

It is also possible to load data in directly from a .csv file and then display in a table. This has been done for table 2

Table 2: UK Passenger transport by mode, figures shown are a percentage of total passenger distance over the year (Department of Transport 2023)

Year	Road	Rail	Air
1977	92	7	0
1978	92	7	1
1979	92	7	1
1980	92	7	1
1981	93	7	1
1982	93	6	1
1983	93	7	1
1984	93	7	1
1985	93	7	1
1986	93	7	1
1987	93	6	1
1988	93	6	1
1989	93	6	1
1990	93	6	1
1991	94	6	1
1992	94	6	1
1993	94	5	1
1994	94	5	1
1995	94	5	1
1996	94	5	1
1997	93	6	1
1998	93	6	1
1999	93	6	1
2000	93	6	1
2001	93	6	1
2002	93	6	1
2003	93	6	1
2004	92	6	1
2005	92	7	1
2006	92	7	1
2007	91	7	1
2008	91	8	1
2009	91	8	1
2010	91	8	1
2011	90	9	1
2012	90	9	1
2013	90	9	1
2014	89	10	1
2015	89	10	1
2016	89	10	1
2017	89	10	1
2018	89	10	1
2019	89	10	1
2020	97	3	0
2021	92	7	1
2022	91	9	1

Table 3: Colour Reference for London Underground lines as listed in TfL colour standard (Transport for London 2022)

London Underground line	PMS	CMYK	RGB	Colour Sample
Bakerloo line	470	C026 M070 Y097 K016	R166 G090 B042	
Hammersmith & City line	197	C003 M048 Y015 K000	R236 G155 B173	
Piccadilly line	072	C100 M097 Y003 K003	R000 G015 B159	
Central line	485	C006 M098 Y100 K001	R225 G037 B027	
Jubilee line	430	C055 M041 Y038 K005	R123 G134 B140	
Victoria line	299	C081 M018 Y000 K000	R000 G160 B223	
Circle line	116	C000 M018 Y100 K000	R255 G205 B000	
Metropolitan line	235	C041 M100 T041 K021	R135 G015 B084	
Waterloo & City line	338	C055 M000 Y039 K000	R107 G205 B178	
District line	356	C096 M027 Y100 K015	R000 G121 B052	
Northern line	Black	C000 M000 Y000 K100	R000 G000 B000	

2 Introduction

You may want to include in this section:

- Why does this research need to be done?
- Where/what is the problem?
- The research question?
- What have others done in this area?
- What is the scope & methodology?
- What is new or interesting about this research?

3 Method & Methodology

You may want to include in this section:

- What information does the reader need to be able to understand the study. This may come from your literature review.
- Any data needed to perform or analyse the results should be referenced.
- What equipment or software packages have been used?
- Has the method been used before and what were the outcomes of this research?
- What was your experimental method/protocol?
- Could the reader reproduce what you have done given the information provided?

4 Results

You may want to include in this section:

- Figures, tables and diagrams including graphs to give results.
- Use headings to divide up the results into sections.
- After each set of data describe what the results show.

5 Discussion

You may want to include in this section:

- What are the implications of the results? (Link the results back to the research questions).
- What facts have been found? (Comment on the facts – in context)
- Highlight reasons why the results were as they were (if know).
- Discuss any limitations, controversies, implications to the field or other fields etc
- Are there any recommendations to the research?
- What future research needs to take place?

6 Conclusions

- This should be one paragraph at most.
- Findings and recommendations should be described.

References

- Adobe (2024). *Raster vs. vector: What are the differences?* / Adobe. en-US. URL: <https://www.adobe.com/creativecloud/file-types/image/comparison/raster-vs-vector.html> (visited on 11/18/2024).
- CSS and AFNOM (2024). *Missing Semester: UoB Remix.* en. URL: <https://missingsemester.afnom.net/> (visited on 10/10/2024).
- Department of Transport (Dec. 2023). *Modal comparisons (TSGB01), Table TSGB0101, Passenger transport by mode, annual from 1952.* en. URL: <https://assets.publishing.service.gov.uk/media/657c3f6b095987001295e18c/tsgb0101.ods> (visited on 11/18/2024).
- Overleaf (2024). *Overleaf Documentation.* en. Citation-Key:overleaf-documentation. URL: <https://www.overleaf.com/learn> (visited on 10/10/2024).
- Rathbone, Sarah (2017a). *The Circle Line seat cover pattern.* Pages: 2472692 Bytes Publisher: Loughborough University Citation Key rathbone2017circle. DOI: 10.17028/RD.LBORO.4909463.V1. URL: https://repository.lboro.ac.uk/articles/figure/The_Circle_Line_seat_cover_pattern/4909463/1 (visited on 10/10/2024).
- (2017b). *The DLR seat cover pattern.* Pages: 2640908 Bytes Publisher: Figshare. DOI: 10.17028/RD.LBORO.4909394.V1. URL: https://lboro.figshare.com/articles/The_DLR_seat_cover_pattern/4909394/1 (visited on 10/10/2024).
- (2017c). *The Northern Line seat cover pattern.* Pages: 2993396 Bytes Publisher: Figshare. DOI: 10.17028/RD.LBORO.4909424.V1. URL: https://lboro.figshare.com/articles/The_Northern_Line_seat_cover_pattern/4909424/1 (visited on 10/10/2024).
- (2017d). *The Piccadilly Line seat cover pattern.* Pages: 3089948 Bytes Publisher: Figshare. DOI: 10.17028/RD.LBORO.4903085.V1. URL: https://lboro.figshare.com/articles/The_Piccadilly_Line_seat_cover_pattern/4903085/1 (visited on 10/10/2024).
- ShareLaTeX (2024). *ShareLaTeX YouTube Channel.* en-GB. Citation-Key: youtube-sharelatex-channel. URL: <https://www.youtube.com/channel/UCiaUNF5GUwJ8owZq5Qgw0ZA> (visited on 10/10/2024).
- Transport for London (Nov. 2022). *TfL Colour Standard - Issue 08.* en. URL: <https://content.tfl.gov.uk/tfl-colour-standard-issue-08.pdf> (visited on 10/10/2024).
- University of Birmingham (Jan. 2024). *House Style Guide.* URL: https://brand.birmingham.ac.uk/wp-content/uploads/2023/08/UoB_House_Style_Guide.docx (visited on 10/10/2024).
- Wright, Joseph (Sept. 2024). *siunitx - A comprehensive (SI) units package.* enlish. URL: <https://texdoc.org/serve/siunitx/0> (visited on 10/28/2024).

A Appendix title

Appendices are optional, and are typically used to include detailed data used in the main body of the report. Always include a sentence or two to introduce the table or other information that you are presenting in each and every appendix.