1 Experiment No. 1

2 Experiment Title

Introduction to different DC and AC Machines and General discussion on safety and precautions

3 Objective

The objectives of this lab are as follows:

- To investigate the torque and speed characteristics of a DC motor.
- To understand the relationship between torque and speed for DC motors.
- To observe the effect of varying load on the motor's speed and torque.

4 Theory

A machine is a device that uses energy to perform a specific task. It can be mechanical, electrical, or a combination of both. Machines typically convert one form of energy into another to accomplish work. power supply three phase asynchronous motor three phase synchronous tacho-generator AC-DC Multimeter Dc Current Stator Universal Motor Resistors 230V. DC Supply 3 point starter

5 Types of DC and AC Machines

5.1 DC Machines

DC machines are commonly used in applications requiring variable speed control and high starting torque. They are classified into:

- **DC Motors**: Convert electrical energy into mechanical energy.
- **DC Generators**: Convert mechanical energy into electrical energy.

Based on excitation, DC machines are further classified as:

- Separately excited DC machines
- Shunt-wound DC machines
- Series-wound DC machines
- Compound-wound DC machines

5.2 AC Machines

AC machines are widely used due to their efficiency and robustness. They are classified into:

- **Induction Machines**: Work on the principle of electromagnetic induction.
- **Synchronous Machines**: Operate at a constant speed determined by the supply frequency.
- **Transformers**: Used to step up or step down voltage levels.

6 Description of Machines

6.1 Three-Phase Asynchronous Motor

A three-phase asynchronous motor, also known as an induction motor, operates on the principle of electromagnetic induction. It is widely used in industrial applications due to its robustness and self-starting capability.

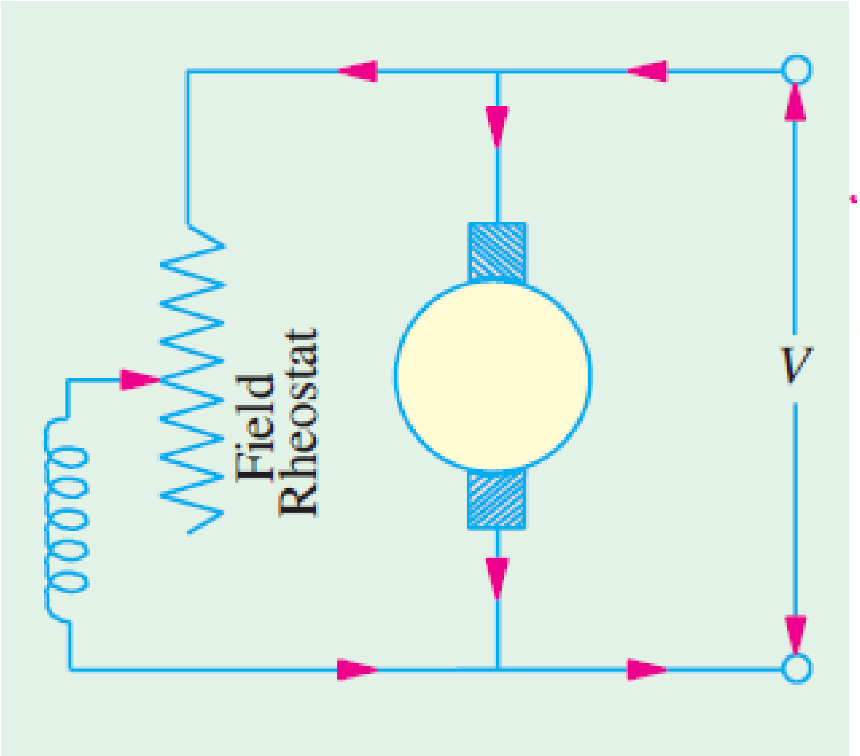


Figure 1: LCD/LED TV Trainer

6.2 Three-Phase Synchronous Motor

A three-phase synchronous motor runs at a constant speed determined by the supply frequency. It requires external excitation and is commonly used in applications requiring precise speed control.

6.3 Tachogenerator

A tachogenerator is a device used to measure the rotational speed of a shaft. It converts mechanical motion into a proportional electrical signal.

6.4 AC-DC Multimeter

An AC-DC multimeter is an instrument used to measure voltage, current, and resistance in both AC and DC circuits.

6.5 DC Current Stator

A DC current stator is a stationary part of a DC machine that produces a magnetic field necessary for the operation of the motor or generator.

6.6 Universal Motor

A universal motor is a type of electric motor that can operate on both AC and DC power supplies. It is commonly found in household appliances like mixers and drills.

6.7 Resistors

Resistors are passive electrical components that limit the flow of current in a circuit, helping in voltage regulation and circuit protection.

6.8 230V DC Supply

A 230V DC supply provides a stable direct current voltage for operating electrical machines and circuits requiring high voltage DC power.

6.9 3-Point Starter

A 3-point starter is a protective device used to limit the inrush current when starting a DC motor, ensuring safe and efficient operation.

7 Safety and Precautions

Handling electrical machines requires adherence to safety guidelines to prevent electrical hazards, injuries, and equipment damage. Some key precautions include:

- Always wear insulating gloves and shoes while working with electrical machines.
- Ensure proper grounding and insulation to avoid electrical shocks.
- Avoid touching live wires and rotating parts while machines are operational.
- Regularly inspect machines for loose connections and overheating.
- Follow manufacturer guidelines and safety procedures during operation and maintenance.

8 Conclusion

DC and AC machines form the backbone of modern electrical applications, providing efficient energy conversion. Understanding their working principles and adhering to proper safety precautions ensures optimal performance and minimizes risks associated with their operation. This lab provided practical exposure to different types of electrical machines and their safety protocols, enhancing theoretical knowledge and practical skills.

8.0.1 DC Motor Specifications

Table 1: DC Motor Specifications

Specification	Value
Power Rating	300 W
Voltage Rating [EXC.SERIES & EXC. SEP]	220 V
Current Rating [EXC SERIES]	1.9 A
Current Rating [EXC SEP]	1.8 A
Vexc	220 V
Iexc	0.1 A
Speed	2500 RPM

8.0.2 DC Generator Specifications

Table 2: DC Generator

Specification	Value
Power Rating	300 W
Voltage Rating [EXC.SERIES]	210 V
Voltage Rating [EXC. COMP]	220 V
Current Rating [EXC SERIES & EXC COMP]	1.4 A
Vexc	0-220 V
Iexc	0.11 A
Speed	3000 RPM

8.0.3 Single-Phase Transformer Specifications

Table 3: Single-Phase Transformer Specifications

Specification	Value
Power Rating	760 kVA
U_1	230 V
U_2	400V-230V
I_1	3.7 A
I_2	1A-1.7A
Frequency	50 Hz

9 Required Apparatus

1. Electric Machine Trainer
    (a) DC Motor Starting Resistor
    (b) DC Power Supply (Rating: Voltage: 200V)
    (c) DC Ammeters (Rating: Current: 5A)
    (d) DC Voltmeter (Rating: Voltage: 500V)

(e) DC Motor Field Resistor

(f) Speed Meter (Rating: 1500 rpm max)

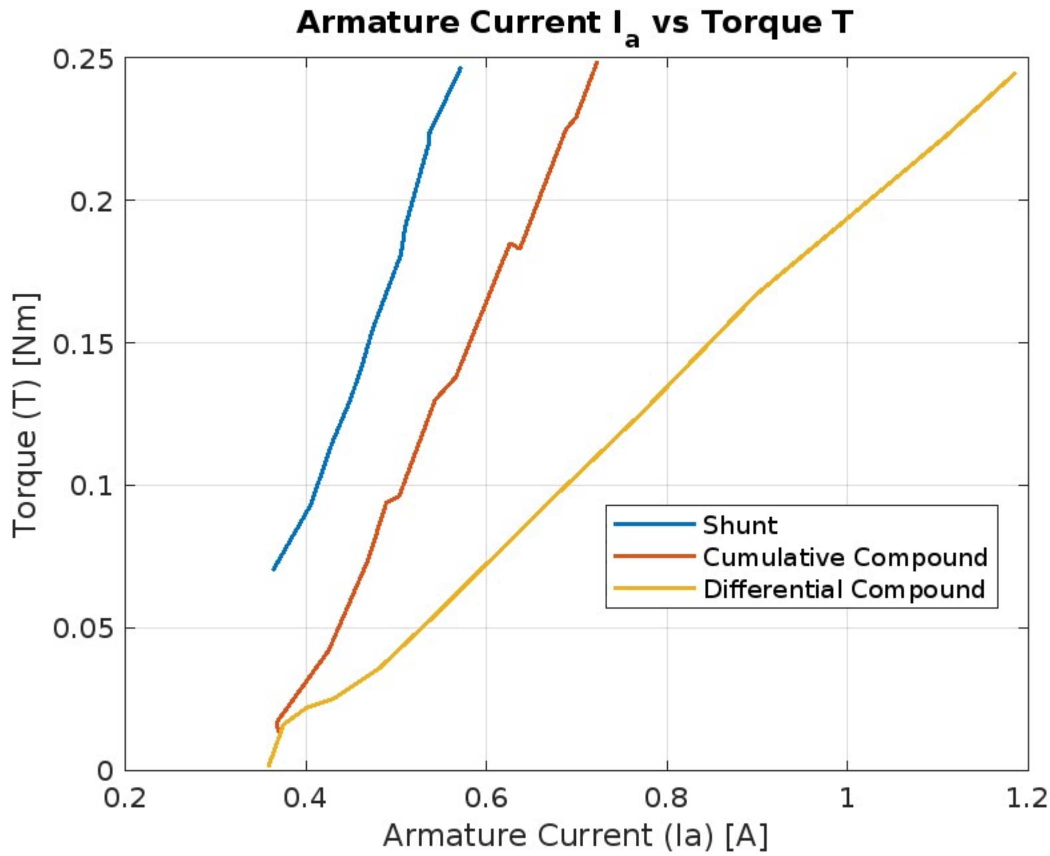
(g) Torque Meter (Rating: 0.24 kg-m max)

2. DC Compound Motor (Ratings: Output: 360W, Voltage: 200V, Current: 2.5A, Speed: 1500 rpm; Field: 0.2A, Pole: 2P)

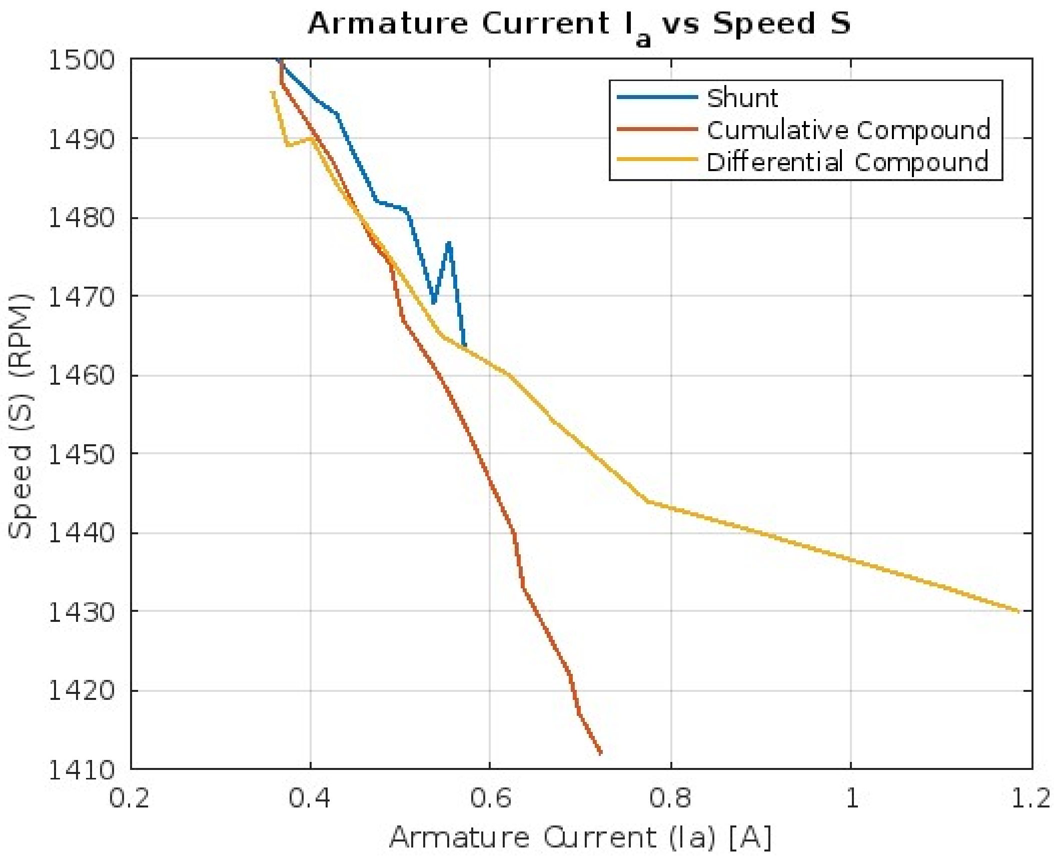
3. Dynamometer (Ratings: Output: 360W, Voltage: 100V, Current: 3A; Pole: 2P; Speed: 4000 rpm max, Type: Eddy Current)

10 Circuit Diagrram

11 Graph



(a) I_a vs. Torque (T) Graph



(b) I_a vs. Speed(S) Graph

12 Discussion

The experiment was conducted to investigate the Torque and Speed Characteristics of a DC Motor. The relationship between torque and speed can be described by the following equations:

$$T = KI_a\Phi \tag{1}$$

$$S = \frac{V_T - I_a R_a}{K\Phi}$$

To start the motor, it was carefully ensured that the starting resistance was kept at its maximum value, and the field resistance was also kept at its maximum. Then, the voltage of the supply was increased to 100V. After that, the starting resistance was decreased. The supply voltage was further increased to 200V, and the field resistance was then decreased to speed up the motor to 1500 rpm, the rated speed of the motor.
There were three knobs to adjust the torque value of the electrodynamometer. Initially, the torque was set to zero by adjusting the knob. Data was then recorded for the armature current, torque value, and speed at different torque levels for the DC shunt and compound motors.

13 Introduction

Electric machines play a crucial role in modern electrical engineering, converting electrical energy into mechanical energy and vice versa. These machines are broadly classified into DC (Direct Current) machines and AC (Alternating Current) machines. This report discusses various types of DC and AC machines, their working principles, and their applications. Additionally, safety measures and precautions associated with handling these machines are discussed to ensure proper operation and accident prevention.

14 Types of DC and AC Machines

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16 Conclusion

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