MODELING AND USE OF FEM ON STATIC STRUCTURE

A SECOND YEAR PROJECT REPORT

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF B.Sc. IN COMPUTATIONAL MATHEMATICS

BY

1. Samrajya Raj Acharya(Exam Roll No.)
2. Bishesh Kafle (Exam Roll No.)
3. Priyanka Panta (Exam Roll No.)
4. Mukesh Tiwari (Exam Roll No.)

SCHOOL OF SCIENCE
KATHMANDU UNIVERSITY
DHULIKHEL, NEPAL

April, 2022

CERTIFICATION

This project entitled "Modeling and use of FEM on static structure" is carried out under my supervision for the specified entire period satisfactorily, and is hereby certified as a work done by following students

1. Samrajya Raj Acharya (Exam Roll No.)
2. Bishesh Kafle (Exam Roll No.)
3. Priyanka Panta (Exam Roll No.)
4. Mukesh Tiwari (Exam Roll No.)

in partial fulfillment of the requirements for the degree of B.Sc. in Computational Mathematics, Department of Mathematics, Kathmandu University, Dhulikhel, Nepal.

Dr. Gokul KC
Assistant Professor
Department of Mathematics,
School of Science, Kathmandu University,
Dhulikhel, Kavre, Nepal
Date:March 29, 2022

APPROVED BY:

I hereby declare that the candidate qualifies to submit this report of the Math Project (MATH-252) to the Department of Mathematics.

Head of the Department
Department of Natural Sciences

School of Science

Kathmandu University

Date:March 29, 2022

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS

Your parameters here.

CHAPTER 1

MOTIVATION/INTRODUCTION

1.1 Context/Rationale/Background

In this section, the author(s) shall discuss the historical background related to the work along with the introduction of the topic in brief.

Guidelines for Layout and Format of B.Sc. Computational Mathematics Project Reports

1. Preliminary pages should be numbered: **i., ii., iii, iv, v, vi,** etc. A page number should not be shown on the title page even though it is counted as **i**.

2. Margins should be maintained on all pages as follows:
   Left margin = **3 cm** (wider for binding)
   Top margin = **2 cm**
   Right & bottom margins = **2 cm**

3. Page number should be placed at the **bottom, center** or **bottom, right** of page.

4. For labeling of Chapters and Sections follow the systematic order:
   1. Chapter 1
      1.1. Section 1
         1.1.1. Sub-section 1
         1.1.2. Sub-section 2, etc.
      1.2. Section 2
      1.3. Section 3, etc.
   2. Chapter 2
   3. Chapter 3, etc.

5. Use 1.5 *line spacing* for all text in the main body of the dissertation.

6. Use Times New Roman, **12 point** font size, or Aerial **11 point** for text.

7. Label Appendices or Annexes as: A, B, C, etc.; and give name (title) to each.

8. Label figure captions at bottom of the figure and according to the Chapter it appears in such as, Figure 1.1, Figure 1.2, Figure 2.1, Figure 2.2, Figure 3.1, etc.

9. Label table headings at the top of the table and according to the chapter it appears in, similar to the figures, e.g., Table 1.1, Table 1.2, Table 2.2, etc.

10. Cite references in the text of the dissertation according to the convention:
    "author's last name (date)" -- in case there is only one author
    "last name of first author" *and* "last name of second author" (date) -- in case of two authors
    "last name of first author" *et al.* (date) -- in case of multiple authors

    Note: Math/Phy students are to typeset the Dissertation in LATEX2e. They can cite the reference in the text in *amsplain* format.

11. List references alphabetically and using correct citations for books, journal articles and conference/seminar proceedings as shown in the examples (following pages).

12. If more than one reference of the same author exists then the references with the same author should be listed chronologically according to publishing date (year).

13. If more than one of the same author's publications exist in the same year (date), then use suffixes a, b, c, etc., after the publication year {e.g., 1998a; 1998b; etc.)

1.1.1 The Layout of the SubSection of the Project Report

Your first subsection of Section 1 of Chapter 1.

Typeset the following commands to compile the format designed Project report guideline

```
\documentclass[a4paper,12pt]{report}    % Document Class
% % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % %
% % % % PACKAGES
% % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % %
\linespread{1.5}                        % For line spacing
\usepackage{amssymb}                    % For AMS symbol
\usepackage{amsmath}                    % This is useful for the matrix
\usepackage{verbatim}                   % For comments in paragraph
\usepackage{graphicx}                   % For imbeding graph
\usepackage{color}                      % Color for the text
\usepackage{makeidx}
\usepackage{url}
\usepackage{sectsty}
\chapterfont{\centering}

% % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % %
% % % % FOR ADJUSTMENT OF PAGES
% % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % %
\usepackage[top=2cm, bottom=2cm, left=3cm, right=2cm]{geometry}

% % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % %
% % % % FOR SHORTCUT USE
% % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % %
\newtheorem{df}{Definition} % For definition
\newtheorem{exm}{Example}   % For Example
\newtheorem{exe}{Exercise}  % For Exercise
\newtheorem{prob}{Problem}  % For Problem
\newtheorem{task}{TASK}     % For Task
\newtheorem{thm}{Theorem}   % For Theorem
% % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % %
```

```
\renewcommand{\chaptername}{CHAPTER}
\renewcommand{\contentsname}{\centering CONTENTS}
\renewcommand{\listfigurename}{\centering LIST OF FIGURES}
\renewcommand{\listtablename}{\centering LIST OF TABLES}

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
\pagestyle{plain}
%=====================================================================
\begin{document}
% % % % % % % % % % % % % %
\pagenumbering{roman}
%=====================================================================
%   Begin your document hereafter
%=====================================================================


{\large
\begin{center}
{\color{red}{\bf{Title: A \LaTeXe template to Typeset Your Dissertation}}}\\
\end{center}


\vspace{0.8cm}

{\normalsize
\begin{center}
A DISSERTATION\\

\vspace{0.5cm}
SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR\\
THE DOCTOR OF PHILOSOPHY (PhD) DEGREE\\
IN MATHEMATICS

\vspace{2cm}
```

```
BY
\end{center}


\begin{center}
{\color{red} {STUDENT NAME, PREVIOUS DEGREE}}
\end{center}

\vspace{1.5cm}

\begin{figure}[htpb]
\centering
\includegraphics[height=4.5cm,width=4.5cm]{photos/kulogo}
\end{figure}


\vspace{2cm}
{\normalsize
\begin{center}
%DEPARTMENT OF NATURAL SCIENCES (MATHEMATICS)\\
SCHOOL OF SCIENCE\\
KATHMANDU UNIVERSITY\\
DHULIKHEL, NEPAL\\
\end{center}
}

\begin{center}
{\color{red} MONTH AND YEAR OF COMPLETION}
\end{center}
}
}
\thispagestyle{empty} % No numbering in this page
%=================================================================
```

```
\newpage
\input{Dedication}

\newpage
\input{Student_declaration}

\newpage
\input{Certificate_by_supervisor}

\newpage
\input{ack}

\newpage
\input{abs}

% ========================================================================

\tableofcontents

\listoffigures
\addcontentsline{toc}{chapter}{LIST OF FIGURES}

\listoftables
\addcontentsline{toc}{chapter}{LIST OF TABLES}

\newpage
\input{param}

% ========================================================================
\newpage
\pagenumbering{arabic}
%\input{chap1}
\include{chap1}
```

```
\newpage
\input{chap2}

\newpage
\include{publ}
%=====================================================================
% For Reference settings
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
\renewcommand{\bibname}{\centering REFERENCES}
\bibliographystyle{amsplain}
\addcontentsline{toc}{chapter}{REFERENCES}
\bibliography{bibtex_database/myrefs} % data base
%=====================================================================
\end{document}
```

1.1.2 AMS Plain Format for References and Citation in Text

Your second subsection of Section 1 of Chapter 1.

Online resource in AMS format as in Doe [1]

Proceeding in AMS format is as in Gokul [2]

PhD Dissertation in AMS format is as in Gurung [3].

Book in AMS format is as in Kopka and Daly [4]

Article in AMS format is as in Roy et al. [5].

–

- **If your citation of an article/book contains one or two authors, then cite it writing authors surname. For example as shown in Kopka and Daly [4].**
- **If your citation of an article/book contains more than two authors, then cite it writing first author surname followed by et al. . For example as shown in Roy et al. [5].**

The current use of reference style is amsplain in KU M.Phil and PhD Dissertation guideline. The other styles used in LaTeXpackage are abbrv, acm,

alpha, plain, amsalpha, apalike, ieeetr, siam, unstr.

1.2 Objectives

1. **To set up differential equations with variable boundary conditions.**
2. **To learn to perform numericals manually and then implement those in a high level programming language**
3. **To learn about FEM, its variations, and its application to various mechanical problems.**
4. **Visualization and Project Writing.**

1.3 Significance/Scope

In this section, the author(s) shall discuss the relevance and the underlying problems that may rise to the need to do this project/work.

Table 1.1: Name and Notation.

Category	Intuitive meaning	Typical element
Nml	numerals	N
UnOps	unary operators	α
BinOps	binary operators	ω
Ide	identifiers	I
Exp	expressions	E
Cmd	commands	C

1.4 Limitations

In this section, the author(s) should enlist or elaborate the possible limitations of the project or the difficulty foreseeable during the work.

Figure 1.1: Shiva Statue Sangha

CHAPTER 2

METHODOLOGY/MODEL EQUATION

2.1 Theoretical/Conceptual Framework

In this section, the author(s) should describe the theoretical/mathematical principles behind the whole work relative to the project. The information collected from literature review shall be relevant in this section.

2.2 Model Equation

Your second section of Section 2 of Chapter 2.

2.2.1 Right Aligned Numbering of an Equation

Your first subsection of Section 2 of Chapter 2.

Follow the right aligned numbering of an equation.

$$\rho\, c\, \frac{\partial u}{\partial t} = \nabla \cdot (k\, \nabla u) + \rho_b\, c_b\, w_b\, (u_a - u) + q_m \tag{2.1}$$

2.2.2 Subsection 2

Your second subsection of Section 2 of Chapter 2.

CHAPTER 3

RESULTS AND DISCUSSIONS

3.1 Result1

In this chapter, the author(s) shall present the results and simulations (in the form of numerical data or graphical form) of the theory described in CHAPTER-2 and finally discuss the results.

3.2 Formation of Table in LaTeX 2_ε

Table 3.1: Values of parameters at different atmospheric temperatures.

Atm.Temp. T_a °C	$m = M_{max} = (m_b c_b)_{max}$ cal/cm^3-min °C	$s = S_{max}$ cal/cm^3-min	$E(\times 10^{-3})$ g/cm^2-min
15	0.003	0.0357	0
23	0.018	0.018	$0, 0.48$
33	0.0315	0.018	$0.48, 0.96$

3.2.1 Subsection 1

Your first subsection of Section 2 of Chapter 3.

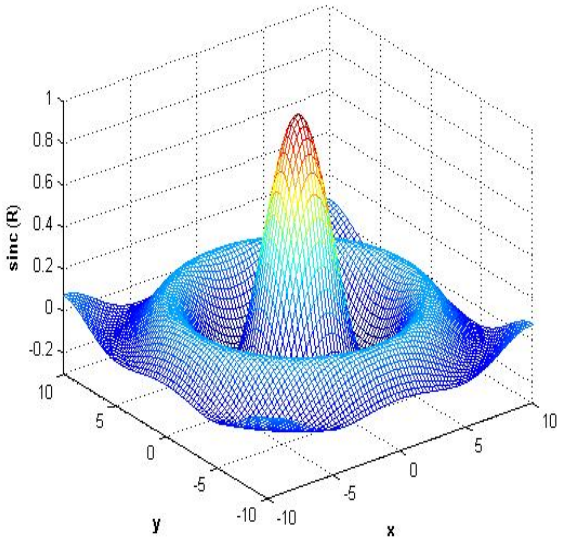

Figure 3.1: Graph of Sinc.

3.2.2 Subsection 2

Your second subsection of Section 2 of Chapter 3.

Figure 3.2: Tulips Flower.

CHAPTER 4

CONCLUSIONS

In this section, the author(s) shall summarize the main points and the results of the work. Include key facts from the background research to help explain your results as needed.

REFERENCES

[1] R. Doe, *Miktex url*, `http://www.miktex.org`, June 2009.

[2] K. C. Gokul, D. B. Gurung, and P. R. Adhikary, *Fem approach for one dimensional temperature distribution in the human eye*, Proceedings of National Conference on Mathematics (Kathmandu) (P. R. Adhikary, K. Jha, and C. Bhatta, eds.), Nepal Mathematical Society, 2012, pp. 35–46.

[3] D. B. Gurung, *Mathematical study of abnormal thermoregulation in human dermal parts*, PhD Dissertation, Kathmandu University, 2008, pp. 1–188.

[4] H. Kopka and P. W. Daly, *A guide to latex*, Addison-Wesley, Reading, MA, 1999.

[5] B. Roy, S. K. Roy, and D. B. Gurung, *Holling-Tanner model with Beddington-DeAngelis functional response and time delay introducing harvesting*, Mathematics and Computers in Simulation **142** (2017), 1–14.