DESIGN A SMALL PERMANENT MAGNET GENERATOR USING 2D FEMM

This thesis is presented in partial fulfillment for the award of the

Bachelor of Electrical Engineering (Honors)

University Teknologi MARA

MOHD FARIZAL BIN HUSSAIN

FACULTY OF ELECTRICAL ENGINEERING

UNIVERSITY TEKNOLOGI MARA

40450 SHAH ALAM

SELANGOR DARUL EHSAN

ACKNOWLEDGEMENT

All praise to ALLAH S.W.T , The Most Gracious and The Most Merciful that has given me the strength and ability to complete this Final Year Project. This project has taken most of time in order to finish it. During to finish it, many people were involved by contributing their most valuable resources, materials, ideas, and supports, just to make sure that this project reach it goal.

First and foremost, the most thankful person to my respected project supervisor, Assoc. Prof. Dr. Chan Sei, who have been really determine to make sure that I am getting the most important information about my final project title. He also gives advice and supported moral to my future world when I will be graduated. Also I wish to thanks to him for his time and valuable information towards the accomplishment of this project especially on the 2D FEMM software.

Not to forget my parent, sisters and brother, grateful acknowledgement because with their support and encouragement I have managed to complete my project. Thank you very much. I hope that the knowledge and the experience that I gained from doing this project will guide me to survive in working world in the future.

Thank you,

Mohd Farizal Bin Hussain

Faculty of Electrical Engineering

University Teknologi Mara (UiTM)

40450 Shah Alam

Selangor Darul Ehsan

May 2010

ABSTRACT

This paper deals with the design of small permanent magnet generator using 2D FEMM. The design will present the parameter computation and performance prediction of a permanent magnet (PM) synchronous generator based on numerical magnetic field analyses. The finite element method is employed to accurately determine the magnetic field distribution and key parameters of the machine, such as the winding flux, back electromotive force, winding inductance. An equivalent electrical circuit is applied to predict the generator performance such as the external characteristic.

Keywords-component; Permanent magnet(PM); Finite Element Analysis (FEA); synchronous generator.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 Introduction

In general, electrical machines play an extremely important role in industry and in our everyday life. Electrical machines generate electrical power in power plants and convert electric power to mechanical power in industrial and consumer applications. If the conversion is from electrical power to mechanical power, the machine is called a motor, while in the conversion from mechanical to electrical; the machine is called a generator. Conversion of energy is based on two electromagnetic phenomena. First, if a conductor is in a magnetic field and there occurs any change in the magnetic field or the conductor moves, a voltage is induced in the conductor. This phenomenon is generally known as Faraday's Law. Second, if a charged item, such as a current-carrying conductor, is placed in a magnetic field, the conductor experiences mechanical force. This is known as the Lorentz force. The DC machine, induction machine, and synchronous machine are the common rotating electrical machines.

In rotating electrical machines the magnetic circuits are formed by ferromagnetic materials in conjunction with air as a medium. The magnetic field is typically produced by feeding electric current through coils that are wound around ferromagnetic materials. In permanent magnet synchronous machines the permanent magnets are the major source of magnetic flux. A permanent magnet is capable of maintaining a magnetic field without any excitation current linkage provided to it. The first commercial versions of industrial permanent magnet synchronous machines emerged in the early 1980s. The development of high energy-product NdFeB (Neodymium-Iron-Boron) magnets accelerated the era of modern permanent magnet