# CERTIFICATE

This is to certify that the project entitled**, "ANALYSIS, DESIGN & DEVELOPMENT OF HYBRID CONTROLLER FOR SPEED CONTROL OF PERMANENT MAGNET BRUSHLESS DC MOTOR DRIVE",** submitted by **Mr. Vakalapudi Harish Kumar,** University Roll No.12246, student of Master of Engineering (Control and Instrumentation) from Delhi College of Engineering, Delhi is a dissertation work carried out by him under my guidance during session 2008-2009 towards the partial fulfillment of the requirements for the award of the degree of Master of Engineering in Control& Instrumentation.

I wish him all the best in his endeavors.

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# ACKNOWLEDGEMENT

This report as we see today is an outcome of persistent effort and a great deal of dedication and it has drawn intellectual and moral support from various people within the institution.

It is my great pleasure to express my profound gratitude to my honorable guide **Dr. VISHAL VERMA,** Assistant Professor, Department of Electrical Engineering, Delhi College of Engineering for his constant Guidance and unflinching encouragement throughout the development of this project. It is a matter of great pride for me to have worked under him. It in itself was a source of inspiration for me to complete the project with great enthusiasm, energy and determination. I also give extra special thanks to him for dedicating his valuable time whenever I needed to discuss project related work.

I would also like to thank **Dr. PARAMOD KUMAR,** Head of the Department, Electrical Engineering Department, Delhi College of Engineering for his valuable suggestions and timely help.

I will be indebted to my parents helping me realize my goals. Without their blessings, this work would not have been possible.

Finally, I would like to thank my friends B. Suresh, G. Ramanjaneyulu, K.V. Santosh and Hakim Bohra for their support throughout my course at DCE.

I thank Almighty GOD for his countless blessings

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**(19/C&I/07)**

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## ABSTRACT

With rapid developments in power electronic technology, power semiconductor technology, modern control theory for motors, the permanent magnet brushless DC motors (PMBLDCM) are been widely used in many fields. Due to the advantages like small size, good performance, simple structure, high reliability and large output torque, BLDC motors have attracted increasing attention. They have also found wide applications in high power servo and robotic application due to their advantages like high power-density ease of control, high efficiency, low maintenance and low rotor inertia.

It is well known that electrical motors use a significant percentage of Electrical Energy and even small improvement in operating efficiency could result in large reduction in consumption of energy. Therefore new techniques are required to extract ultimate performance from these drives. There has also been tremendous research for providing suitable speed controller for PMBLDC motor. Many control strategies have been proposed till today. The main drawback of fixed gain controllers is that their performance deteriorates as a result of changes in system operating conditions. Besides, these controllers show either steady state error (PD controller) or sluggish response (PI, PID controllers). This has resulted in the increased demand of modern nonlinear control structures. In recent times Fuzzy Logic has emerged as one of the most attractive non linear controller for research and application in the industrial processes giving robust performance in the face of parameter variation and load disturbance effects. The main objective is to compensate for overshoots and oscillations in the response of the PMBLDC motor a wide speed range. Applications today demand high-speed control accuracy and good dynamic responses. In this thesis, the PMBLDCM drive is modelled and simulated in MATLAB/SIMULINK environment. The controllers such as Proportional Integral controller, Fuzzy logic controller, series hybrid controller (better known as fuzzy precompensated PI controller) and a proposed parallel hybrid controller (better known as fuzzy tuned PI controller) are implemented for speed controller in the SIMULINK environment, and the drive performance when using these controllers is observed and compared. The feasibility with these different controllers is also evaluated. The performance comparison is done based in terms of several performance measures such as settling time, rise time, tolerance to load variations and stable performance under all operating conditions.

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| | |
|---|---|
| $\omega_r^*(n)$ | Reference speed |
| $\omega_r(n)$ | Rotor speed |
| e | Speed error |
| $\Delta e$ | Change in speed error |
| $y_c$ | Precompensated reference |
| $e_2$ | Speed error with precompensated reference |
| $\Delta e_2$ | Change in Speed error with precompensated reference |
| $T^*$ | Reference torque from controller |
| $I^*$ | Reference current generated from ref torque |
| a(n) | Output fuzzy variable, corresponding to $K_p$ |
| b(n) | Output fuzzy variable corresponding to $K_i$ |