A SIMULATION BASED MINOR PROJECT REPORT

on

CHARACTERISTICS OF A DC MOTOR

by

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In

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TABLE OF CONTENTS

DECLARATION

We hereby declare that this submission is our work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

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ACKNOWLEDGEMENT

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.

We also do not like to miss the opportunity to acknowledge the contribution of all faculty members of the department for their kind assistance and cooperation during the development of our project. Last but not the least, we acknowledge our friends for their contribution in the completion of the project.

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CHAPTER-1

INTRODUCTION

1.1 DC MOTOR

A DC motor in simple words is a device that converts direct current(electrical energy) into mechanical energy. It's of vital importance for the industry today, and is equally important for engineers. The very basic construction of a DC motor contains a current carrying armature which is connected to the supply end through commutator segments and brushes it is placed within the north south poles of a permanent or an electro-magnet as shown in the diagram.

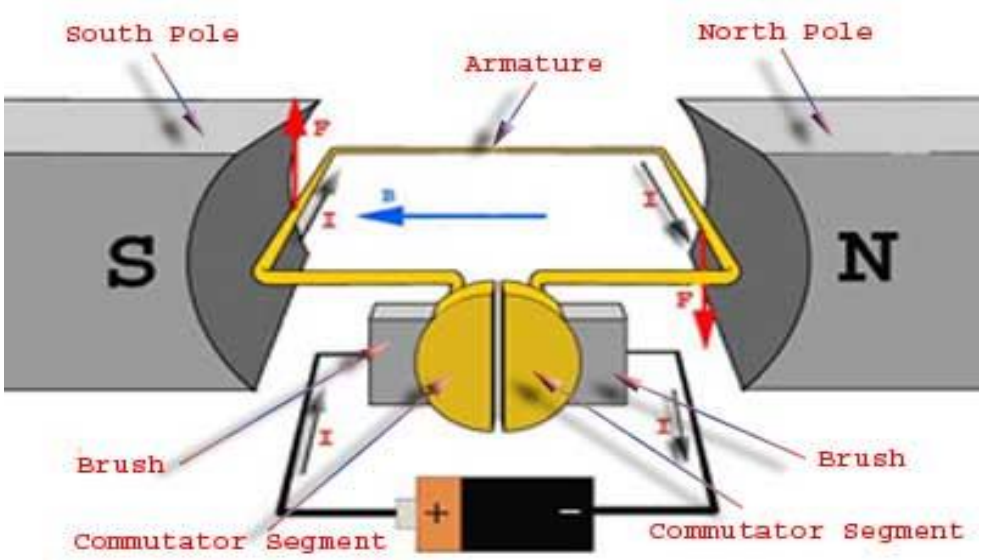
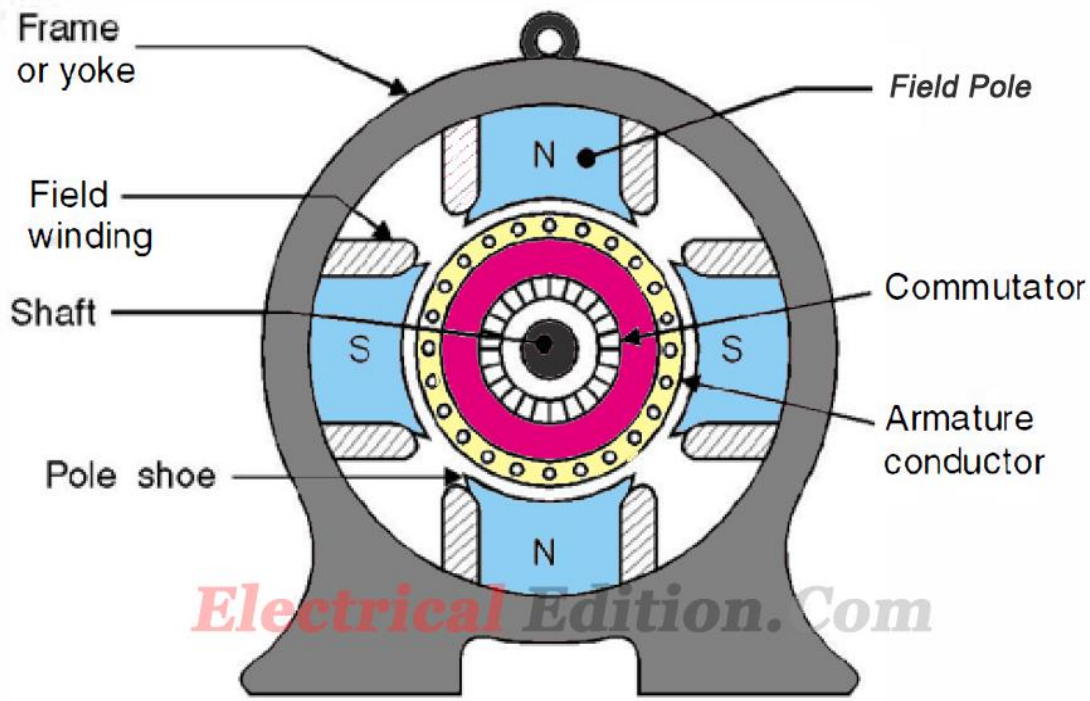


Fig.1 Current carrying armature

1.12 CONSTRUCTION

A DC motor like we all know is a device that deals in the conversion of electrical energy to mechanical energy and this is essentially brought about by two major parts required for the construction of DC motor, namely

- Stator – The static part that houses the field windings and receives the supply and,
- Rotor – The rotating part that brings about the mechanical rotations.
- Other than that there are several subsidiary parts namely the
- Yoke of DC motor
- Poles of DC Field winding of DC motor
- Armature winding of DC motor
- Commutator of DC motor
- Brushes of DC motor



1.3 YOKE OF DC MOTOR

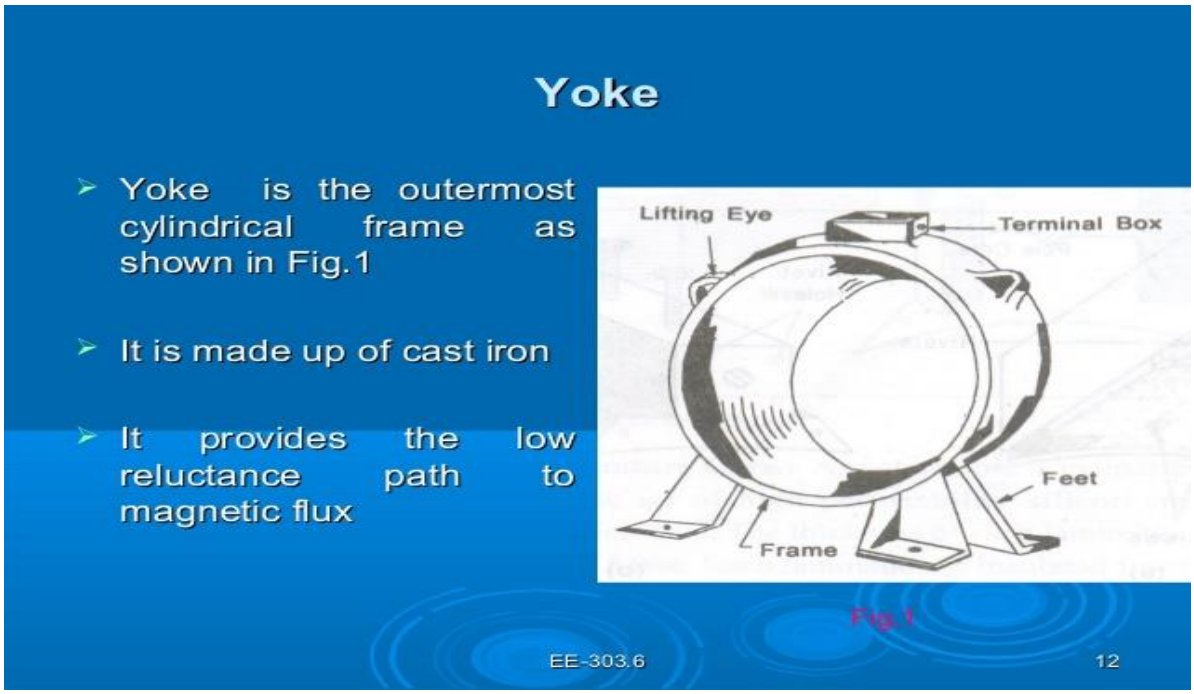


Fig.2: Yoke of DC Motor

The magnetic frame or the **yoke of dc motor** made up of cast iron or steel and forms an integral part of the stator or the static part of the motor. Its main function is to form a protective covering over the inner sophisticated parts of the motor and provide support to the armature. It also supports the field system by the dc motor. The magnetic frame or the **yoke of DC motor** made up of cast iron or steel and forms an integral part of the stator.

1.4 POLES OF THE MOTOR

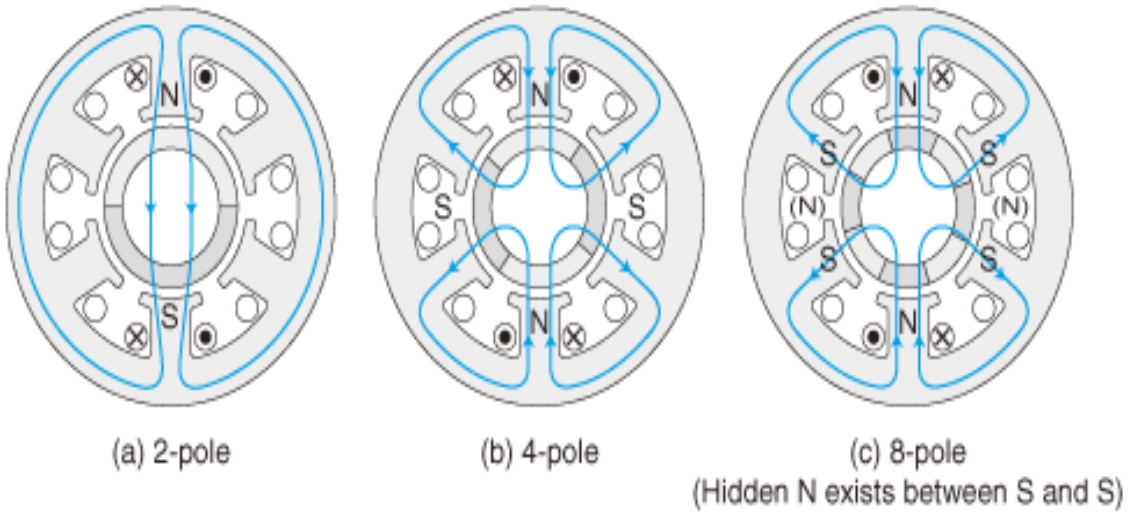


Fig.3 Poles of the Motor

The magnetic **poles of DC motor** are structures fitted onto the inner wall of the yoke with screws. The construction of magnetic poles basically comprises of two parts namely, the pole core and the pole shoe stacked together under hydraulic pressure and then attached to the yoke. These two structures are assigned for different purposes, the pole core is of small cross sectional area and its function is to just hold the pole shoe over the yoke,

1.5 Field Winding of DC Motor

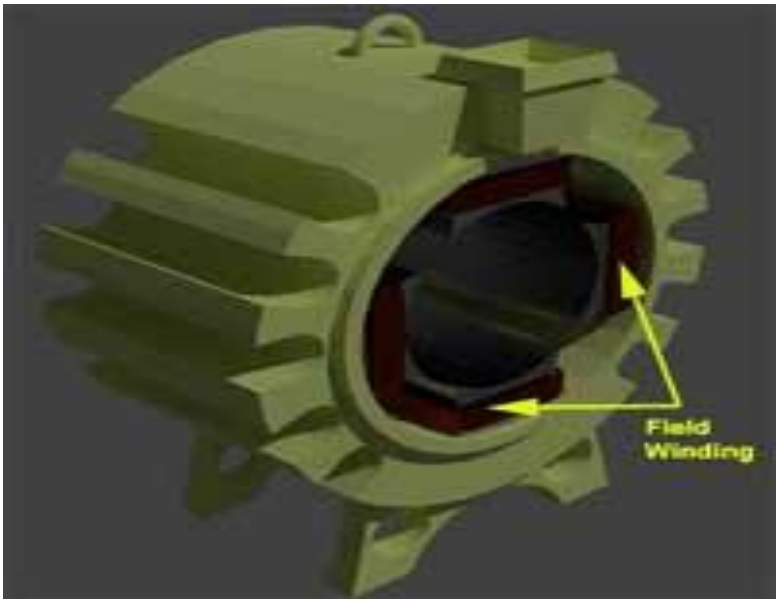


Fig.4 Field Winding

The **field winding of DC motor** are made with field coils (copper wire) wound over the slots of the pole shoes in such a manner that when field current flows through it, then adjacent poles have opposite polarity are produced. The field winding basically form an electromagnet, that produces field flux within which the rotor armature of the DC motor rotates, and results in the effective flux cutting.

1.6 Armature Winding of DC Motor

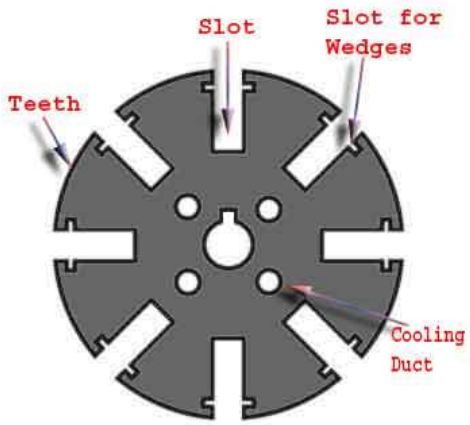


Fig.5 Armature Winding

The **armature winding of DC motor** is attached to the rotor, or the rotating part of the machine, and as a result is subjected to altering magnetic field in the path of its rotation which directly results in magnetic losses. For this reason the rotor is made of armature core, that's made with several low-hysteresis silicon steel lamination, to reduce the magnetic losses.

1.7 Characteristics Of DC Shunt Motors

Generally, three characteristic curves are considered important for DC motors which are,
(i) Torque vs. armature current, (ii) Speed vs. armature current and (iii) Speed vs. torque.

1.8 Torque Vs. Armature Current (T_a-I_a)

In case of DC shunt motors, we can assume the field flux ϕ to be constant. Though at heavy loads, ϕ decreases in a small amount due to increased armature reaction. As we are neglecting the change in the flux ϕ, we can say that torque is proportional to armature current. Hence, the Ta-Ia characteristic for a dc shunt motor will be a straight line through the origin. Since heavy starting load needs heavy starting current, **shunt motor should never be started on a heavy load.**

1.9 Speed Vs. Armature Current (N-Ia)

We know

$$N \propto E_b/\phi$$

As flux ϕ is assumed to be constant, we can say N ∝ Eb. But, as back emf is also almost constant, the speed should remain constant. But practically, ϕ as well as Eb decreases with increase in load. Back emf Eb decreases slightly more than ϕ, therefore, the speed decreases slightly. Generally, the speed decreases only by 5 to 15% of full load speed. Therefore, **a** characteristic in the following figure, the straight horizontal line represents the ideal characteristic and the actual characteristic is shown by the dotted line.

1.10 Speed Versus Torque (N-Ta)

This characteristic is also called as **mechanical characteristic**. The curve depicts that the speed exponentially decreases

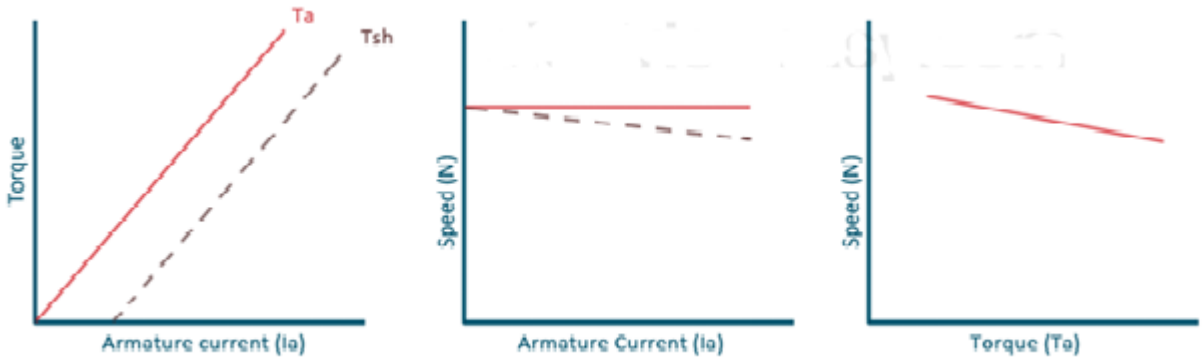


Fig.6 Charactersic of DC shunt motor

$$E_a = \frac{\Phi n Z}{60}\left(\frac{P}{A}\right) = k_a \Phi\omega \quad \text{(Eq (7.3))} \text{ V}$$

$$T = \frac{1}{2\pi}\Phi I_a Z\left(\frac{P}{A}\right) = k_a \Phi I_a \quad \text{(Eq (7.9))} \text{ Nm}$$

where n = speed in rpm, while $\omega = \frac{2\pi n}{60}$ = speed in rad/s

The above equations depict the relation between Characteristics of DC motors. Generally, three characteristic curves are considered important for DC motors which are, (i) Torque vs. armature current, (ii) Speed vs. armature current and (iii) Speed vs. torque.

CHAPTER 2

MATLAB MODEL

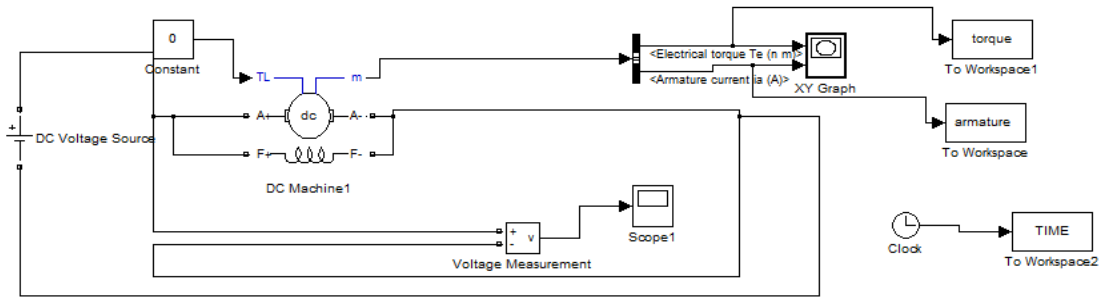


Fig.7 Matlab model of dc motor

The matlab circuit for plotting the characterstics of dc motor is as shown above. It consists of a DC motor, Dc supply, voltmeter, scope, and a bus bar.

2.1 TORQUE V/S SPEED CHARACTERISTIC OF DC MOTOR

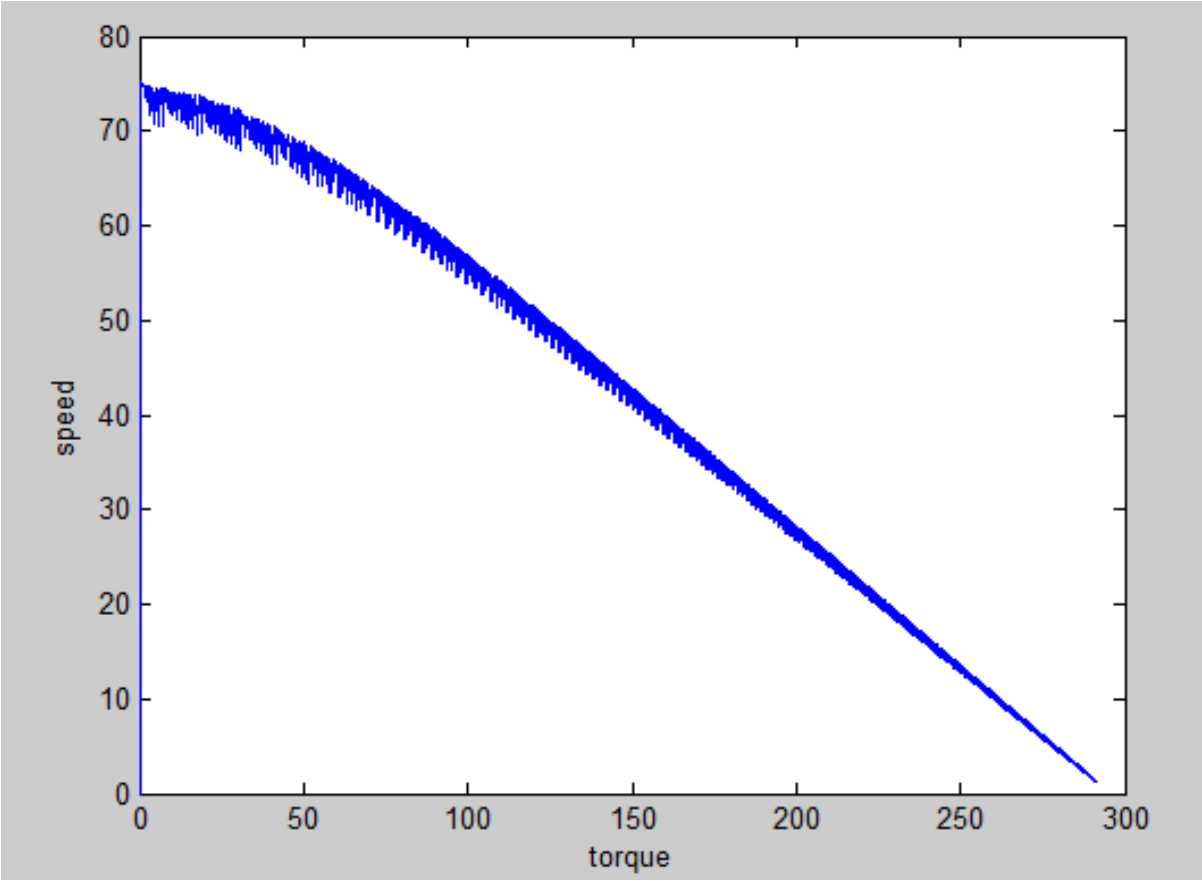


Fig.8 Torque-speed characteristic of a dc motor.

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The figure shown above is the torque versus speed characterstics of dc motor . On ‘x’ axis we have ‘torque’ and on ‘y’ axis we have ‘speed’.

2.2 TORQUE V/S ARMATURE CURRENT CURVE OF DC MOTOR

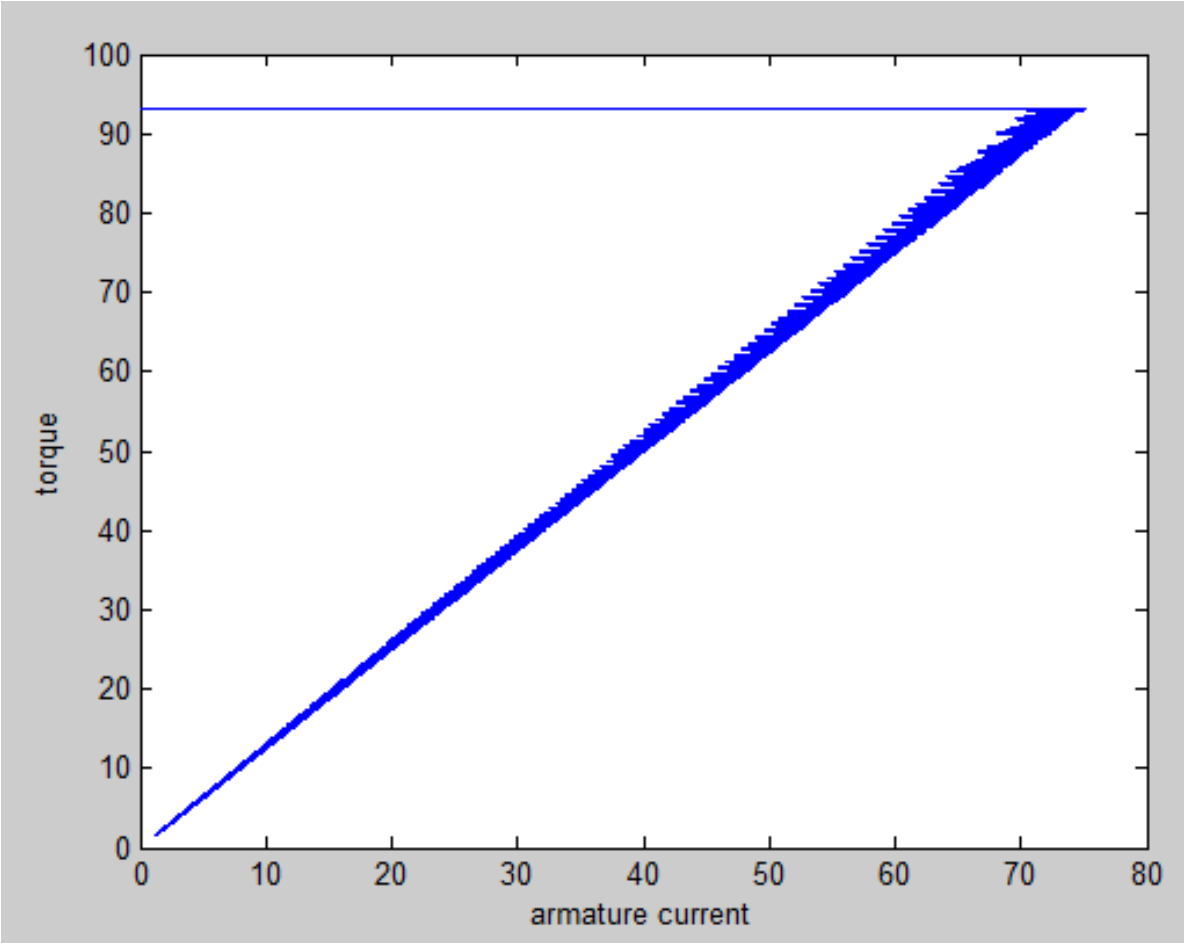

Fig.9 Torque-armature curve of dc motor.

The figure shows the torque versus armature curve of a dc motor. On ‘x’ axis we have ‘armature current’ and on ‘y’ axis we have ‘torque’.

2.3 SPEED VS ARMATURE CURRENT CHARACTERISTIC OF DC MOTOR

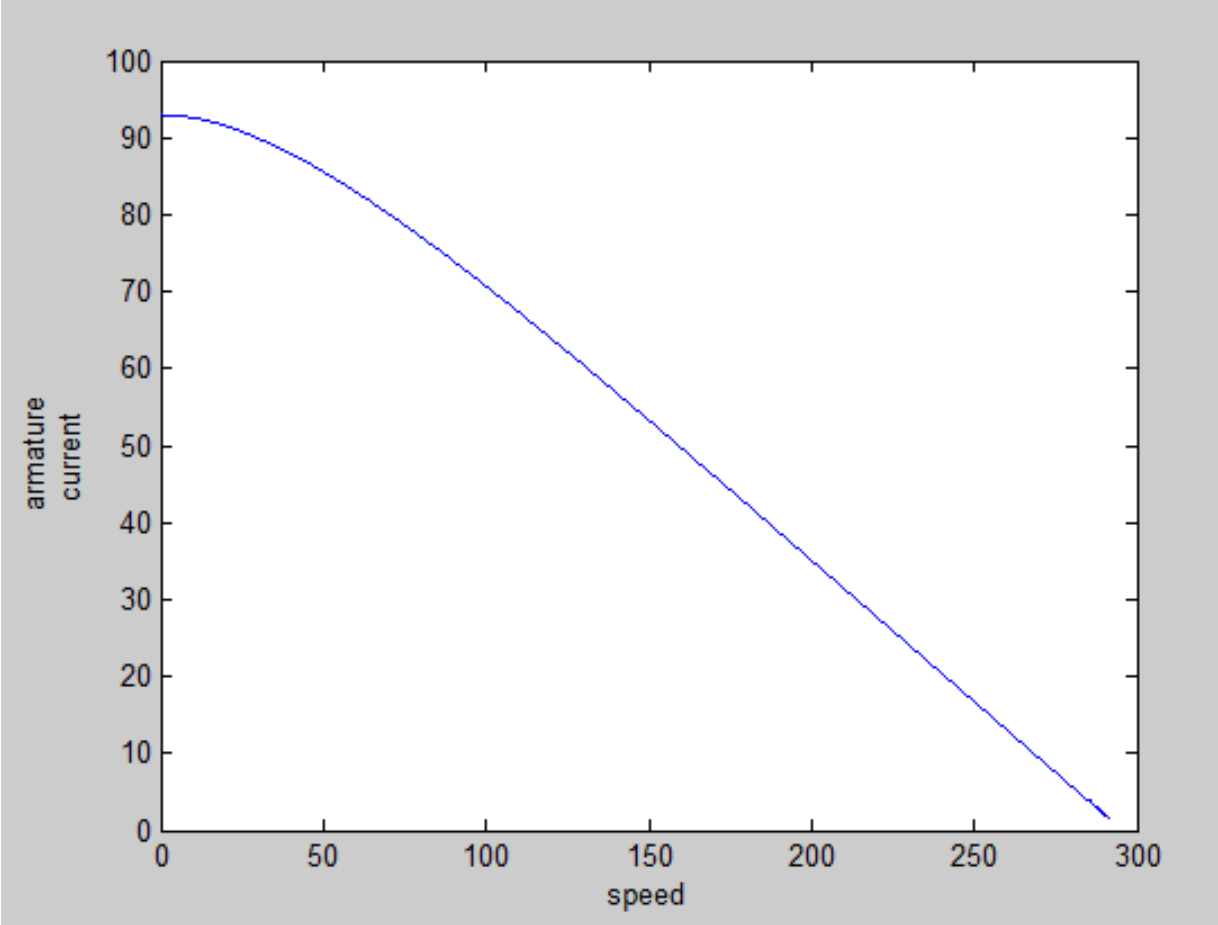

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Fig.10 speed-armature current curve of dc motor.

The figure shows the speed versus armature current characterstics of a dc motor. On ‘x’ axis we have ‘speed’ and on ‘y’ axis we have ‘armature current’.

CHAPTER-3

CONCLUSION

It was wonderful and learning experience for us while working on this project. This project took us through the various phases of project development and give us real insight to the world of electrical engineering. The joy of working and the thrill involved tackling the various problems and challenges gave us feel of developers industry.

It was due to this project we came to know the importance of dc motor in our day to day life. We enjoyed each and every bit of hard work dedication that was involved in this project. It was through this project we were able to view the clear picture of the importance of characteristic of DC Motor. It was a prime success overall.

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