

PRELIMINARY STUDY ON POWER TRAIN SYSTEM  
FOR ELECTRIC VEHICLE

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April 2009

‘I/We hereby declared that I/We have read through this report and found that it has  
comply the partial fulfillment for awarding the degree of Bachelor of Mechanical  
Engineering (Design and Innovation)’

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This report is submitted in partial fulfilment of requirement for the  
Degree of Bachelor in Mechanical Engineering  
(Design and Innovation)

Faculty of Mechanical Engineering  
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April 2009

“I hereby declared that this report is a result of my own work except for the excerpts  
that have been cited clearly in the references”

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*For my beloved mother, Hajah Wan Ruhani Binti Wan Ismail,  
my late father, Haji Che Hashim Bin Abdullah,  
and my wonderful siblings.*

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## ABSTRACT

Electric vehicle presents the answer to present problem of internal combustion engine vehicles such as spiking oil price and high emission of polluted contents. Although still not practical for commercial use, studies and researches is intensively been made all around the world to overcome the challenges and problems of present electric vehicle. Relative to that, power and torque output of an electrical powertrain system is one of the concerns regarding electric vehicle performance. By generating and selecting conceptual design of an electric vehicle powertrain system using systematic approach, this study attempts to determine the power and torque output of the selected powertrain system.

## ABSTRAK

Kenderaan elektrik menyediakan jawapan kepada beberapa masalah kenderaan enjin pembakaran dalam masakini seperti harga minyak yang melambung tinggi dan kadar pelepasan asap yang mengandungi bahan yang mencemarkan. Walaupun ianya masih belum boleh dianggap praktikal untuk kegunaan komersial, banyak kajian dan penyelidikan yang sedang dijalankan di seluruh dunia untuk mengatasi rintangan dan cabaran kenderaan elektrik masakini. Seiringan dengan itu, kuasa dan tork yang terjana adalah antara beberapa isu berkaitan dengan prestasi kenderaan elektrik. Dengan menggunakan beberapa kaedah sistematik untuk menjana dan memilih konsep rantaian kuasa bagi kenderaan elektrik, kajian ini berusaha untuk mengira kuasa dan tork yang terjana oleh rekaan konsep yang telah dipilih.



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## LIST OF SYMBOL

$F_r$	=	Wheel Resistance	N
$f_r$	=	Rolling Resistance Coefficient	
$m_f$	=	Vehicle Mass	kg
$g$	=	Gravitational Acceleration	$\text{ms}^{-2}$
$\alpha_{st}$	=	Angle of Inclination	°
$F_l$	=	Aerodynamic Resistance	N
$\rho_l$	=	Density of air	$\text{kg m}^{-3}$
$c_w$	=	Drag Coefficient	
$A$	=	Maximum vehicle cross section	$\text{m}^2$
$v$	=	Velocity	$\text{ms}^{-1}$
$F_{st}$	=	Gradient Resistance	N
$F_a$	=	Acceleration Resistance	N
$\gamma$	=	Rotational inertia coefficient	

$a$	=	Acceleration	$\text{ms}^{-2}$
$F_{Z,b}$	=	Anticipated Driving Resistance	N
$\mu$	=	Coefficient of friction	
$F_n$	=	Normal force	N
$T$	=	Torque	Nm
$N$	=	Rotaional speed	rpm

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## CHAPTER I

### INTRODUCTION

#### 1.1 Project Background

Electric vehicle has become more and more in demand due to several factors. Spiking oil price and public awareness of the environmental pollution are amongst the factors that urge many parties to escalate their effort in making electric vehicle practical for public use. Unlike its counterpart, the internal combustion engine vehicle, electric vehicle has not enjoyed popularity amongst public consumer as there are several challenges and difficulties that have to be overcome before electric vehicle can become comparable with its biggest rival.

Intensive study and research may help in making the electric vehicle a feasible alternative to the ICE vehicle. Emergence of a lot study and research may also help improve the public awareness and public perception of electric vehicle.

One of the concerns regarding electric vehicle is its power and torque output. When compared with internal combustion engine, electric vehicle has yet to prove its performance.

This study will attempt to do a theoretical estimation of the power and torque output of an electric vehicle powertrain system. In doing so, hopefully this report will become the base or reference for future development and research on electric vehicle powertrain system.

## 1.2 Problem Statement

Electric powertrain system has been sidelined since the emergence of the ICE car back in the early 20<sup>th</sup> century. Recent oil crisis has sparked a lot of positive attention to the electric vehicle. Many organization and party has begun active in the scene of electric vehicle such as the various drag and racing electric vehicle competition to further enhance the public awareness of the forgotten technology.

This study is done in hopes of helping the electric vehicle get some attention to all responsible party in UTeM and hopefully in Melaka by analysing the torque and power output of a conceptual electric vehicle powertrain.

A lack of research done by the UTeM students on this matter makes this study worthwhile. An analysis on the performance of electric vehicle powertrain especially the torque and power output on the drive wheel are the main focus of this study.

In order to accomplish that feat, several target performance characteristic were set beforehand so that the conceptual electric powertrain will have a benchmark whereupon it will be compared. The performance targets were taken from the Advanced Vehicle Testing Activity that was conducted jointly by the Idaho National Laboratory and National Renewable Energy Laboratory that specialised on alternative energy vehicle testing.

## 1.3 Objective

The objective of this study is to analyze the power and torque output of a conceptual electric powertrain system.

## 1.4 Scope

The scope of this study is important as it serves as guidelines for the study direction. The scope of this project is divided into several parts:

- a) Literature study on electric vehicle
  - Research on electric vehicle powertrain component such as electric motor, energy source, electronic control module, gearing system and anything related to electric vehicle powertrain component.
  - Research on electric vehicle powertrain configuration such as electric propulsion configuration, energy source configuration and anything related to electric vehicle configuration.
- b) Analysis of the power and torque output of electric vehicle powertrain system
- c) Determining the design requirements of the electric vehicle powertrain system.
- d) Identifying the best component for the electric vehicle powertrain (conceptual design)

## 1.5 Report Outline

This report is intended for 'Projek Sarjana Muda II'. In this report, there are four chapters that made this report whole.

The first chapter is introduction chapter. This chapter will explain the project's direction and motive. A brief background of the project will be explained at the start of the chapter. Problem statement will explain the requirements of this project and the importance of this project. After the statement of objective and scope, a brief summary of the report ensues.

The second chapter of this report is literature review on electric vehicle. To better organise the report, this chapter is divided into several subtopic. The first

subtopic is introduction of the chapter. Then, definition of electric vehicle and powertrain is stated. After that findings related to electric vehicle powertrain is stated.

Methodology of the project is explained in chapter three. In this chapter, detailed explanation on how the project will proceed is explained. It described all the processes involve in obtaining the project's objective.

Chapter four will state all the results and findings of this study in detail. Further analysis of the result will follow that were also stated in detail.

The final chapter of this report contains the conclusion and recommendation for future project.