

A Project Report
on
**Thermo-Structural Design & Analysis of Control Surface TPS for
Hypersonic Missile**
Submitted in partial fulfilment of the requirements for the award of the degree
BACHELOR OF TECHNOLOGY
IN
MECHANICAL ENGINEERING
by
Mohammed Abdullah Ghorl (17RT1A0332)
Under the guidance of
Mr S. Narendar
(Scientist-D, TSTF, DSMT, Defense Research & Development Organization)
Dr S. M. Hussaini
(HoD, Mechanical Engineering, NSAKCET)



Department of Mechanical Engineering
**NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND
TECHNOLOGY**
Approved by AICTE, Affiliated to JNTUH, Malakpet, Hyderabad
Year of submission: 2021

CERTIFICATE

This is to certify that the project report entitled **Thermo-Structural Design & Analysis of Control Surface TPS for a Hypersonic Missile** being submitted by

Mohammed Abdullah Ghori

17RT1A0332

In partial fulfillment for the award of the Degree of Bachelor of Technology in Mechanical Engineering to the Jawaharlal Nehru Technological University, Hyderabad is a record of bonafide work carried out under my guidance and supervision at Nawab Shah Alam Khan College of Engineering and Technology.

The results embodied in this project report have not been submitted to any other University or Institute for the award of any Degree or Diploma.



Dr. Syed Mujahed Hussaini

Project Guide & Head of the Department



Dr. Syed Abdul Sattar

Principal

PRINCIPAL

Nawab Shah Alam Khan

College of Engineering & Technology

New Malakpet, Hyderabad-500024

External Examiner:

Name:

Signature with date:

Note: Exam was conducted online
project supervision - 
20/06/21



सत्यमेव जयते

Govt. of India
Ministry of Defence
DEFENCE RESEARCH & DEV. ORGN.
DEFENCE RESEARCH & DEVELOPMENT
LABORATORY
PO: KANCHANBAGH
HYDERABAD - 500 058
Ph.040-24583150, Fax No.040-24583154

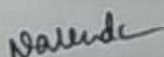
Letter No. DRDL/DHRTM/HRD/PROJECT/2021/

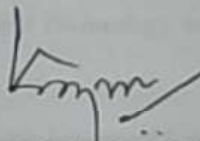
Date: 10th June 2021

CERTIFICATE

This is to certify that **Sri Mohammed Abdullah Ghor** student of **B.Tech. Mechanical** (Roll No. 17RT1A0332) of **Nawab Shah Alam Khan College of Engineering & Technology**, Dept. of Mechanical Engineering, Hyderabad has undergone the Internship from **1st January 2021 to 31st March 2021** at Defence Research & Development Laboratory (DRDL), Kanchanbagh, Hyderabad. He has successfully completed the Internship under the guidance of **Shri. S. Narendar, Scientist 'D', STF/DSMT, DRDL**. His Project title was "**Thermo-Structural Design and Analysis of Control Surface TPS for a Hypersonic Missile**".

During his internship period, he was found to be sincere & hard working. He also took keen interest in the learning about Hypersonic Flows and CFD.


(Shri S. Narendar)
Scientist-D
STF/DSMT
DRDL


(Dr. K. NAGESHWARA RAO)
Scientist-G
Director, HRTM
For Director DRDL

Dr. K. NAGESWARA RAO
Sc-G, DIRECTOR HR&TM
Defence Res. & Dev. Laboratory
Kanchanbagh PO, Hyderabad-58
For DIRECTOR

ACKNOWLEDGEMENT

The project work for this dissertation was carried out at *Defence Research & Development Organisation* during the period 2020-2021. This dissertation has been a part of the Major Project submitted to *Jawaharlal Nehru Technological University, Hyderabad* in partial fulfilment of the requirements for the award of degree "*Bachelor of Technology in Mechanical Engineering*".

It is with sincere appreciation and thanks to those outstanding individuals who truly made this work possible are duly acknowledged. I am greatly indebted to my project supervisor *Mr S. Narendar* (Scientist-D, TSTF, DSMT, DRDO) for his months of patience, efforts and invaluable guidance as a mentor & advisor. Without his keen insight and depth of engineering expertise, the accomplishment of this study would have been significantly impaired. I also wish to thank my internal project supervisor, *Professor S. M. Hussaini* (HoD, Department of Mechanical Engineering, NSAKCET) for his exceptional guidance & ingenuity that has added greatly to the success of this project. I am proud to consider *Mr S. Narendar* and *Professor S. M. Hussaini* a professional mentor and an inspiration.

I would like to express my gratitude towards *Mr Syed Saadullah Hussaini* (Scientist-E, DLRL) for his efforts in helping me get this incredible opportunity of interning at DRDO.

I would like to thank the project coordinator, *Mr Aqeel Ahmed* for his guidance. Additionally, I am also grateful to our principal, *Dr Syed Abdul Sattar* and the management of *Nawab Shah Alam Khan College of Engineering and Technology* under whose supervision the institution runs most successfully.

I am extremely thankful to my parents, brothers and sister for their enormous love & support throughout this endeavour.

Lastly, I would also like to acknowledge all the staff members and friends who have taken time out to help me make this project a whopping success.

ABSTRACT

On 24 July 1969, *Apollo 11* successfully re-entered the Earth's atmosphere, returning from a historic manned mission to the moon. During the re-entry, the vehicle's Mach Number was 32.5 and the velocity of the capsule exceeded 11.2 km/s. Due to such colossal entry speed, a temperature of 11,600 K was induced at the stagnation region & boundary layer of the Apollo 11 capsule.

The development of a hypervelocity vehicle is associated with numerous technical challenges. One of the most complex issues faced by the engineers, that dominates the design of a hypersonic vehicle is *Aerodynamic Heating*, a flow consequence that is further substantial for an air-breathing hypersonic vehicle. It is therefore imperative to design a robust heat shielding system that can mitigate the deleterious effects of aerodynamic heating on the airframe & payload of the vehicle. However, the design of a thermal management system requires accurate prediction of various flow phenomena such as entropy layer, viscous interactions, chemical nonequilibrium etc. that affects the aerothermodynamics of the flow around a hypervelocity vehicle. Based on the intensity of aerodynamic heating and the design requirements, an optimal thermal management system must be designed such that they provide indispensable protection without adding excessive load to the structure of the vehicle.

This project focuses on the design & validation of a *hot structure* system for the control surface of a hypersonic missile flying at Mach 7.0. A Multiphysics simulation that involves coupled Fluid-Thermal-Structural analysis was performed in which the flow of air & the wall temperature due to aerodynamic heating was analysed. Different TPS concepts & high-temperature materials were studied to assess their performance under such intense flight conditions. Finally, a structural simulation was conducted to study the viability and performance of the multi-material wing structure.

Key Words: Hypersonic, Aerothermodynamics, CFD, Multiphysics, Metal Matrix Composite, Super Alloys, CMC, Chemical Nonequilibrium, Ablative Protection

Table of Contents

Acknowledgment	i
Abstract	ii
List of Figures	iii
List of Tables	v
Symbols & Nomenclature	vi
Chapter 1 Introduction	1
1.1 Background	1
1.2 Objectives of Dissertation	3
1.3 Outline of Dissertation	4
Chapter 2 Hypersonic Aerothermodynamics	5
2.1 Hypersonic Shockwaves & Expansion waves	5
2.2 Hypersonic Viscous Heating	7
2.3 Chemically Reacting Flows	9
2.4 Kinetic Theory of Gases	9
2.5 Numerical Methods of Hypersonic Flows	10
Chapter 3 Thermal Management Systems	13
3.1 Active Thermal Protection	13
3.2 Passive Thermal Protection	16
3.3 Hot Structures	18
3.4 Ablative Thermal Protection	22
3.5 Computational Methods for TPS Analysis	23
Chapter 4 Design Methodology	25
4.1 Aerodynamic Geometry	25

4.2 Computational Grids & Solver Setup	30
Chapter 5 Results & Discussions	35
5.1 Steady-State Hypersonic CFD Simulation Results	35
5.2 Transient Thermal Analysis Results	39
5.3 Transient Structural Analysis Results	43
Chapter 6 Conclusion	51
6.1 Scope & Limitations	52
6.2 Future Work	52
References	53

A Project Report

On

Solar Refrigerator System Without Compressor

Submitted in partial fulfillment of the requirements for the award of degree

BACHELOR OF TECHNOLOGY

IN

MECHANICAL ENGINEERING

By

MOHMMED KHAJA 17RT1A0378

MD OMAIR AHMED 17RT1A0382

SHAIK ABDUL OBAID 17RT1A0393

SYED HUSSAIN AHMED 17RT1A03A8

Under the guidance of

Dr. NOOR ALAM

(Associate professor)



Department of Mechanical Engineering

**NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND
TECHNOLOGY**

Approved by AICTE, Affiliated to JNTUH, Malakpet, Hyderabad

Year of submission: 2021

CERTIFICATE

This is to certify that the project report entitled SOLAR REFERIGERATOR WITHOUT COMPRESSOR being submitted by

MOHAMMED KHAJA 17RT1A0378

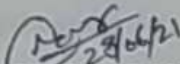
MD OMAIR AHMED 17RT1A0382

SHAIK ABDUL OBAID 17RT1A0393

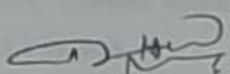
SYED HUSSAIN AHMED 17RT1A03A8

In partial fulfillment for the award of the Degree of Bachelor of Technology in Mechanical Engineering to the Jawaharlal Nehru Technological University, Hyderabad is a record of bonafied work carried out under my guidance and supervision at Nawab Shah Alam Khan Collage of Engineering and Technology Hyderabad .

The results embodied in this project report have not been submitted to any other University or Institute for the award of any Degree or Diploma.


DR. NOOR ALAM

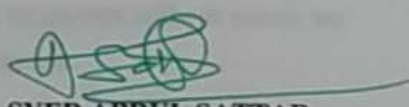
Project Guide


Mr. MOHAMMED AQEEL AHMED

Project Coordinator


Dr. SYED MULAHED HUSSAINI

Head of the Department


Dr. SYED ABDUL SATTAR

Principal

PRINCIPAL

**Nawab Shah Alam Khan
College of Engineering & Technology
New Malakpet, Hyderabad-500024.**

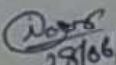
EXTERNAL EXAMINER:

Name:

Signature with date

Note - Exam was conducted online

2

Project supervisor - 
28/06/21

ACKNOWLEDGEMENT

The research work for this thesis was carried out at the Mechanical Engineering department of Nawab Shah Alam College of Engineering and Technology during the period 2020-2021. This thesis has been a part of Major project submitted to Jawaharlal Nehru Technological University, Hyderabad in partial fulfillment of the requirements for the award of degree "Bachelor of Technology in Mechanical Engineering".

The satisfaction and euphoria that accompany the successful completion of the project would be great but incomplete without mentioning people who made it possible with their constant guidance and encouragement. In this context,

We would cordially thank to our internal guide **Dr. Noor Alam**, project coordinator Mr. Mohammed Aqeel Ahmed and head of mechanical engineering department Dr. Syed Mujahed Hussaini for all their technical guidance, constant encouragement and moral support in carrying out our project and making it a success.

We are also grateful to our principal, Dr. Syed Abdul Sattar and management of Nawab Shah College of Engineering and Technology under whose supervision the institution runs most successfully.

We would like to express out our heart-felt gratitude to our parents without whom we would not have been privileged to achieve and fulfill our dreams.

We would also like to express our gratitude to all the people behind the screen who helped us to transform an idea into real application.

We thank all the other staff members and our helping friends who have extended their timely help and eased our task

Development of solar refrigeration

Abstract—

The global increasing demand for refrigeration, led to production of more electricity and consequently more use of chlorofluorocarbons (CFCs) which acts as a contributing factor in the depletion of ozone layer. Thermoelectric refrigeration is new alternative because it can convert waste electricity into useful cooling. Therefore, thermoelectric refrigeration is greatly needed, particularly for developing countries where long life and low maintenance are needed. The objective of this study is to design and develop a working thermoelectric refrigerator that utilizes the Peltier effect to refrigerate and maintain a selected temperature low. The requirements are to cool this volume to temperature within a time period of 2 hours and provide retention of at least next half an hour. Our project also utilizes the solar energy to run a thermoelectric system. In this project we have fabricated a thermoelectric system using both solar power and electrical power supply. The project has various applications like, food preservation, military or aerospace, medical and pharmaceutical equipment.

Index Terms— Peltier effect, Module, Thermoelectric, Solar powered, Heat flow, Coefficient of Performance

Table of content

Title page

Certificate

Acknowledgement

Abstract

- 1 Chapter 1 introduction**
 - 1.1 seebeck effect**
 - 1.2 peltier effect**
 - 1.3 Thompson effect**
- 2 Chapter 2 literature review**
- 3 Chapter 3 hardware design**
 - 3.1 understanding thermoelectric cooling**
 - 3.2 peltier effect**
 - 3.2.1 how it works**
 - 3.2.2 choosing materials**
 - 3.2.3 TEC construction**
 - 3.2.4 benefits of TEC**
 - 3.3 construction**
 - 3.4 performance**
 - 3.5 requirement of thermoelectric —module**
 - 3.6 consumer products**
 - 3.7 science and imaging**
 - 3.8 identification**
 - 3.9 solar refrigeration**
 - 3.10 types of solar refrigeration**
 - 3.11 battery**
 - 3.11.1 history of battery**
 - 3.11.2 principle of operation**

- 3.11.3 categories and types
- 3.11.4 primaries batteries
- 3.11.5 secondary batteries
- 3.11.6 battery cell types
- 4 Chapter 4 solar energy
 - 4.1 how solar works
 - 4.2 solar cells
 - 4.3 solar cell technologies
- 5 Chapter 5 construction
 - 5.1 thermoelectric module
- 6 Chapter 6 operating principle of thermoelectric refrigeration
 - 6.1 thermoelectric module
- 7 Chapter 7 working principle
 - 7.1 technical specification
 - 7.2 insulation resistance requirement
 - 7.3 reliability
- 8 Chapter 8 hardware of TEC
 - 8.1 computation of cooling power
 - 8.2 TEC selection
 - 8.3 selection of heat sink
 - 8.4 heat sideheat sink
 - 8.5 results of a temperture reading
- 9 Chapter 9 advantages and disadvantages
 - 9.1 advantages
 - 9.2 disadvantages
 - 9.3 limitations
 - 9.4 applications
- 10 Chapter 10 conclusions
 - 10.1 conclusion
 - 10.2 future scope
- 11 Chapter 11 refrences

A Project Report
On
DESIGN AND FABRICATION OF SOLAR POWERED E BICYCLE
Submitted in partial fulfillment of the requirements for the award of degree
BACHELOR OF TECHNOLOGY
IN
MECHANICAL ENGINEERING

By

SHAIK ABDUL WASI	(17RT1A0394)
SHAIK ASHRAF ALI	(17RT1A0395)
M.A.RAHMAN	(18RT5A0316)
MOHD SADIQ	(18RT5A0326)

Mr. RAZA AHMED KHAN
(Associate professor)



Department of Mechanical Engineering
NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY
Approved by AICTE, Affiliated to JNTUH, Malakpet, Hyderabad
Year of submission: 2021

CERTIFICATE

This is to certify that the project report entitled **DESIGN AND FABRICATION OF SOLAR POWERED E BICYCLE** being submitted by

SHAIK ABDUL WASI

(17RT1A0394)

SHAIK ASHRAF ALI

(17RT1A0395)

M.A.RAHMAN

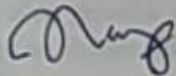
(18RT5A0316)

MOHD SADIQ

(18RT5A0326)

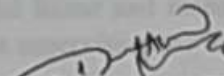
In partial fulfillment for the award of the Degree of Bachelor of Technology in Mechanical Engineering to the Jawaharlal Nehru Technological University, Hyderabad is a record of bonafied work carried out under my guidance and supervision at Nawab Shah Alam Khan Collage of Engineering and Technology Hyderabad.

The results embodied in this project report have not been submitted to any other University or Institute for the award of any Degree or Diploma.



Mr. RAZA AHMED KHAN

Project Guide



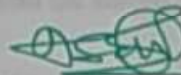
Mr. MOHAMMED AQEEL AHMED

Project Coordinator



Dr. SYED MUJAHED HUSSAINI

Head of the Department



Dr. SYED ABDUL SATTAR

Principal

PRINCIPAL

Nawab Shah Alam Khan

College of Engineering & Technology

New Malakpet, Hyderabad-500024.

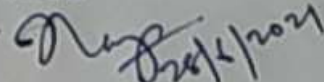
EXTERNAL EXAMINER:

Name:

Signature with date:

Note: Exam was conducted online

project supervisor:-



ACKNOWLEDGEMENT

The research work for this thesis was carried out at the Mechanical Engineering department of Nawab Shah Alam College of Engineering and Technology during the period 2020-2021. This thesis has been a part of Major project submitted to Jawaharlal Nehru Technological University, Hyderabad in partial fulfillment of the requirements for the award of degree "Bachelor of Technology in Mechanical Engineering".

The satisfaction and euphoria that accompany the successful completion of the project would be great but incomplete without mentioning people who made it possible with their constant guidance and encouragement. In this context,

We would cordially thank to our internal guide, Mr. Raza Ahmed khan project coordinator Mr. Mohammed Aqeel Ahmed and head of mechanical engineering department Dr. Syed Mujahed Hussaini for all their technical guidance, constant encouragement and moral support in carrying out our project and making it a success.

We are also grateful to our principal, Dr. Syed Abdul Sattar and management of Nawab Shah College of Engineering and Technology under whose supervision the institution runs most successfully.

We would like to express out our heart-felt gratitude to our parents without whom we would not have been privileged to achieve and fulfill our dreams.

We would also like to express our gratitude to all the people behind the screen who helped us to transform an idea into real application.

We thank all the other staff members and our helping friends who have extended their timely help and eased our task.

ABSTRACT

Electric bicycles (e-bicycle) are considered a sustainable alternative to automobile transportation today. The electric bike includes all the benefits that conventional bicycles offer, plus faster, more comfortable and longer trips, as well as less effort for the user. In this paper, we specifically focus on a new type of e-bike, the so-called 'solar-powered e-bike'. Therefore, this review paper explores existing literature findings for the use of solar energy in transportation, and more specifically in e-bicycle. This paper aims to capture the status of and experiences with the use of e-bicycle; more specifically, with solar-powered e-bicycle. It presents research conducted so far on e-bicycle and solar-powered e-bicycle, as well as the main technical features of the solar e-bike. Finally, it analyzes a sample of e-bicycle' and solar-powered e-bicycle' users, based on Dutch National Travel Survey data and an experimental field study conducted in 2017.

Data showed that the main target group of (solar) e-bicycle are commuters in the age group between 40 and 60 years old, commuting distances longer than 6 km, with a gross income higher than €2500. Solar-powered e-bicycle are concluded to have potential as a sustainable way of transportation in urban areas and cities, potentially replacing the conventional means of transport.

CHAPTER 3 DESIGN AND FABRICATION 5

CHAPTER 4 TECHNICAL SPECIFICATIONS 14

CHAPTER 5 FUTURE SCOPE AND USE 31

CHAPTER 6 CONCLUSIONS 55

CHAPTER 7 REFERENCES 74

Chapter 1

INTRODUCTION

CONTENT	PAGE NO :
TITLE PAGE	i
CERTIFICATE	ii
ACKNOWLEDGEMENT	iii
ABSTRACT	iv
CHAPTER: 1 INTRODUCTION	1
CHAPTER: 2 LITERATURE REVIEW	2
CHAPTER: 3 DESING AND FABRICATION	5
CHAPTER: 4 TECHNICAL SPECIFICATIONS	50
CHAPTER: 5 FUTURE SCOPE AND USES	53
CHAPTER: 6 CONCLUSIONS	55
CHAPTER: 7 REFERENCES	56

A Project Report
On
Design & Analysis of Composite Car Bumper
Submitted in partial fulfillment of the requirements for the award of degree
BACHELOR OF TECHNOLOGY
IN
MECHANICAL ENGINEERING

By
MOHD KHALEEL UR RAHEMAN (17RT1A0379)
MOHD SULEMAAN UDDIN ALI KHAN (17RT1A0386)
MOHAMMED SHOAIB HUSSAIN (18RT5A0318)

Under the guidance of
Dr. SYED MUJAHED HUSSAINI
(Head of the Department)



Department of Mechanical Engineering
**NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND
TECHNOLOGY**

Approved by AICTE, Affiliated to OU, Malakpet, Hyderabad

Year of submission: 2021

CERTIFICATE

This is to certify that the project report entitled "Design & Analysis of Composite Car Bumper" being submitted by

MOHD KHALEEL UR RAHEMAN

(17RT1A0379)

MOHD SULEMAAN UDDIN ALI KHAN

(17RT1A0386)

MOHAMMED SHOAIB HUSSAIN

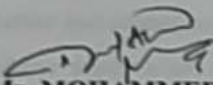
(18RT5A0318)

In partial fulfillment for the award of the Degree of Bachelor of Technology in Mechanical Engineering to the Jawaharlal Nehru Technological University, Hyderabad is a record of bonafied work carried out under my guidance and supervision at Nawab Shah Alam Khan Collage of Engineering and Technology Hyderabad.

The results embodied in this project report have not been submitted to any other University or Institute for the award of any Degree or Diploma.


Dr. SYED MUJAHED HUSSAINI

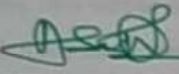
Project Guide


Mr. MOHAMMED AQEEL

Project Coordinator


Dr. SYED MUJAHED HUSSAINI

Head of the Department


Dr. SYED ABDUL SATTAR

Principal

PRINCIPAL
Nawab Shah Alam Khan
College of Engineering & Technology
New Malakpet, Hyderabad-500024.

EXTERNAL EXAMINER:

Name:

Signature with date:

Note: Exam was conducted online
Project supervisor - 
28/06/21 ii

ACKNOWLEDGEMENT

The research work for this thesis was carried out at the Mechanical Engineering department of Nawab Shah Alam College of Engineering and Technology during the period 2020-2021. This thesis has been a part of Major project submitted to Jawaharlal Nehru Technological University, Hyderabad in partial fulfillment of the requirements for the award of degree "Bachelor of Technology in Mechanical Engineering".

The satisfaction and euphoria that accompany the successful completion of the project would be great but incomplete without mentioning people who made it possible with their constant guidance and encouragement. In this context,

We would cordially thank to our internal guide **Dr. Syed Mujahed Hussaini**, project coordinator Mr. Mohammed Aqeel Ahmed and head of mechanical engineering department Dr. Syed Mujahed Hussaini for all their technical guidance, constant encouragement and moral support in carrying out our project and making it a success.

We are also grateful to our principal, **Dr. Syed Abdul Sattar** and management of Nawab Shah College of Engineering and Technology under whose supervision the institution runs most successfully.

We would like to express out our heart-felt gratitude to our parents without whom we would not have been privileged to achieve and fulfill our dreams. We would also like to express our gratitude to all the people behind the screen who helped us to transform an idea into real application.

We thank all the other staff members and our helping friends who have extended their timely help and eased our task.

ABSTRACT

Bumper is one of the main parts of automobile industry which are used as protection for the vehicle from front and rear collision. The aim of this project is to analyze and study the structure & material employed for car bumper. In this study, the most important variables like material, structures, shapes and impact conditions are studied for analysis of bumper beam in order to improve the crashworthiness during collision. The simulation of the bumper is characterized by impact modelling using Ansys R18.1. In this research, the three types of materials were selected that are relevant to be applied to front bumper beam.

- ▶ The materials are expanded polypropylene (EPP), glass mat thermoplastic (GMT), and sheet molding compound (SMC).
- ▶ These materials were studied by impact modelling to determine structural, modal, and thermal analysis.
- ▶ The selected materials are compared to each other to find the best material with highest material strength and structure.
- ▶ The results showed that a modified SMC bumper can reduce the impact of collision with higher performance and was suggested to replace GMT AND EPP.
- ▶ The findings also showed that EPP cannot totally absorb the energy and reduce the impact of collision.

KEYWORDS: Bumper, collision, sheet molding compound, energy.

CONTENTS

1 INTRODUCTION	1
1.1 Bumper	1
1.2 Types of bumper	2
1.3 Objectives of bumper	4
1.4 Applications	4
1.5 Materials Used	4
1.6 Properties of Materials	9
1.7 Expanded polypropylene (EPP)	12
1.8 Glass Mat Thermoplastics	14
1.9 Sheet Molding Compound	14
1.10 2D Model of Bumper	15
2. INTRODUCTION TO SOLID WORKS	16
2.1 Solid Works Software	16
2.2 Design in Solid Works Software	19
3 INTRODUCTION TO ANSYS 18.1	22
3.1 STRUCTURAL ANALYSIS:	22
3.2 Structural Analysis of Expanded polypropylene (EPP):	25
3.3 Structural Analysis of Glass Mat Thermoplastics:	32
3.4 Structural Analysis of Sheet Molding Compound:	37
3.5 MODAL ANALYSIS	41
3.6 Modal Analysis of Expanded polypropylene (EPP):	42
3.7 Modal Analysis of Glass Mat Thermoplastics:	49
3.8 Modal Analysis of Sheet Molding Compound:	52
3.9 Thermal Analysis:	57
3.10 Thermal Analysis of Expanded Polypropylene:	58
3.11 Thermal Analysis of Glass Mat Thermoplastics:	63

3.12 Thermal Analysis of Sheet Molding Compound	67
4 TOTAL ANALYSIS RESULT	73
5 CONCLUSION	74
6 FUTURE SCOPE OF THE WORK	75
REFERENCES	
1. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 1-100.	26
2. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 101-200.	27
3. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 201-300.	28
4. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 301-400.	29
5. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 401-500.	30
6. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 501-600.	31
7. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 601-700.	32
8. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 701-800.	33
9. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 801-900.	34
10. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 901-1000.	35
11. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 1001-1100.	36
12. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 1101-1200.	37
13. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 1201-1300.	38
14. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 1301-1400.	39
15. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 1401-1500.	40
16. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 1501-1600.	41
17. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 1601-1700.	42
18. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 1701-1800.	43
19. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 1801-1900.	44
20. Gupta, S. J. A. (1998) <i>Plastics Technology</i> , 2nd edn, pp. 1901-2000.	45

NAWAB SHAHA ALAMI KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING
4-2 A & B Sections Major Projects Review (A.Y 2020-2021) Marks Distribution Sheet

Batch No.	Hall Ticket No.	Marks Distribution						
		Abstract (15)	Review-1 (15)	Review-2	Review-3 (20)	Report (10)	Pre-Viva (25)	Total (100)
Energy Harvesting through Exercise								
A1.	16E01A0355	12	12	14	13	10	19	80
	16E01A0360	14	14	14	18	10	21	91
	15E01A0357	14	14	14	19	10	22	93
Power Generation in Railway Track by using Mechanical Motion.								
A2.	15R01A0337	14	14	14	19	10	23	94
	15R01A0362	14	13	12	18	10	21	88
	15R01A03E3	15	14	15	14	10	16	84
	17R01A0344	15	14	15	14	10	23	91
Design and Fabrication of 2 Wheel Drive for Industrial Fork Lift								
A3.	16E01A0302	14	12	14	16	09	20	85
	16E01A0329	15	10	14	19	08	21	87
	17R01A0348	14	14	15	18	08	22	91
	17R01A0367	15	14	14	18	09	22	92
Design of Air Conditioning System for Hospitals								
A4.	16E01A0361	15	14	14	18	10	23	94
	16E01A0368	15	13	13	17	10	21	89
	16R01A0383	15	12	12	18	08	17	82
	17R01A0329	15	14	14	18	09	23	93
Heat Load Calculation for Commercial Building using HAP.								
A5.	16R01A0316	15	15	14	18	10	24	96
	16R01A0355	15	14	14	15	10	18	86
	16R01A03A4	15	14	14	14	10	18	85
	16R01A03B4	14	14	14	14	10	18	84

Design and Analysis of Composite Aircraft Wing					Guide: Mr. Mohammed Asgeel Ahmed			
A6	16R1TA0120	15	11	12	15	08	24	85
	16R1TA0121	15	11	12	15	08	24	85
	16R1TA0145			13			18	31
	17R1TA0136	15	11	12	15	08	23	84
Design and Analysis of Helical Coiled Heat Exchanger					Guide: Mr. Mirza Haroon Baig			
A7	17R1TA0301	15	11	12	15	08	25	86
	17R1TA0311	15	11	12	15	08	24	85
	17R1TA0130	15	11	12	15	08	24	85
Fabrication of Electric Bicycle					Guide: Mr. Ameer Uir Rahman			
A8	17R1TA0107	15	11	12	15	08	20	81
	17R1TA0121			13			23	36
	17R1TA0126	15	11	12	15	08	23	84
	17R1TA0128	15	11	12	15	08	20	81
Hybrid Power Generation from Solar and Wind Energy.					Guide: Mr. Shabbir Ahmed			
A9	17R1TA0108	15	11	12	15	08	23	84
	17R1TA0134			13			23	36
	17R1TA0142	15	11	12	15	08	22	83
	17R1TA0143	15	11	12	15	08	20	81
Fabrication of Pneumatic Paper Cup Making Machine.					Guide: Mr. Syed Shakeel Ahmed			
A10	17R1TA0112	15	11	12	15	08	19	80
	17R1TA0127			13			21	34
	17R1TA0141	15	11	12	15	08	22	83
	17R1TA0160	15	11	12	15	08	18	79

Fabrication of Electric Scooter					Guide: Mr. Raza Ahmed Khan			
A11	17RTIA0319	15	11	12	15	08	25	86
	17RTIA0320			13			25	38
	17RTIA0331	15	11	12	15	08	24	85
	17RTIA0346	15	11	12	15	08	22	83
Thermo-Structural Design and Analysis of Hypersonic Cruise Missile Wing.					Guide: Dr. S.M. Hussaini			
A12	17RTIA0332	15	11	12	15	08	25	86
Electromagnetic Braking System					Guide: Mr. Md Sharjeel Zeeshan			
A13	17RTIA0333	15	11	12	15	08	23	84
	17RTIA0338			13			22	35
	17RTIA0361	15	11	12	15	08	24	85
	16RTIA0346	15	11	12	15	08	15	76
Dual Axis Solar Tracking System					Guide: Mr. Shabbir Ahmed			
A14	17RTIA0351	15	11	12	15	08	21	82
	17RTIA0356			13			25	38
	17RTIA0357	15	11	12	15	08	24	85
	17RTIA0362	15	11	12	15	08	23	84
Fabrication of Air Operated Vice					Guide: Mr. Ameer Ur Rahman			
A15	17RTIA0366	15	11	12	15	08	23	84
	17RTIA0368			13			21	34
	17RTIA0370	15	11	12	15	08	21	82

A Solution for Joint Pain and Other Diseases through portable Exercise Machine									
Machine									
B1	17RTIA0374	15	11	12	15	08	23	84	
	17RTIA0377			13			22	35	
	17RTIA0383	15	11	12	15	08	23	84	
Development of Solar Refrigerator Without Compressor	17RTIA0391	15	11	12	15	08	23	84	
	17RTIA0378	15	11	12	15	08	23	84	
	17RTIA0382			13			24	37	
B2	17RTIA0393	15	11	12	15	08	23	84	
	17RTIA0348	15	11	12	15	08	22	83	
Design and Analysis of Composite Car Bumper									
B3	17RTIA0379	15	11	12	15	08	25	86	
	17RTIA0386			13			24	37	
	18RTSA0318	15	11	12	15	08	25	86	
Two-Bay crack Arrest Capability Evaluation in Metallic Fuselage									
B4	17RTIA0381	12	12	12	17	8	20	82	
	17RTIA03A0	13	13	13	17	9	24	89	
	17RTIA03A2	13	13	13	17	9	22	86	
	18RTSA0310	13	13	13	18	69	24	90	

Design and Fabrication of Stair Lift									
B5	17RT1A0389	14	14	14	14	18	09	23	91
	17RT1A03A5	14	14	14	14	18	09	24	92
	17RT1A03A7	13	13	13	13	18	09	20	86
Design and Fabrication of Solar E-Bicycle	17RT1A03B6	13	13	13	13	18	09	20	86
	17RT1A0394	14	14	14	14	19	10	25	97
	17RT1A0395	15	15	15	15	20	10	25	99
B6	18RT5A0316	14	14	14	14	19	10	24	96
	18RT5A0326	15	15	15	15	19	10	24	97
Design and Enhancement of Oxygen Concentrator Machine									
B7	17RT1A03A6	12	12	12	12	17	08	21	83
	17RT1A03C1	12	12	12	12	17	08	21	83
	17RT1A03B4	13	13	13	13	18	09	23	90
Design and analysis of composite gear box casting	17RT1A03B8	14	14	14	14	18	09	23	91
	17RT1A03C0	13	13	13	13	17	09	23	88
	17RT5A0306	14	14	14	14	18	09	23	92
B8	17RT5A0328	13	13	13	13	18	09	24	91
	17RT1A03B5	10	10	10	10	13	07	23	73
	18RT5A0304	13	13	13	13	17	09	23	87

Design and Fabrication of Solenoid Engine					Guide: Mr. Syed Suddat Ali				
B9	17RT5A0309	13	13	13	17	08	21	84	
	17RT5A0314	12	12	12	17	08	20	82	
	17RT5A0325	14	14	14	18	09	22	90	
	17RT5A0326	12	12	12	17	08	21	83	
Fabrication of Screw turbine for Electricity generation					Guide: Mr. Tasleem Banu				
B10	18D95A0311	14	14	14	19	10	25	97	
	18RT5A0328	13	13	13	17	09	21	86	
Design of central Air Conditioning System in College Building					Guide: Mr. Md Rasheed				
B11	18RT5A0315	13	13	13	17	09	22	87	
	18RT5A0325	13	13	13	18	09	23	89	
	18RT5A0308	13	13	13	17	08	21	84	
	18RT5A0317	13	13	13	17	09	17	81	
Experimental Investigation on CI Engine using tyre pyrolysis oil					Guide: Mr. Ahmad Hussain				
B12	18RT5A0303	13	13	13	17	09	23	88	
	18RT5A0314	13	13	13	17	09	24	89	
	18RT5A0330	13	13	13	17	09	23	87	
	18RT5A0331	13	13	13	18	09	23	90	

Friction Stir Spot Weldments by using similar metals				Guide: Dr. Zahid Hassan				
B13	18RTSA00104	13	13	13	17	09	23	87
	18RTSA00111	13	13	13	18	09	23	89
	18RTSA00112	13	13	13	17	09	22	86
Development of Solar Water Heater	18RTSA00102	13	13	13	18	09	24	90
	18RTSA00101	14	14	14	18	09	25	93
	18RTSA00105	13	13	13	17	09	24	89
B14	18RTSA00109	13	13	13	18	09	25	92
	18RTSA00129	13	13	13	18	09	24	91
Heat Transfer Analysis on Rectangular plate by natural convection.				Guide: Dr. Noor Alam				
B15	18RTSA00113	13	13	13	17	08	21	84
	18RTSA00107	13	13	13	17	09	21	86
	18RTSA00119	14	14	14	18	09	22	91
Fabrication of Four Way Motorized Hack Saw	18RTSA00122	14	14	14	18	09	24	93
	18RTSA00121	14	14	14	18	09	23	91
	18RTSA00124	13	13	13	18	09	23	90
B16	18RTSA00127	13	13	13	17	09	21	85

Nawab Shah Alam Khan College of Engineering & Technology, JNTUH Hyderabad
DEPARTMENT OF MECHANICAL ENGINEERING
B.Tech IV YEAR, II SEM - Major Project ATTAINMENT CALCULATIONS - Academic Year: 2020-21

Subject: Major Project

C821R

Name of the Faculty: Mohammed Aqeel Ahmed

S.No.	HT No.	Internal (25 M)	External (75 M)
1	17RT1A0301	25	74
2	17RT1A0307	20	67
3	17RT1A0308	23	70
4	17RT1A0311	24	72
5	17RT1A0312	19	66
6	17RT1A0319	25	70
7	17RT1A0320	25	71
8	17RT1A0321	23	71
9	17RT1A0326	23	68
10	17RT1A0327	21	70
11	17RT1A0328	20	68
12	17RT1A0329	23	70
13	17RT1A0330	24	72
14	17RT1A0331	24	74
15	17RT1A0332	25	74
16	17RT1A0333	23	72
17	17RT1A0334	23	69
18	17RT1A0336	16	69
19	17RT1A0338	22	70
20	17RT1A0341	22	68
21	17RT1A0342	22	67
22	17RT1A0343	20	65
23	17RT1A0344	21	68
24	17RT1A0346	22	65
25	17RT1A0348	22	69
26	17RT1A0351	21	65
27	17RT1A0356	25	72
28	17RT1A0357	24	72
29	17RT1A0360	18	65
30	17RT1A0361	24	72
31	17RT1A0362	23	68
32	17RT1A0366	23	70
33	17RT1A0367	22	70
34	17RT1A0368	21	67
35	17RT1A0370	21	68
36	17RT1A0374	23	63
37	17RT1A0377	22	66
38	17RT1A0378	23	64
39	17RT1A0379	25	74
40	17RT1A0381	20	62
41	17RT1A0382	24	64
42	17RT1A0383	23	63
43	17RT1A0386	24	72
44	17RT1A0389	23	68
45	17RT1A0391	23	65
46	17RT1A0393	23	66
47	17RT1A0394	25	72
48	17RT1A0395	25	74
49	17RT1A03A0	24	65
50	17RT1A03A2	22	64
51	17RT1A03A5	24	68
52	17RT1A03A6	21	62
53	17RT1A03A7	20	66
54	17RT1A03A8	22	62
55	17RT1A03B4	23	67
56	17RT1A03B5	23	50
57	17RT1A03B6	20	66
58	17RT1A03B8	23	68
59	17RT1A03C0	23	65
60	17RT1A03C1	21	62
AVG of 1-60		22.47	67.77

S.No.	HT No.	Internal (25 M)	External (75 M)
61	17RTSA0306	23	69
62	17RTSA0309	21	63
63	17RTSA0314	20	62
64	17RTSA0325	22	68
65	17RTSA0326	21	62
66	17RTSA0328	24	67
67	17RTSA0329	18	
68	18D9SA0311	25	72
69	18RTSA0301	25	68
70	18RTSA0302	24	66
71	18RTSA0303	23	65
72	18RTSA0304	23	64
73	18RTSA0305	24	65
74	18RTSA0306	21	64
75	18RTSA0307	21	65
76	18RTSA0308	21	63
77	18RTSA0309	25	67
78	18RTSA0310	24	66
79	18RTSA0311	23	66
80	18RTSA0312	22	64
81	18RTSA0313	21	63
82	18RTSA0314	24	65
83	18RTSA0315	22	65
84	18RTSA0316	24	72
85	18RTSA0317	17	64
86	18RTSA0318	25	72
87	18RTSA0319	22	69
88	18RTSA0322	24	69
89	18RTSA0323	23	68
90	18RTSA0324	23	67
91	18RTSA0325	23	66
92	18RTSA0326	24	73
93	18RTSA0327	21	64
94	18RTSA0328	21	65
95	18RTSA0329	24	67
96	18RTSA0330	23	64
97	18RTSA0331	23	67
98			
99			
100			
101			
102			
103			
104			
105			
106			
107			
108			
109			
110			
111			
112			
113			
114			
115			
116			
117			
118			
119			
120			
AVG of 61-120		22.54	66.28

S.No.	HT No.	Internal (25 M)	External (75 M)
121			
122			
123			
124			
125			
126			
127			
128			
129			
130			
131			
132			
133			
134			
135			
136			
137			
138			
139			
140			
141			
142			
143			
144			
145			
146			
147			
148			
149			
150			
151			
152			
153			
154			
155			
156			
157			
158			
159			
160			
161			
162			
163			
164			
165			
166			
167			
168			
169			
170			
171			
172			
173			
174			
175			
176			
177			
178			
179			
180			
AVG of 121-180		#DIV/0!	#DIV/0!

AVERAGE	22.49	67.21
COURSE OUTCOMES	CO1,CO2, CO3,CO4	CO1,CO2, CO3,CO4
CO WISE SUM	22.49	67.21
CO Wise Percentage %	89.98	89.61

	INTERNAL MARKS %	INTERNAL ATTAINMENT	EXTERNAL MARKS %	EXTERNAL ATTAINMENT	DIRECT ATTAINMENT LEVELS
CO1	89.98	3	89.61	3	3
CO2	89.98	3	89.61	3	3
CO3	89.98	3	89.61	3	3
CO4	89.98	3	89.61	3	3
AVG	89.98	3.00	89.61	3.00	3.00

CO-PO Matrix for LABs

CO ATTAINMENT	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	3	3	2	3	3	2	2	3	2	2
CO2	3	3	3	3	2	3	3	3	3	3	2	2	3	2	3
CO3	3	3	3	3	3	3	3	2	3	3	2	2	3	2	3
CO4	3	3	3	2	3	3	3	2	3	3	2	2	3	2	2.5
Average	3.00	3.00	2.75	3.00	2.25	3.00	3.00	2.25	3.00	3.00	2.00	2.00	3.00	2.00	2.63

3.1.3

LAB	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Direct Attainment	3.00	3.00	2.75	3.00	2.25	3.00	3.00	2.25	3.00	3.00	2.00	2.00	3.00	2.00	2.63
Indirect Attainment	2.625	2.75	2.5	2.5	3	2	2.5	2	2.15	2	2.6	2.35	2.75	2.875	2.75
Final Attainment	2.93	2.95	2.70	2.90	2.40	2.80	2.90	2.20	2.83	2.80	2.12	2.07	2.95	2.18	2.65

3.3.2