DC MACHINES LABORATORY

LAB MANUAL

Academic Year	**:**	**2018 - 2019**
Course Code	**:**	**AEE104**
Regulations	**:**	**IARE-R16**
Class	**:**	**III Semester (EEE)**

Department of Electrical and Electronics Engineering

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal – 500 043, Hyderabad

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Dundigal, Hyderabad - 500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

Program Outcomes	
PO1	**Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem Analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO3	**Design / Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health, safety, cultural, societal and environmental considerations.
PO4	**Conduct Investigations of Complex Problems**: Use research based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage**: Create, select, and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life - Long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and life - long learning in the broadest context of technological change.
Program Specific Outcomes	
PSO1	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.
PSO2	**Problem - Solving Skills:** Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.
PSO3	**Successful Career and Entrepreneurship:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.

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ATTAINMENT OF PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES

Exp. No.	Experiment	Program Outcomes Attained	Program Specific Outcomes Attained
1	Magnetization characteristic of DC shunt generator	PO1, PO2	PSO1, PSO2
2	Load Test on DC shunt generator	PO1, PO3	PSO1
3	Load test on DC series generator	PO1, PO2	PSO1, PSO2
4	Load test on DC compound generator	PO1, PO4	PSO1, PSO2
5	Hopkinson’s test on DC shunt machines	PO1, PO2, PO3	PSO2
6	Field’s test on DC series machines	PO1, PO2, PO3	PSO1
7	Speed control of DC shunt motor and Swinburne’s test on DC shunt motor	PO1, PO2	PSO1, PSO2
8	Brake test on DC compound motor	PO1, PO3, PO4	PSO2
9	Brake test on DC shunt motor	PO1, PO3, PO4	PSO1, PSO2
10	Retardation test on DC shunt motor	PO1, PO2	PSO1, PSO2
11	Separation of losses in DC shunt motor	PO1, PO2, PO4	PSO1
12	Characteristics of DC shunt generator using digital simulation	PO1, PO2	PSO2, PSO3
13	Load test on DC shunt generator using digital simulation	PO1, PO3	PSO2, PSO3
14	Speed control techniques of DC motor using programmable logic controller and Lab VIEW	PO1, PO2	PSO2, PSO3

DC MACHINES LABORATORY

OBJECTIVE:

The objective of the DC Machine Lab is to expose the students to the operation of DC machines and give them experimental skill. It also aims to understand the generation of DC voltages by using different types of generators and study their performance and enable the students to understand the working principles of DC motors and their load characteristics, starting and methods of speed control. Further it helps to familiarize with the constructional details of different types of DC generators, DC motors working principle and their performance.

OUTCOMES:

Upon the completion of DC Machines laboratory course, the student will be able to attain

1. Familiarity with the types of DC machines and their basic characteristics.
2. Study the methods to predetermine the efficiency of DC machines.
3. Knowledge of methods and measuring devices for determination of various characteristics and parameters of electrical machines.
4. Understand the operation of DC machines in load sharing.
5. Demonstrate the ability to work effectively in groups to troubleshoot and analyze electrical machines.

EXPERIMENT - 1

MAGNETIZATION CHARACTERISTIC OF DC SHUNT GENERATOR

1.1 AIM:

To determine the magnetization (open circuit) characteristics of DC shunt generator, the critical field resistance and critical speed.

1.2 NAME PLATE DETAILS:

Motor

Voltage	
Current	
Output	
Speed	

Generator

Voltage	
Current	
Output	
Speed	

1.3 CIRCUIT DIAGRAM:

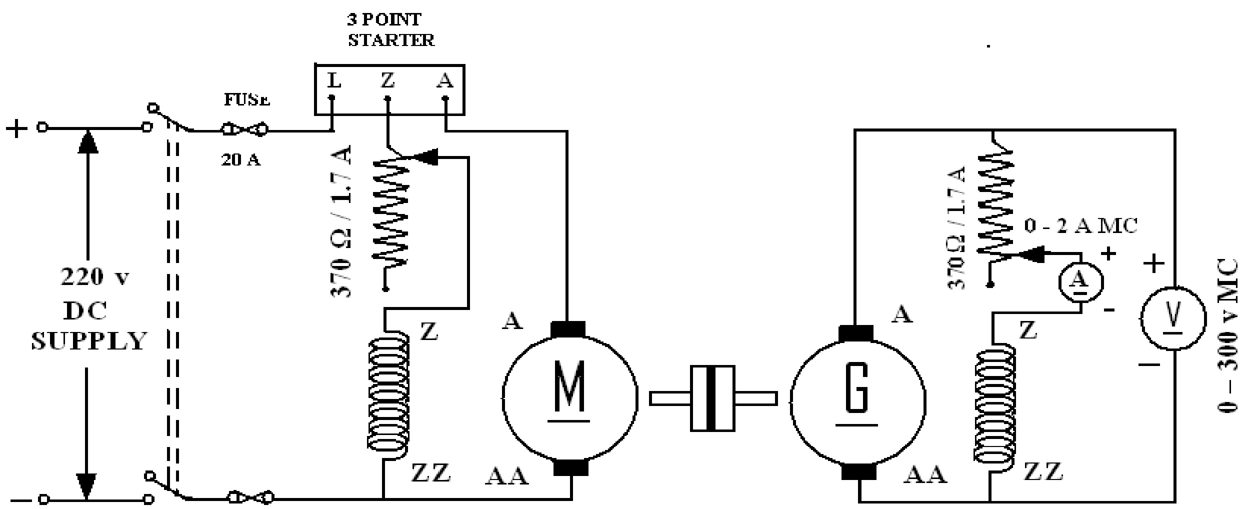


Fig - 1.1 DC Shunt Motor - Shunt Generator Set

1.4 APPARATUS:

S.No.	Item	Type	Range	Quantity
1	Ammeter			
2	Voltmeter			
3	Rheostat			
4	Tachometer			
5	Connecting wires			

1.5 PROCEDURE:

1. Choose the proper ranges of meters after noting the name plate details of the given machine and make the connections as per the circuit diagram.
2. Keep the motor field rheostat (R_f) in the minimum resistance position.
3. Keep the generator field rheostat (R_f) in the maximum resistance position
4. Observe the speed of the generator using a tachometer and adjust to the rated value by varying the motor field rheostat. Keep the same speed through out the experiment.
5. Note down the terminal voltage of the generator. This is the e.m.f. due to residual magnetism.
6. Increase the generator field current I_f (ammeter) by gradually moving the rheostat for every value and note down the corresponding voltmeter reading. Increase the field current till induced e.m.f is about 120% of rated value.
7. Draw the characteristics of generated emf (E_g) versus field current (I_f)
8. Draw a tangent to the initial portion of O.C.C from the origin. The slope of this straight line gives the critical field resistance and also calculates critical speed.

1.6 TABULAR COLUMN:

S No	Field Current (Amp)	Generated Voltage (Volts)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

1.7 MODEL GRAGH:

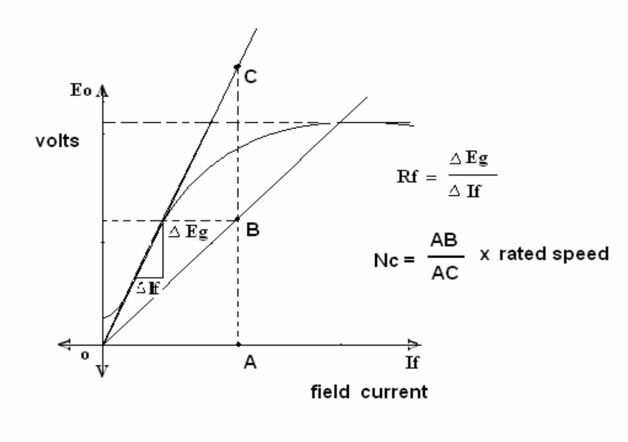


Fig - 1.2 Magnetization Characteristics Curve

1.8 PRECAUTIONS:

1. Field rheostat of motor should be at minimum position
2. Avoid parallax errors and loose connections

1.9 RESULT:

1.10 PRE LAB VIVA QUESTIONS:

1. Under what conditions does the DC shunt generator fail to self - excite?
2. OCC is also known as magnetization characteristic, why?
3. How do you check the continuity of field winding and armature winding?
4. How do you make out that the generator is DC generator without observing the name plate?
5. Does the OCC change with speed?

1.11 POST LAB VIVA QUESTIONS:

1. Define critical field resistance.
2. How do you get the maximum voltage to which the generator builds up from OCC?
3. What does the flat portion of OCC indicate?
4. Why OCC does not start from origin?
5. Why is Rf > Ra in dc shunt machine?
6. How do you create residual magnetism if it is wiped out?
7. Why does the OCC differ for decreasing and increasing values of field current?

EXPERIMENT - 2

LOAD TEST ON DC SHUNT GENERATOR

2.1 AIM:

To conduct load test on DC shunt generator and to draw its external and internal characteristics

2.2 NAME PLATE DETAILS:

Motor

Voltage	
Current	
Output	
Speed	

Generator

Voltage	
Current	
Output	
Speed	

2.3 CIRCUIT DIAGRAM:

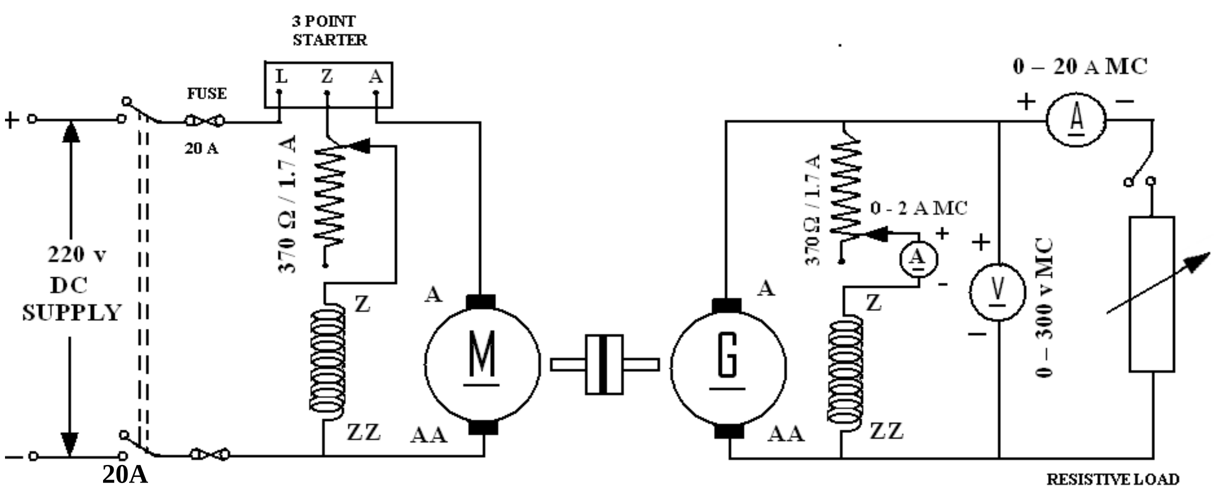


Fig - 2.1 DC Shunt Motor - Shunt Generator Set

2.4 APPARATUS:

S. No.	Item	Type	Range	Quantity
1	Ammeter			
2	Voltmeter			
3	Rheostats			
4	Tachometer			
5	Connecting wires			

2.5 PROCEDURE:

1. Make the connections as shown in the circuit diagram. Keep the motor field rheostat in the minimum position and the generator field rheostat in the maximum position at starting.
2. Start the MG set and bring it to the rated speed of the generator by adjusting the motor field rheostat.
3. Adjust the terminal voltage to rated value by means of the generator field rheostat. Keep the rheostat in this position through out the experiment as its variation changes the field circuit resistance and hence the generated emf.
4. Put on the load and note the values of the load current, $I_{L;}$ terminal voltage, V and field current, I_f at different values of the load until full load current is obtained.
5. Calculate the armature current in each case: $I_a = I_L + I_f$.
6. Measure the armature resistance by volt ampere method. Note down the voltage drop V_a across the armature for different values of current I passing through it. Armature resistance in each case is calculated. $R_a = V_a / I$., R_a (Hot) = 1.25 $R_{a.}$ Take the mean of the values which are close together as the resistance of the armature, R_a.
7. Calculate the generated e.m.f. E at each value of the load current. $E= V+ I_a R_a$.
8. Draw external characteristic, V_T versus I_L and internal characteristic, E versus I_L.

2.6 TABULAR COLUMN:

S.No	I_L(Amp)	I_F(Amp)	I_a(Amp)	V_T(Volt)	E(Volt)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

2.7 MODEL GRAPH:

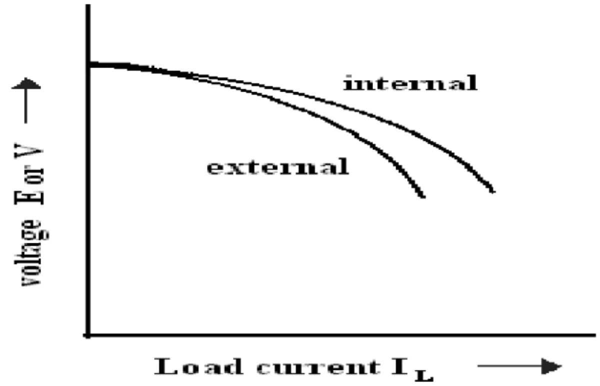


Fig - 2.2 Internal and External Characteristics of DC Shunt Generator

2.8 PRECAUTIONS:

1. Avoid parallax errors and loose connections
2. Take care while using the starter.
3. The speed should be adjusted to rated speed.
4. There should be no loose connections.

2.9 RESULT:

2.10 PRE LAB VIVA QUESTIONS:

1. Why is the generated emf not constant even though the field circuit resistance is kept unaltered?
2. Find out the voltage drop due to full load armature reaction?
3. State the conditions required to put the DC shunt generator on load.
4. How do you compensate for the armature reaction?
5. What happens if shunt field connections is reversed in the generator?
6. The EMF induced in armature conductors of DC shut generator is AC or DC?

2.11 POST LAB VIVA QUESTIONS:

1. Specify the applications of DC shunt generators.
2. Differentiate between DC shunt Motor and DC shunt generator.
3. Which method is suitable for testing of high rating DC generator?
4. Why the terminal voltage decreases when load is increased on the generator?

EXPERIMENT - 3

LOAD TEST ON DC SERIES GENERATOR

3.1 AIM:

To obtain the external and internal characteristics of DC series generator by conducting load test.

3.2 NAME PLATE DETAILS:

Motor

Voltage	
Current	
Output	
Speed	

Generator

Voltage	
Current	
Output	
Speed	

3.3 CIRCUIT DIAGRAM:

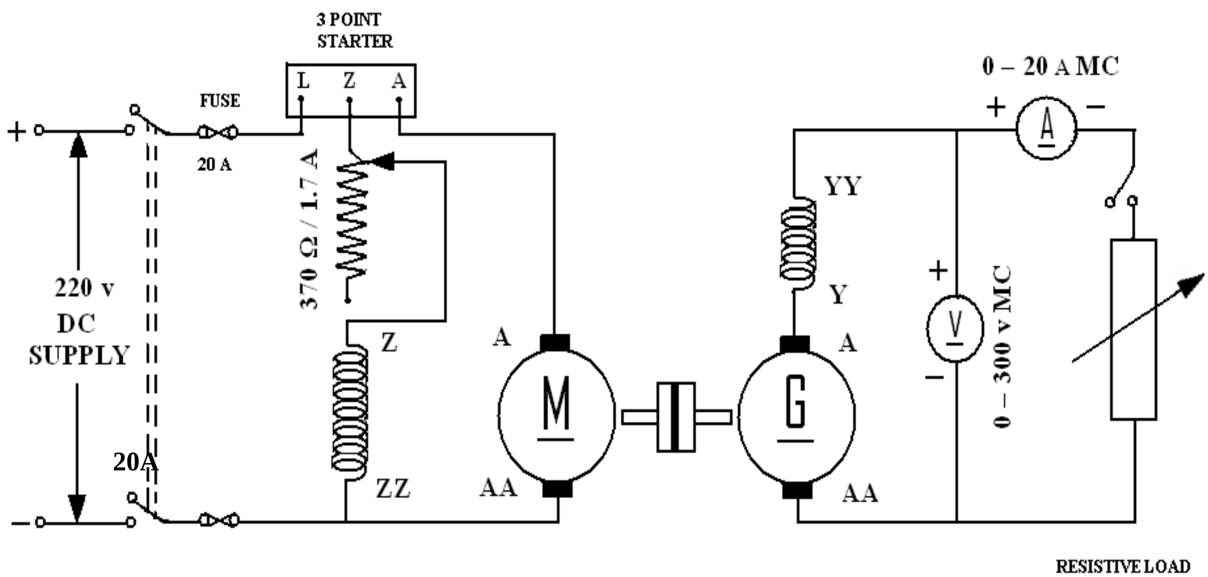


Fig - 3.1 DC Shunt Motor - Series Generator Set

3.4 APPARATUS:

S.No.	Item	Type	Range	Quantity
1	Ammeter			
2	Voltmeter			
3	Rheostat			
4	Tachometer			
5	Connecting wires			

3.5 PROCEDURE:

1. Choose the proper ranges of meters after noting the name plate details of the given machine and make the connections as per the circuit diagram.
2. Keeping the motor field resistance minimum and the generator output terminals are open circuited, give supply and start the motor - generator set.
3. Adjust the speed of the MG Set to the rated speed of the generator using the motor field rheostat (R_f)
4. Note down the voltage due to residual magnetism on no load.
5. Run the DC series generator under rated load conditions and note down the terminal voltage and load current by removing the loads slowly. (but not no-load condition)
6. Measure the generator armature resistance R_a by drop method.
7. Calculate the generated emf E at each load from the relation, $E_g = V + I(R_a + R_{Se})$.
8. Draw the external characteristic, V_T vs. I_L and the internal characteristic, E_g Vs I_a on the same graph sheet.

3.6 TABULAR COLUMN:

S. NO.	I_L(Amp)	V_T(Volt)	$E_g = (V_T + I_L(R_a + R_S))$
1			
2			
3			
4			
5			

3.7 MODEL GRAPH:

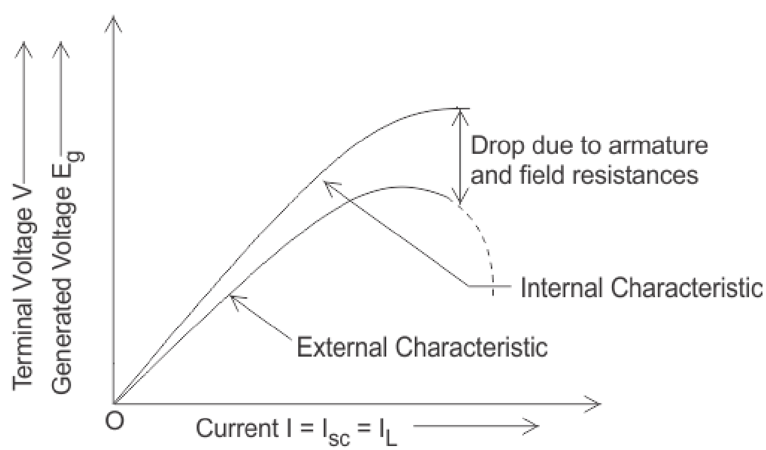


Fig - 3.2 Internal and External Characteristics of DC series generator

3.8 PRECAUTIONS:

1. Don’t switch on the supply without any load.
2. Avoid parallax errors and loose connections.

3.9 RESULT:

3.10 PRE LAB VIVA QUESTIONS:

1. What are the applications of DC series generator?
2. To conduct the test on DC series generator, can we use any other prime mover other than DC shunt motor?
3. Why DC series motor should not start without any load?
4. State the applications of the series generator.
5. State voltage builds up conditions of a series generator.

3.11 POST LAB VIVA QUESTIONS:

1. In what way does the series generator differ fundamentally from shunt generator?
2. Why does a series generator have rising characteristics?
3. Why the series generators will only built up when load switch is on?
4. Why the series generator used as voltage booster in transmission system?

EXPERIMENT - 4

LOAD TEST ON DC COMPOUND GENERATOR

4.1 AIM:

To obtain internal and external characteristic of DC compound generator by conducting load test.

4.2 NAME PLATE DETAILS:

Motor

Voltage	
Current	
Output	
Speed	

Generator

Voltage	
Current	
Output	
Speed	

4.3 CIRCUIT DIAGRAM:

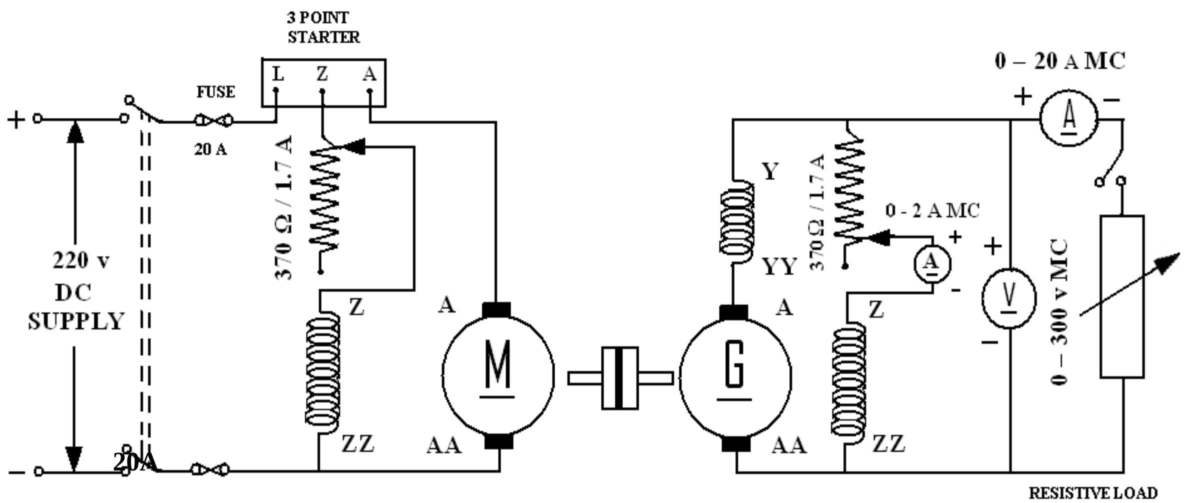


Fig - 4.1 DC Shunt Motor - Compound Generator Set

4.4 APPARATUS:

S.No.	Item	Type	Range	Quantity
1	Ammeter			
2	Voltmeter			
3	Rheostat			
4	Tachometer			
5	Connecting wires			

4.5 PROCEDURE:

1. Make the connections as shown in the circuit diagram.
2. Keep the motor field rheostat in minimum resistance position (Resistance) and the Generator field rheostat in maximum resistance position at starting.
3. Start the MG set and bring it to the rated speed of the Generator by adjusting the motor field rheostat.
4. Adjust the terminal voltage of the generator to rated value by means of the generator field rheostat. Keep the rheostat in this position throughout the experiment as its variation changes the field circuit current and hence the generated e.m.f.
5. Put on the load and note down the values of load current I_L and terminal voltage V_T at the generator side, for different values of load until full load current.
6. Draw external characteristics V_T vs I_L & Internal characteristics Eg vs I Where $Eg = V + I_aR_a$.

4.6 TABULAR COLUMN:

S.NO.	I_L(Amp)	V_T(Volt)	$Eg = V+ I_aR_a$
1			
2			
3			
4			
5			

4.7 MODEL GRAPH:

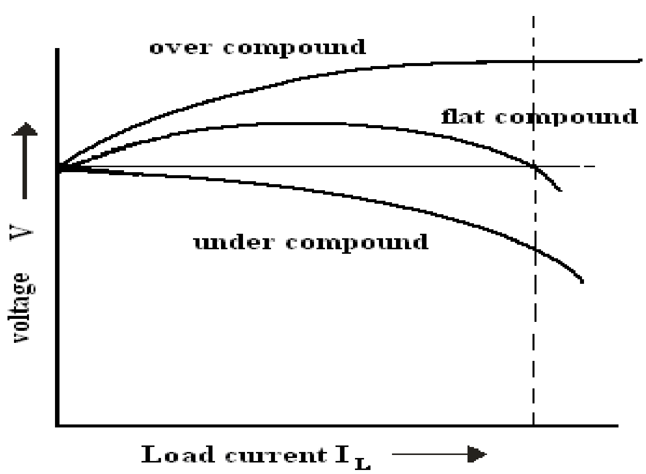


Fig – 4.2 Load Characteristics of DC Compound Generator

4.8 PRECAUTIONS:

1. Avoid parallax errors and loose connections.
2. Take care while using the starter.
3. The speed should be adjusted to rated speed.
4. There should be no loose connections.
5. Remove the load gradually in steps and switch off the motor.

4.9 RESULT:

4.10 PRE LAB VIVA QUESTIONS:

1. Where you can use DC Compound Generator?
2. Comment on the shape of load current Vs speed curve of the differential compounded generator.
3. How do you reverse the terminal voltage of an over compounded short shunt generator without effecting the over compounding?
4. Mention the applications of differential compound generator.
5. Mention the applications of over compound generator.

4.11 POST LAB VIVA QUESTIONS:

1. What do you understand from load curves?
2. Which causes the drop between internal & external characteristics?
3. A cumulative compound generator is generating full load, what will happen if its series field winding gets short – circuited?
4. Explain the difference between cumulative and differential compound generators.

EXPERIMENT - 5

HOPKINSON'S TEST ON DC SHUNT MACHINES

5.1 AIM:

To perform Hopkinson's test on the given motor - generator set and determine the efficiency of both motor and generator.

5.2 NAME PLATE DETAILS:

Motor

Voltage	
Current	
Output	
Speed	

Generator

Voltage	
Current	
Output	
Speed	

5.3 CIRCUIT DIAGRAM:

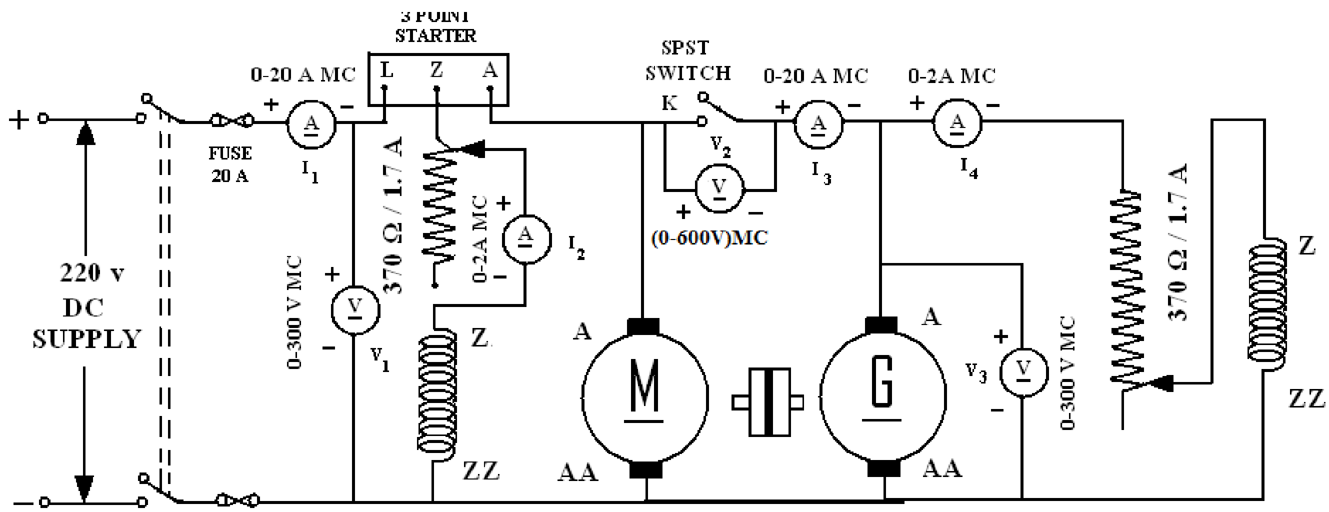


Fig – 5.1 Identical DC Shunt Machines

5.4 APPARATUS:

S. No	Item	Type	Range	Quantity
1	Ammeter			
2	Ammeter			
3	Voltmeter			
4	Voltmeter			
4	Rheostats			
5	Tachometer			
6	Connecting wires			

5.5 PROCEDURE:

1. Make the connections as per the circuit diagram. Keep the motor field rheostat at minimum and generator field rheostat at maximum resistance position and the switch K is in open position.
2. Start the motor - generator set slowly with motor starter and adjust the field rheostat of motor such that the motor / generator rotate at rated speed.
3. Excite the generator by decreasing the generator field rheostat resistance until the voltmeter across the switch reads zero, then close the switch K.
4. Load the generator in steps by decreasing the field rheostat resistance of the generator or by increasing the field rheostat resistance of the motor.
5. Take the readings of all the meters for each load and measure the speed in each step.
6. Open the switch K and reduce the excitation of the generator by increasing the field rheostat of the generator.
7. Switch off the supply to motor-generator switch.

5.6 TABULAR COLUMN:

S.No.	V_1(Volt)	I_1(Amp)	I_2(Amp)	I_3(Amp)	I_4(Amp)	N(rpm)
1						
2						
3						
4						
5						

5.7 CALCULATIONS:

I_1 = line current of motor ; I_2 = exciting current of motor

I_3 = load current of generator. ; I_4 = exciting current generator

Armature cu loss in generator $W_{ag} = (I_3 + I_4)^2 R_{ag}$

Armature cu loss in motor $W_{am} = (I_1 + I_3 - I_2)^2 R_{am}$

Shunt cu loss in generator $W_{fg} = VI_4$, Shunt cu loss in motor $W_{fm} = VI_2$

Total power drawn from supply = VI_1 = Total cu loss and Stray losses

Total stray loss for the set $W_s = VI_1 - [W_{ag} + W_{am} + W_{fg} + W_{fm}]$

Stray losses of each machine = $W_S / 2$

Efficiency of motor:

Motor input Power = $V (I_1 + I_3)$
Armature Cu loss in motor = $(I_1 + I_3 - I_2)^2 R_a$
Output power = input power to Motor – (motor armature copper loss + Motor shunt field loss + Stray loss)

$$= V (I_1 + I_3) – [(I_1 + I_3 - I_2)^2 R_{am} + VI_2 + W_s / 2]$$

$$\% \text{ Efficiency} = \frac{\text{Output power}}{\text{Input power}} \times 100$$

Efficiency of Generator:

Generator output power = VI_3

Input Power = (Output power + Generator Armature copper loss + Generator Shunt field loss + stray loss)

$$= VI_3 + (I_3 + I_4)^2 R_{ag} + VI_4 + W_s / 2$$

$$\% \text{ Efficiency} = \frac{\text{Output power}}{\text{Input power}} \times 100$$

5.8 TABULAR COLUMN:

Motor:

S.No	Input Current $(I_1 + I_3 - I_2)$	Armature Cu loss $(I_1 + I_3 - I_2)^2 R_{am}$	Field cu Loss VI_2	Stray loss $W_s / 2$	Output Power	Input power	% Efficiency
1							
2							
3							
4							
5							

Generator:

S.No	output Current I_3	Armature Cu loss $(I_3 + I_4)^2 R_{ag}$	Field cu Loss VI_4	Stray loss $W_s / 2$	Input Power	Output power	% Efficiency
1							
2							
3							
4							
5							

5.9 MODEL GRAPH:

Plot the output versus efficiency curves for both the motor and the generator as shown below.

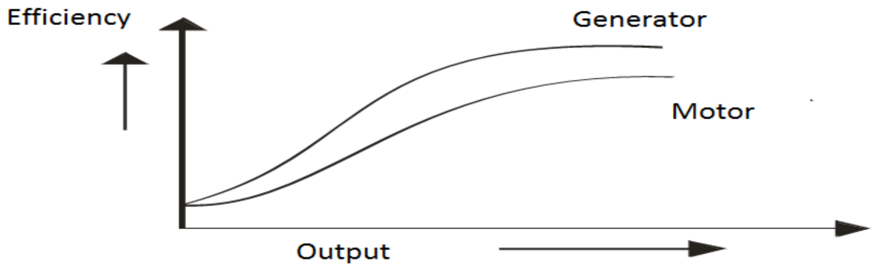


Fig – 5.2 Efficiency of Identical DC shunt machines

5.10 PRECAUTIONS:

1. Keep the motor rheostat in minimum position and generator field rheostat in maximum position.
2. Excessive care while closing the parallel switch K. The voltmeter must read zero across K which is to be closed after it reads zero.
3. Check the position of the rheostat positions before stating the motor.
4. Before making or breaking the circuit, supply must be switched off

5.11 RESULT:-

5.12 PRE LAB VIVA QUESTIONS:

1. What are the advantages of the test?
2. Can you explain this test be applied to compound machines?
3. When two DC machines are paralleled as is done in this test, which machine acts as generator and which machine acts as motor?
4. Hopkinson’s test on DC machines is conducted at ….load.

5.13 POST LAB VIVA QUESTIONS:

1. Hopkinson’s test is a ………..test.
2. What are the disadvantages of this test?
3. What are heat run tests?

EXPERIMENT - 6

FIELD TEST ON DC SERIES MACHINES

6.1 AIM:

To determine the efficiency of the two DC series machines by conducting field test.

6.2 NAME PLATE DETAILS:

Motor

Voltage	
Current	
Output	
Speed	

Generator

Voltage	
Current	
Output	
Speed	

6.3 CIRCUIT DIAGRAM:

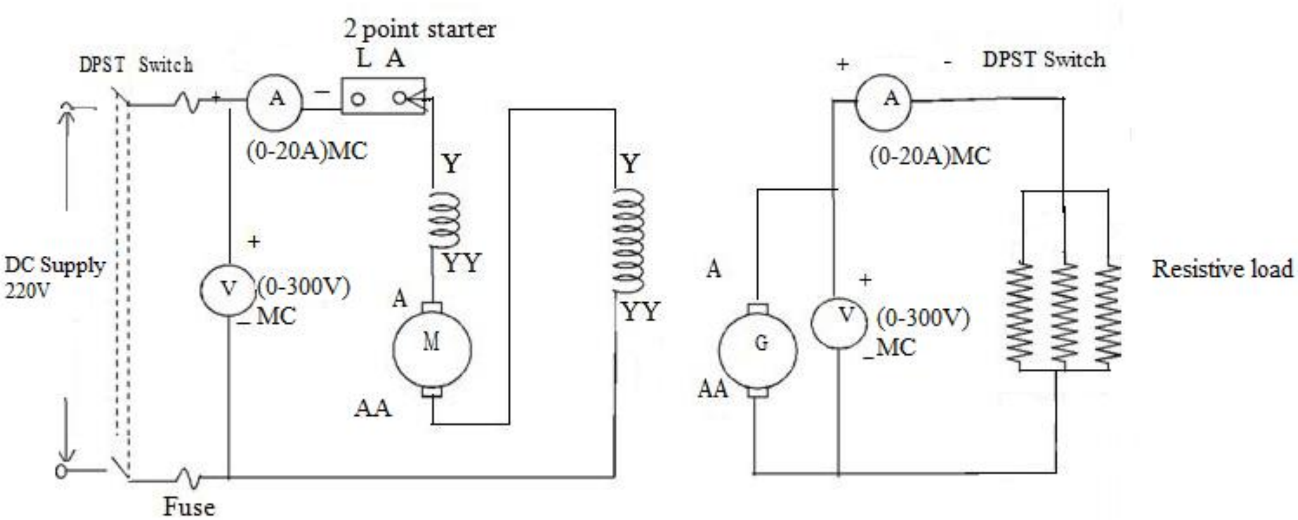


Fig – 6.1 Identical DC Series Machines

6.4 APPARATUS:

S.NO	Meter	Type	Range	Quantity
1	Volt meter			
2	Ammeter			
3	Ammeter			
4	Rheostat			
5	Resistive load			
6	Connecting wires			

6.5 PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Start the motor by moving the handle of the starter slowly.
3. Now keep the input DC voltage constant at 220V DC.
4. Now increase the load of the generator up to the rated value of armature current and note down the readings of ammeter, voltmeters connected in the circuit.
5. Reduce the loads one by one till the motor speed does not exceed 1800rpm.
6. Note down the readings of the instruments at different loads.
7. Gradually, reduce the armature voltage of the prime mover and then switch off the Supply.

6.6 TABULAR COLUMN:

Armature resistance of the motor R_{a1}=

Series field resistance of the motor R_{se1}=

Armature resistance of the generator R_{a2}=

Series field resistance of the generator R_{se2}=

S. No	V_1(volts)	I_1 (Amps)	V_L (volts)	I_L (amps)	N (rpm)
1					
2					
3					
4					
5					

6.7 CALCULATIONS:

Power input $P_{in}= V_1I_1$

Power output $P_{out}= V_LI_L$

Total losses of the two machines $P_L= P_{in}-P_{out}$ Field copper

losses in the motor= $I_1^2R_{se1}$

Field copper losses in the generator= $I_1^2 R_{se2}$ Armature copper

losses in the motor= $I_1^2R_{a1}$

Armature copper losses in the generator= $I_L^2 R_{a2}$

Total copper losses in the field and armature of the motor and generator is P_{cu}

$P_{cu}= I_1^2R_{se1}+ I_1^2 R_{se2}+ I_1^2R_{a1}+ I_L^2 R_{a2}$

Stray losses per each machine $W_s= (P_L-P_{cu})/2$

Motor efficiency calculations:

Power input to the motor $P_{in}=V_1I_1$

Total losses in the motor $P_T=I_1^2R_{se1}+I_1^2R_{a1}+W_s$

Motor output $P_{out}=P_{in}- P_T$

%Efficiency $\eta= P_{out} / P_{in}{}^{*}100$

Generator efficiency calculations:

Generator output P_{out} (g) $_{=}V_LI_L$

Total losses of the generator $W_{gt}= W_s+ I_L^2 R_{se2}+I_L^2 R_{a2}$

Power input to the generator $P_{in}= P_{out}(g) + W_{gt}$

% Efficiency of the generator $\eta= P_{out(g)} / P_{in}{}^{*}100$

6.8 PRECAUTIONS:

1. Don't switch on the supply without any load.
2. Take care while using the starter.
3. The speed should be adjusted to rated speed.
4. There should be no loose connections.

6.9 RESULT:

6.10 PRE LAB VIVA QUESTIONS:

1. Why Series motor should not start at no load?
2. What is the main advantage of this test?
3. Is it possible to conduct Field test on any another DC machine

6.11 POST LAB VIVA QUESTIONS:

1. Why the field of generator connected to motor?
2. What are the applications of D.C series generator?
3. Why the series generator used as voltage booster in transmission system?

EXPERIMENT – 7

(A) SPEED CONTROL OF DC SHUNT MOTOR

7.1 AIM:

To vary the speed of the given DC shunt motor by armature control and field control methods

7.2 NAME PLATE DETAILS:

Motor

Voltage	
Current	
Output	
Speed	

7.3 CIRCUIT DIAGRAMS:

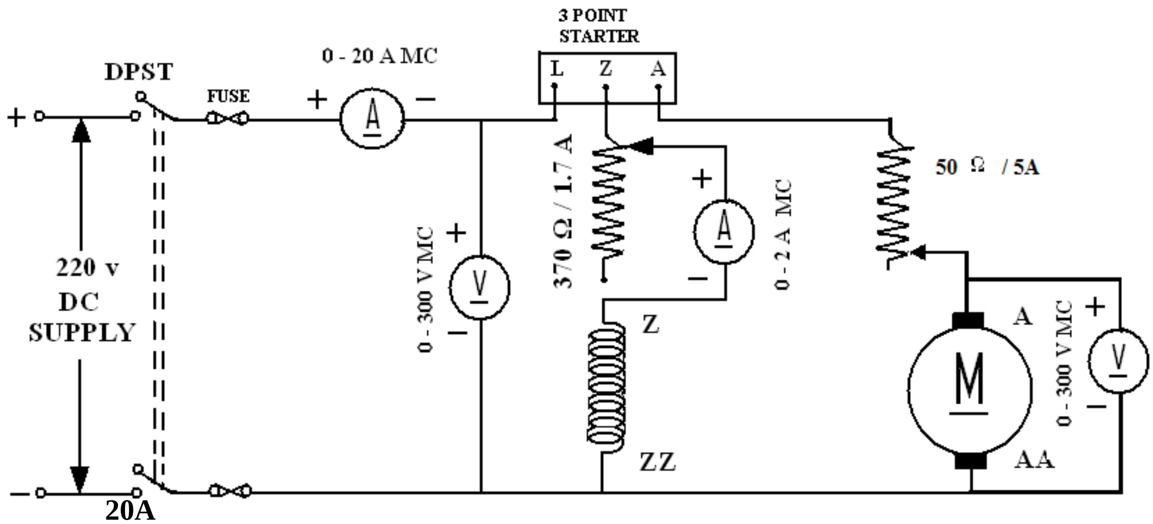


Fig – 7.1 DC Shunt Motor

7.4 APPARATUS:

S.No.	Item	Type	Range	Quantity
1	Ammeter			
2	Voltmeter			
3	Rheostat			
4	Tachometer			
5	Connecting wires			

7.5 PROCEDURE OF SPEED CONTROL:

Part - A
Armature Control Method: (below rated speed)

1. Choose the proper ranges of meters after noting the name plate details of the given machine and make the connections as per the circuit diagram.
2. Keep the motor field rheostat (R_f) in the minimum position and the armature rheostat (R_{as}) in the maximum position, start the MG set.
3. Give supply and accelerate the motor using 3-point starter.
4. Decrease the armature rheostat value and note down speed and induced emf in motor winding.
5. Tabulate these readings and plot the graph Eb V_S N.

Part - B
Field Control Method: (above rated speed)

1. Maintain the armature rheostat in maximum position and vary the field current (I_f) by varying the field rheostat. Note down the speeds (N) at different values of field current**.** Take care that the speed doesn't exceed 2000 rpm. Note down the armature voltage also.
2. Tabulate these readings and plot the N V_s I_f describes the field control of motor speed on no load.

7.6 TABULAR COLUMN:

ARMATURE CONTROL METHOD

S. No.	E_b(Volt)	Speed (rmp)
1		
2		
3		
4		
5		
6		

FIELD CONTROL METHOD

S. No.	I_f (Amp)	Speed (rpm)
1		
2		
3		
4		
5		
6		

7.7 MODEL GRAPH:

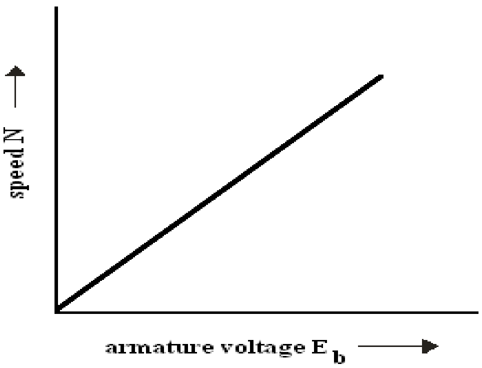


Fig – 7.2 Armature Control

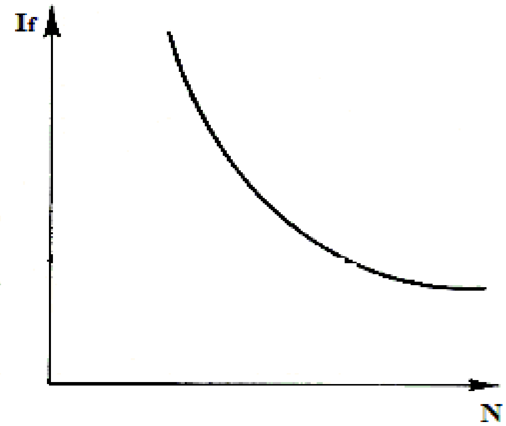


Fig 7.3 Field Control

7.8 PRECAUTIONS:

1. Avoid parallax errors and loose connection.
2. Take care while using the starter.
3. Keep the armature and field rheostats at proper positions.
4. The speed should be adjusted to rated speed.
5. There should be no loose connections.

7.9 RESULT:

7.10 PRE LAB VIVA QUESTIONS:

1 Explain why the graph of armature speed control of motor is linear?
2 Comment on the efficiency calculated by this method.
3 Why do you need a starter in a dc motor?
4 What is meant by rated speed?
5 Can we start the dc shunt motor and series motor without load?
6 What is meant by speed regulation?
7 Can we operate a dc motor an ac supply?
8 What are the other methods of controlling the speed of dc shunt motor?

7.11 POST LAB VIVA QUESTIONS:

1. How do you change the direction of rotation of a D.C. motor?
2. What is the disadvantage of using armature control of speed on load?
3. What are the limitations of shunt field control?
4. Can we conduct continuity test on ac supply?
5. While running if the field winding gets disconnected, what will happen?
6. What is the shape of the curve of field control of method motor speed? Explain why is it so?

7 (B) SWINBURNE'S TEST OF DC SHUNT MOTOR

7.1 AIM:

Pre - determine the efficiency and constant losses of a DC shunt machine by Swinburne's method.

7.2 NAME PLATE DETAILS:

Motor

Voltage	
Current	
Output	
Speed	

7.3 CIRCUIT DIAGRAM:

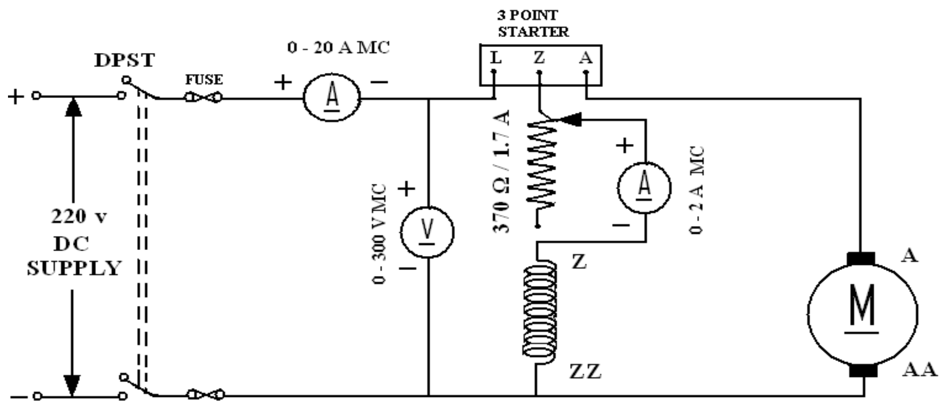


Fig – 7.1 DC Shunt Motor

7.4 APPARATUS:

S. No.	Item	Type	Range	Quantity
1	Ammeter			
2	Ammeter			
3	Voltmeter			
4	Rheostats			
5	Connecting wires			

7.5 PROCEDURE:

1. Choose the proper ranges of meters after noting the name plate details of the given machine and make the connections as per the circuit diagram.
2. Keep the motor field rheostat (R_{fm}) in the minimum position, start the motor by closing the switch and operating the starter slowly.
3. Run the motor at rated speed by adjusting the motor field rheostat.
4. Note down the voltage, no load current and field current.

7.6 TABULAR COLUMN:

S. No	V(Volt)	I_{Lo}(Amp)	Speed(rpm)
1			

7.7 CALCULATIONS FOR SWINBURNS TEST

From the no load test results,

Supply voltage = V_L Volts.

No load line current = I_{Lo} Amperes.

Field current= I_f Amperes.

Therefore No load Armature Current = I_{ao} = I_L-I_f Amperes.

Resistance cold = R_m

Effective resistance R_e = 1.25 x R_m ohms.

No load copper losses are =$I_{ao}^2 R_e$

No load power input=$V_L I_L$

Constant losses = (No load power input - No load copper losses). ------------ (1)

Efficiency as motor:

Efficiency=output/input = (input – total losses)/ input.

Where total losses = constant losses + variable losses.

Constant losses are known value from the equation (1)

Variable loss = $I_a^2 R_e$, where $I_a = I_L - I_f$

Input = $V_L I_{L..}$ V_L is rated voltage of the machine

Assume line currents (I_L) as 2, 4,6,----20A and find corresponding efficiency

Efficiency as generator:

Efficiency=output/input = output / (output + total losses).

Where losses = constant losses + variable losses

Constant losses are same for both motor and Generator

Armature Current = $I_a = I_L + I_F$

Variable loss = $I_a^2 R_e$

Output power = $V_L I_L$. V_L is rated voltage of the machine

Assume load currents (I_L) as 2, 4, 6, ----20A and find corresponding efficiencies

7.8 TABULAR COLUMN:

As a Motor: Rated voltage V_L = Rated speed N =

S.No	I_L	Input Power ($V_L I_L$)	Constant losses $W_{const.}$	Copper losses $W_{cu} = I_a^2 R_e$	Total losses = ($W_{cons.}+W_{cu}$)	Output power = (input power – losses)	η
1							
2							
3							
4							
5							

As a Generator: Rated voltage V_L = Rated speed N =

S.No	I_L	Out power ($V_L I_L$)	Constant losses $W_{const.}$	Copper losses $W_{cu} = I_a^2 R_e$	Total loss = ($W_{cons.} + W_{cu}$)	Input power = (output power+ losses)	η
1							
2							
3							
4							
5							

7.9 MODEL GRAPH:

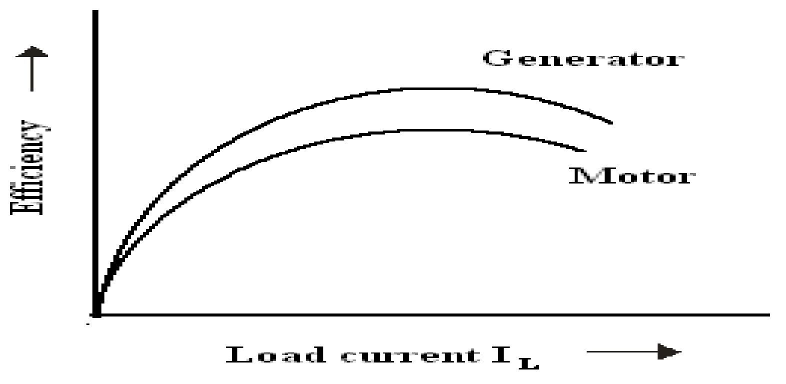


Fig – 7.2 Load Characteristics of DC Shunt Motor and Generator

7.10 PRECAUTIONS:

1. Run the motor at rated speed and rated voltage.
2. Avoid loose connections and parallax errors

7.11 RESULT:

7.12 PRE LAB VIVA QUESTIONS:

1. Will the values deduced from the Swinburne's method exactly coincide with the values realized by direct loading on the machine? Why?
2. Why are the constant losses calculated by this method less than the actual losses?
3. Can we conduct Swinburne's test on dc series motor?
4. What are the drawbacks of Swinburne's test?

7.13 POST LAB VIVA QUESTION:

1. Why Swinburne's is used to find efficiency of high rating motors?
2. How you can say that the wattmeter reading in the experiment is constant losses?
3. Why constant losses are constant irrespective of load?
4. Advantage of this test.

EXPERIMENT – 8

BRAKE TEST ON DC COMPOUND MOTOR

8.1 AIM:

To determine the efficiency of DC compound motor by conducting brake test

8.2 NAME PLATE DETAILS:

Compound Motor

Voltage	
Current	
Output	
Speed	

8.3 CIRCUIT DIAGRAM:

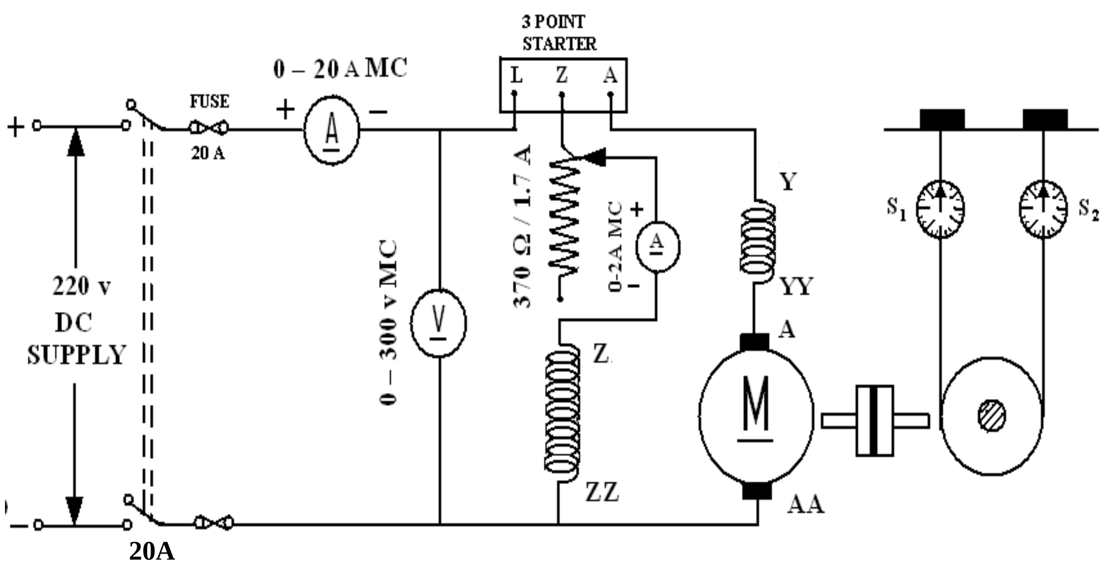


Fig – 8.1 DC Compound Motor with Brake Drum

8.4 APPARATUS:

S. No.	Item	Type	Range	Quantity
1	Ammeter			
2	Ammeter			
3	Voltmeter			
4	Rheostats			
5	Tachometer			
6	Connecting wires			

8.5 PROCEDURE:

1. Make the connections as shown in the circuit diagram.
2. Keeping the field rheostat (R_f) at the minimum position, switch on the supply and start the motor.
3. Adjust the speed of the motor on no load to its rated value by means of the field rheostat. Do not disturb the position of the rheostat throughout the test.
4. Put on the load by tightening the screws of the spring balances. Note down the spring tensions, the speed, the voltage and the currents at different loads until full load current is obtained.
5. The load on the drum is removed and the motor is stopped.
6. The efficiency is calculated at different load conditions

8.6 CALCULATIONS:

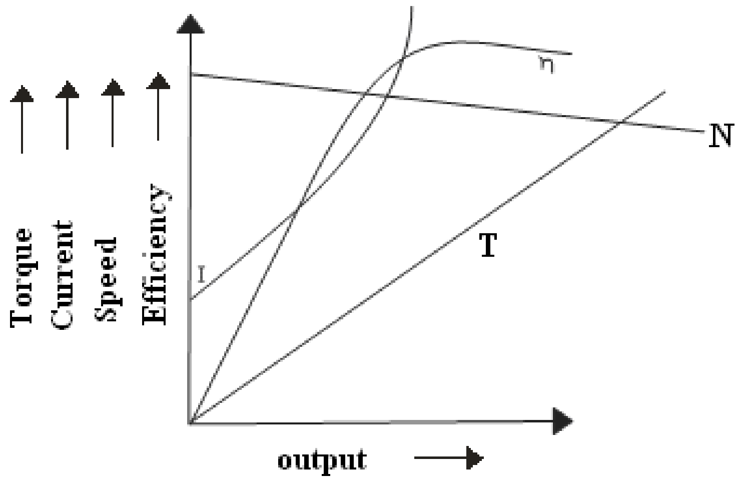
1. Measure the circumference of the brake drum and calculate its radius (r), in meters.
2. Calculate the torque, T = wrg(N - m). Where w = ($w_1 - w_2$)= spring balance reading (the difference between the spring tensions) and 'g' is acceleration due to gravity i.e.9.81. Calculate the power output of the motor given by P_0= 2 ΠNT/60
3. Calculate the input power, $P_I = VI_L$(I_L is the line current = $I_a + I_f$).
4. Calculate the percentage efficiency, $\eta = P_0/P_I * 100$
5. Draw the following graphs:

   a) Output Vs η, T, I_a and N in one graph. b) Speed Vs Torque.

8.7 TABULAR COLUMN:

S No	I_L (A)	I_f (A)	V (V)	W_1 Kg	W_2 Kg	W (kg) $W_1 - W_2$	N (RPM)	T= rgW (N-m)	P_0= 2ΠNT/60	P_I= $V_L I_L$	η = P_0/P_Ix 100
1											
2											
3											
4											
5											

8.8 MODEL GRAPH:



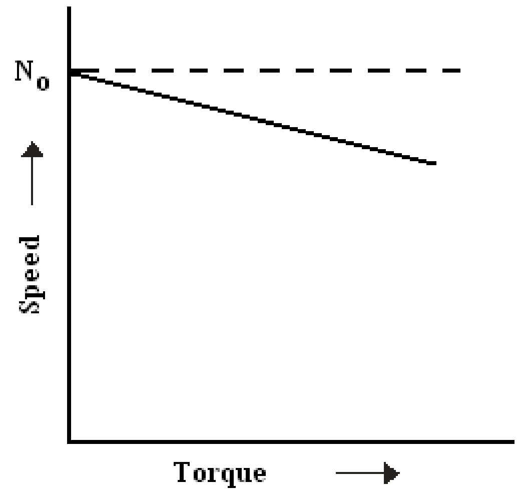


Fig – 8.2 Performance Characteristics of Compound Motor

8.9 PRECAUTIONS:

1. Check the position of the rheostat position before stating the motor.
2. Avoid parallax errors and loose connections
3. Take care while using the starter.
4. The speed should be adjusted to rated speed.
5. Pour water in the brake drum for cooling purpose.

8.10 RESULT:

8.11 PRE LAB VIVA QUESTIONS:

1. Differentially compounded after reversal?
2. Mention the applications of the cumulative compounded motor?
3. Which type of DC starter is used to start the compound motor?

8.12 POST LAB VIVA QUESTIONS:

1. Why differentially compounded motors are not in common use?
2. What is the speed regulation of DC motor?
3. What is Difference between Shunt and compound motors?

EXPERIMENT - 9

BRAKE TEST ON A DC SHUNT MOTOR

9.1 AIM:

To obtain the performance characteristics of DC shunt motor by conducting brake test.

9.2 NAME PLATE DETAILS:

Motor

Voltage	
Current	
Output	
Speed	

9.3 CIRCUIT DIAGRAM:

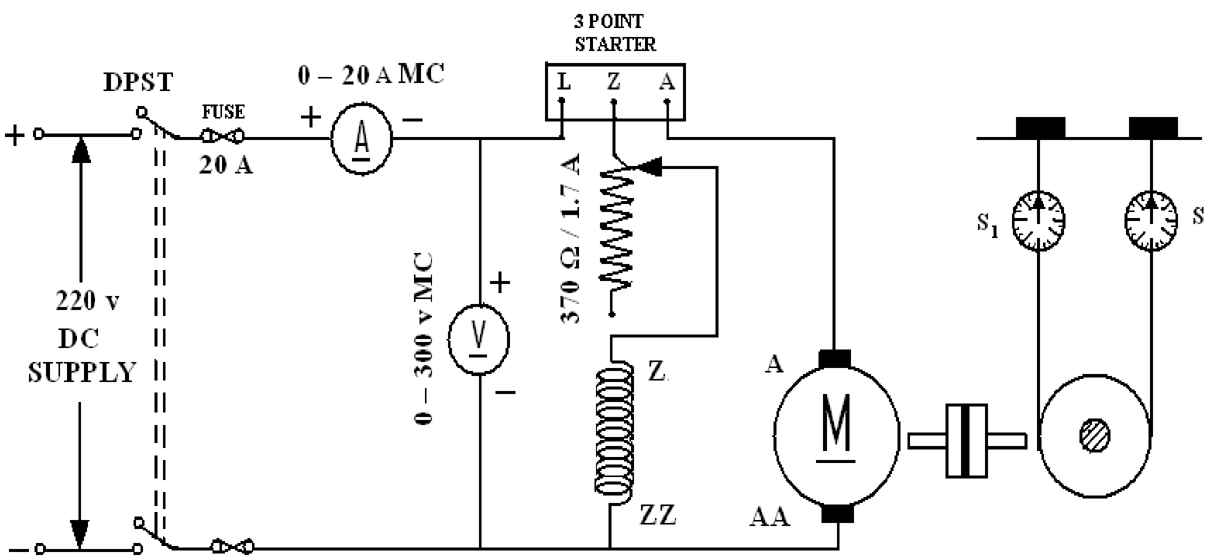


Fig – 9.1 DC Shunt Motor with Brake Drum

9.4 APPARATUS:

S. No.	Item	Type	Range	Quantity
1	Ammeter			
2	Ammeter			
3	Voltmeter			
4	Rheostats			
5	Connecting wires			

9.5 PROCEDURE:

1 Make the connections as shown in the circuit diagram.

2 Keeping the field rheostat (R_f) at the minimum position, switch on the supply and start the motor.

3 Adjust the speed of the motor on no load to its rated value by means of the field rheostat. Do not disturb the position of the rheostat throughout the test.

4 Put on the load by tightening the screws of the spring balances. Note down the spring tensions, the speed, the voltage and the currents at different loads until full load current obtained.

9.6 CALCULATIONS:

1. Measure the circumference of the brake drum and calculate its radius (r), in meters.
2. Calculate the torque, T = Wrg (N-m). Where $W = W_1 – W_2$ = spring balance reading (the difference between the spring tensions) and 'g' is acceleration due to gravity i.e.9.81. Calculate the power output of the motor given by P_0= 2ΠNT/60
3. Calculate the input power, $P_I = VI_L$ (I_L is the line current = $I_a + I_f$).
4. Calculate the percentage efficiency, $\eta = P_0/P_I$x 100
5. Draw the following graphs:
   a) Output Vs η, T, I_a and N in one graph.
   b) Speed Vs Torque.

9.7 TABULAR COLUMN:

S No	I_L (A)	V_L (V)	W_1 Kg	W_2 Kg	W (kg) = $W_1 – W_2$	N (RPM)	T = rgW (N-m)	P_0= 2ΠNT/60	P_I= V_L I_L	η = P_0/P_Ix 100
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

9.8 MODEL GRAPH:

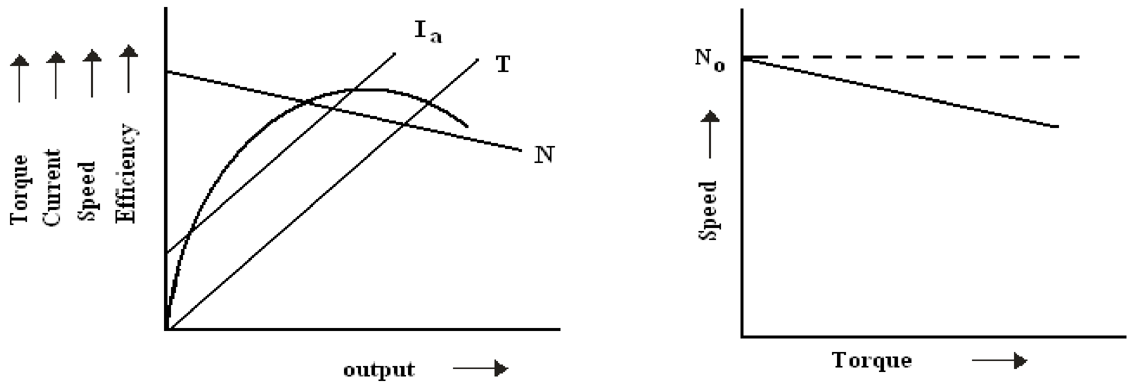


Fig – 9.2 Performance Characteristics of DC Shunt Motor

9.9 PRECAUTIONS:

1 Take care while using the starter.

2 The speed should be adjusted to rated speed.

3 There should be no loose connections.

4 Pour water in the brake drum for cooling purpose.

9.10 RESULT:

9.11 PRE LAB VIVA QUESTIONS:

1. Why did you use a 3-point starter for starting DC shunt motor?
2. What is the efficiency range of DC motor?
3. Where can you use the DC shunt motor?
4. What is the starting torque?

9.12 POST LAB VIVA QUESTIONS:

1. If starter is not available, how can you start DC motor?
2. Why is it considered as a constant speed motor?
3. Why brake test is used to find the efficiency of DC motor?
4. Why the starting torque is low in dc shunt motor?

EXPERIMENT - 10

RETARDATION TEST

10.1 AIM:

To determine the stray losses and efficiency of DC shunt machine by conducting retardation test.

10.2 NAME PLATE DETAILS:

MOTOR

Voltage	
Current	
Output	
Speed	

10.3 CIRCUIT DIAGRAM:

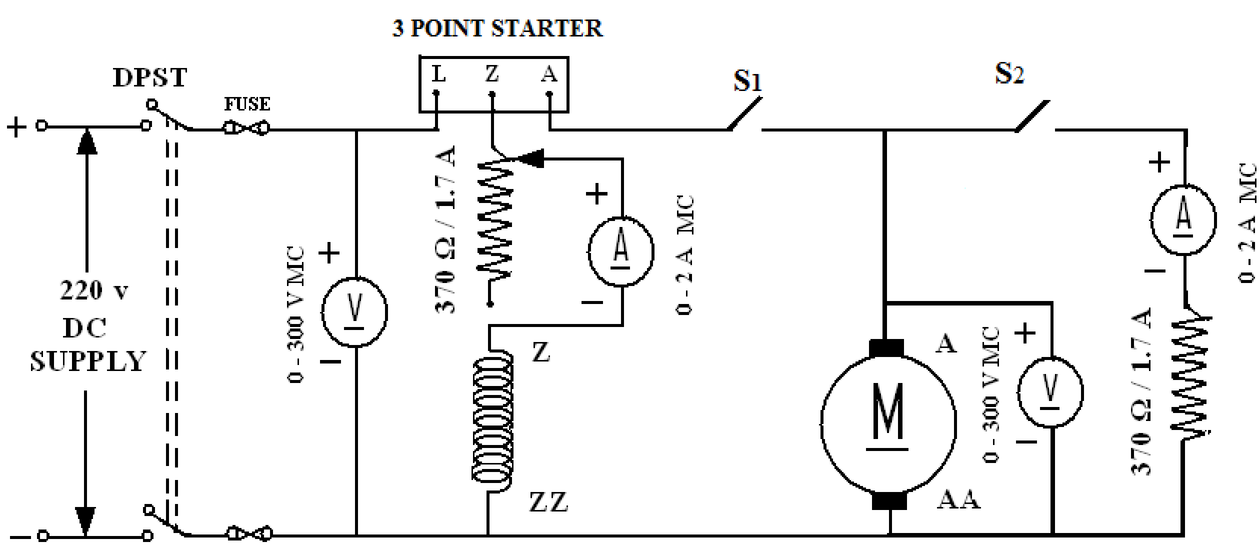


Fig – 10.1 DC Shunt Motor

10.4 APPARATUS:

S.No	Meter	Type	Range	Quantity
1	Ammeter			
2	Ammeter			
3	Voltmeter			
4	Rheostat			
5	Tachometer			

10.5 PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Initially the switch S_2 is open and S_1 is closed then the motor is started with the help of three point starter.
3. The speed is adjusted to just above the rated speed by adjusting the field rheostat.
4. The voltage is noted then switch S_1 is opened and also note down the time taken to reach the armature voltage to a voltage of 25% less than the initial value.
5. Again S_1 is closed immediately before the motor reaches to zero speed and rheostats are adjusted until the motor reaches its rated speed.
6. Then S_1 is opened and at a time S_2 is closed at this instant record the readings of ammeter and also note down the time taken to reach the armature voltage to a voltage of 25% less than the initial voltage.

10.6 TABULAR COLUMN:

S_1 close and S_2 open

S No	Vs (Volts)	I_f (A)	Time (t1)

S_1 open at a time S_2 close

S No	Va (Volts)	I_a(A)	Time (t2)

10.7 CALCULATIONS:

Rotational losses or stray losses $P_S=P_S{}^1(t_2/t_1-t_2)$

$P_S{}^1 = V_{avg} * I_{Lavg}$

Input power = V I_L

I_L = full load current of the motor

Armature cu losses = Ia^2 Ra

Ia = I_L-I_f

Total losses = Armature cu losses + Stray losses

Output power=Input -Total losses

Motor efficiency ή = output/input.

10.8 PRECAUTIONS:

1. Take care while using the starter.
2. The speed should be adjusted to rated speed.
3. There should be no loose connections.

10.9 RESULT:

10.10 PRE LAB VIVA QUESTIONS:

1. What is another name for Retardation test?
2. What is the difference between Retardation and Swinburne test?

10.11 POST LAB VIVA QUESTIONS:

1. The values obtained from this test are Pessimistic or Optimistic?
2. Is it possible to conduct Retardation test on DC series machines?

EXPERIMENT - 11

SEPARATION OF CORE LOSSES IN DC SHUNT MOTOR

11.1 AIM:

To perform suitable tests on the given DC shunt machine and determine from the experiment the stray losses and separates these into friction, hysterics and eddy current losses.

11.2 NAME PLATE DETAILS:

MOTOR

Voltage	
Current	
Output	
Speed	

11.3 CIRCUIT DIAGRAM:

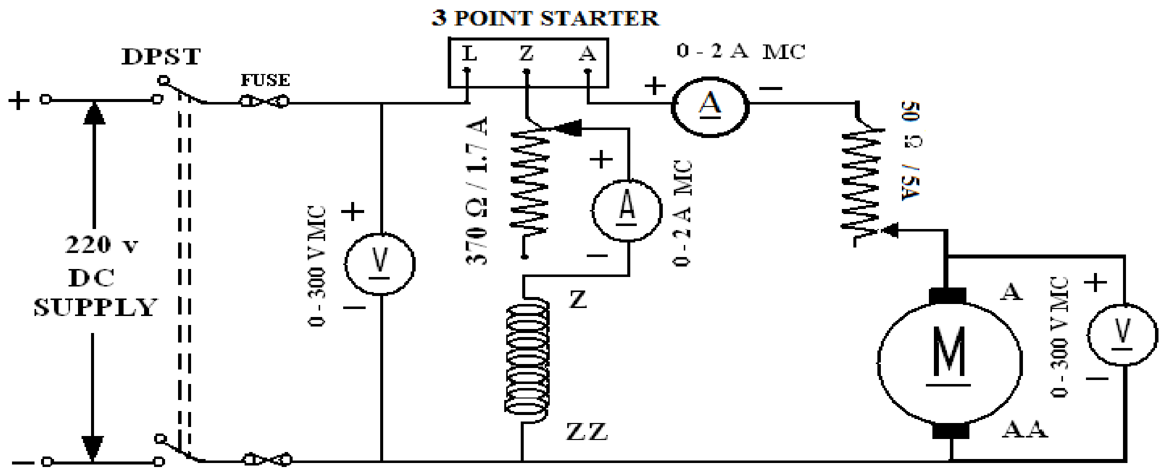


Fig – 11.1 DC Shunt Motor

11.4 APPARATUS:

S. No	Apparatus	Type	Range	Quantity
1	Ammeter			
2	Voltmeter			
3	Rheostat			
4	Connecting wires			

11.5 PROCEDURE:

1. Make the connections as per the circuit diagram as shown in Fig.
2. Start the motor slowly using starter keeping the field and armature rheostats in minimum and maximum position respectively.
3. Adjust the field current to the rated value at no- load
4. By increasing the armature circuit resistance in steps.
5. Take the readings of voltmeter, ammeter and speed at constant field current.
6. The above step is repeated for different values of speed then tabulates the readings.
7. Bring the armature rheostat back to full resistance (initial) position.
8. Repeat the experiment with a reduced field current. (75% rated excitation).
9. Tabulate armature resistance with the help of Multimeter.

11.6 TABULAR COLUMN:

Normal Field Current (I_{f1}) =

S.No.	N(rpm)	Va(Volt)	I_a(Amp)	E_b =Va-Ia Ra	W=E_b Ia	$\frac{W}{N}$
1						
2						
3						
4						
5						

75 % of Normal Field Current (I_{f2}) =

S.No.	N(rpm)	Va(Volt)	I_a(Amp)	E_b =Va-Ia Ra	W=E_b Ia	$\frac{W}{N}$
1						
2						
3						
4						
5						

11.7 MODEL GRAPH:

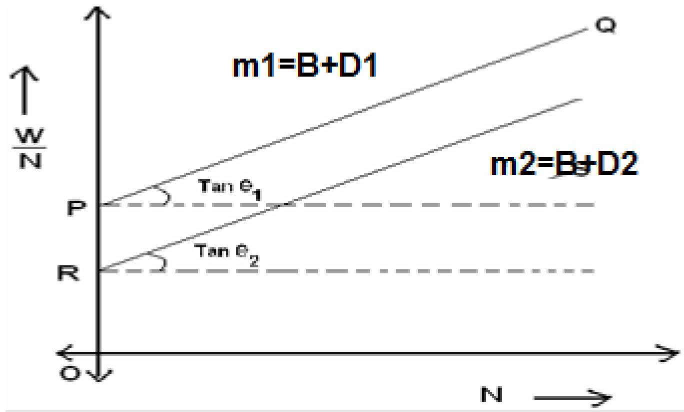


Fig – 11.2 Separation of Losses

11.8 CALCULATIONS:

DC machine is running at no load by varying the speed Keeping the excitation constant speed is the speed at the motor for Rated field current (I_{f1}).

Frictional losses α N_1

Windage losses α N_1^2

Mechanical losses = $AN_1+B N_1^2$

Hysteresis losses = C_1N_1

Eddy current losses= $D_1 N_1^2$

$W_1/N_1=(A+C_1)+(B+D_1)N_1$

For Reduced field current (I_{f2})

C_2N_2= Hysteresis loss

$D_2 N_2^2$= Eddy current loss

$W_2/N_2=(A+C_2)+(B+D_2)N_2$

From graph OP= $A+C_1$

OR= $A+C_2$

OP-OR= C_1-C_2 ---------------------------------- (1)

$Tan\phi_1=B+D_1$; $Tan\phi_2= B+D_2$

$Tan\phi_1- Tan\phi_2=D_1-D_2$--------------------------- (2)

$C_1/C_2= (I_{f1}/I_{f2})^{1.6}$---------------------------------- (3)

$D1/D2= (I_{f1}/I_{f2})^2$------------------------------------ (4)

At rated speed the various losses are results

Hysteresis loss = ………………W

Eddy Current loss = ……………… W

Friction loss = …………………… W

Wind age loss = ……………….. W

11.8 PRECAUTIONS:

1. Keep the field current constant during each part of the experiment.
2. Check the position of the rheostat positions before stating the motor.

11.9 RESULT:

11.10 PRE LAB VIVA QUESTIONS:

1. Where are eddy current losses occurring in a D.C. Machine?
2. How are the magnetic losses minimized?
3. How is brush contact resistance loss taken into consideration in practice?
4. Give the expression for hysteresis loss?
5. Differentiate MNA and GNA?
6. Which test gives us stray losses?

11.11 POST LAB VIVA QUESTIONS:

1. How Hysteresis losses occur in a D.C. Machine?
2. What is the effect of armature reaction?
3. How do you minimize cross magnetizing effect of armature reaction?

EXPERIMENT - 12

MAGNETIZATION CHARACTERISTIC OF DC SHUNT GENERATOR BY USING DIGITAL SIMULATION

12.1 AIM:

To determine experimentally the magnetization or open circuit characteristic of a D.C Shunt generator and to determine the critical field resistance and critical speed, by using simscape power systems.

.

12.2 APPARATUS:

S. No	Software	Desktop
1	Simscape power systems	1

12.3 CIRCUIT DIAGRAM:

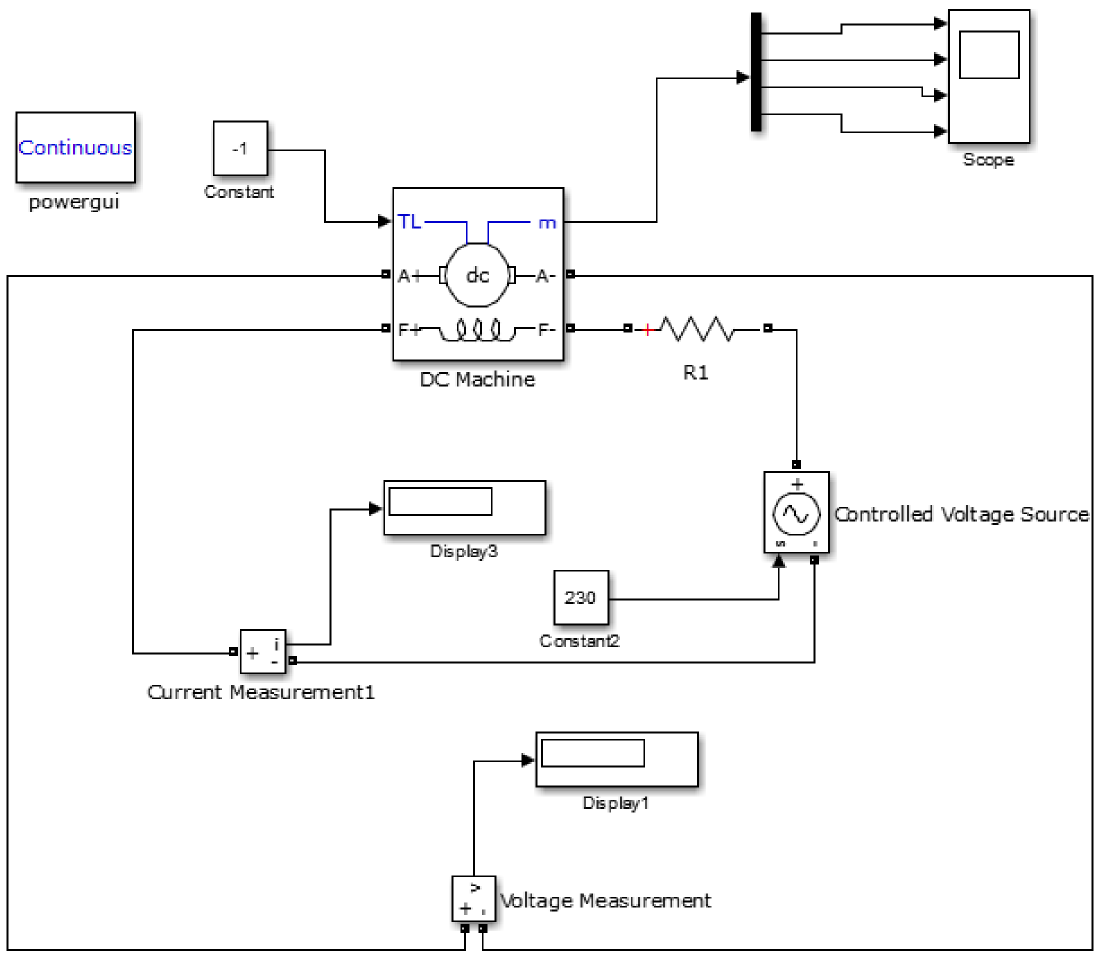


Fig - 12.1 DC Shunt Motor - Shunt Generator Set

12.4 PROCEDURE:

1. Connect the circuit as per the figure 12.1 using simscape power systems
2. Note down the readings of ammeter and voltmeter by varying field rheostat in steps.
3. Draw the Open circuit characteristics between field current and no load voltage.

12.5 TABULAR COLUMN:

S.No.	ASCENDING	
	Field Current (Amp)	Generated Voltage (Volts)
1		
2		
3		
4		
5		
6		
7		

12.6 MODEL GRAGH:

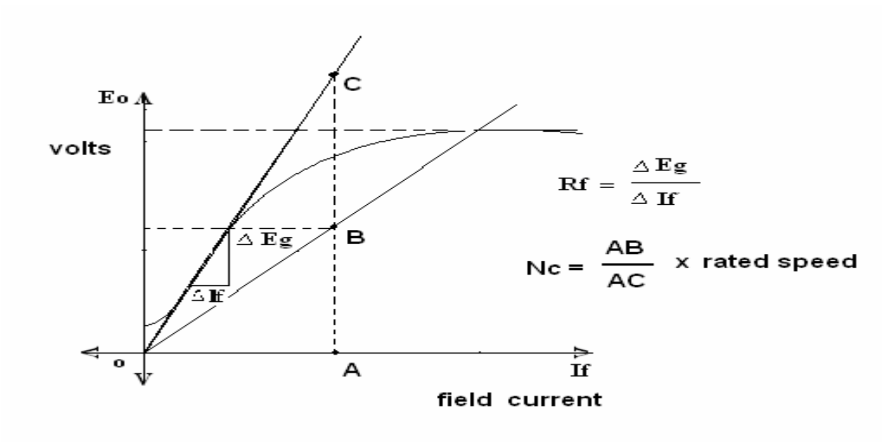


Fig - 12.2 Magnetization Characteristics Curve

12.7 RESULT:

12.8 PRE LAB VIVA QUESTIONS:

1. Under what conditions does the DC shunt generator fail to self - excite?
2. OCC is also known as magnetization characteristic, why?
3. How do you check the continuity of field winding and armature winding?
4. How do you make out that the generator is DC generator without observing the name plate?
5. Does the OCC change with speed?

12.9 POST LAB VIVA QUESTIONS:

1. Define critical field resistance.
2. How do you get the maximum voltage to which the generator builds up from OCC?
3. What does the flat portion of OCC indicate?
4. Why OCC does not start from origin?
5. Why is Rf > Ra in dc shunt machine?
6. How do you create residual magnetism if it is wiped out?
7. Why does the OCC differ for decreasing and increasing values of field current?

EXPERIMENT-13

LOAD TEST ON DC SHUNT GENERATOR BY USING DIGITAL SIMULATION

13.1 AIM:

To draw the external characteristics of shunt generator, by using sims cape power systems.

13.2 APPARATUS:

S. No	Software	Desktop
1	Simscape power systems	1

13.3 CIRCUIT DIAGRAM:

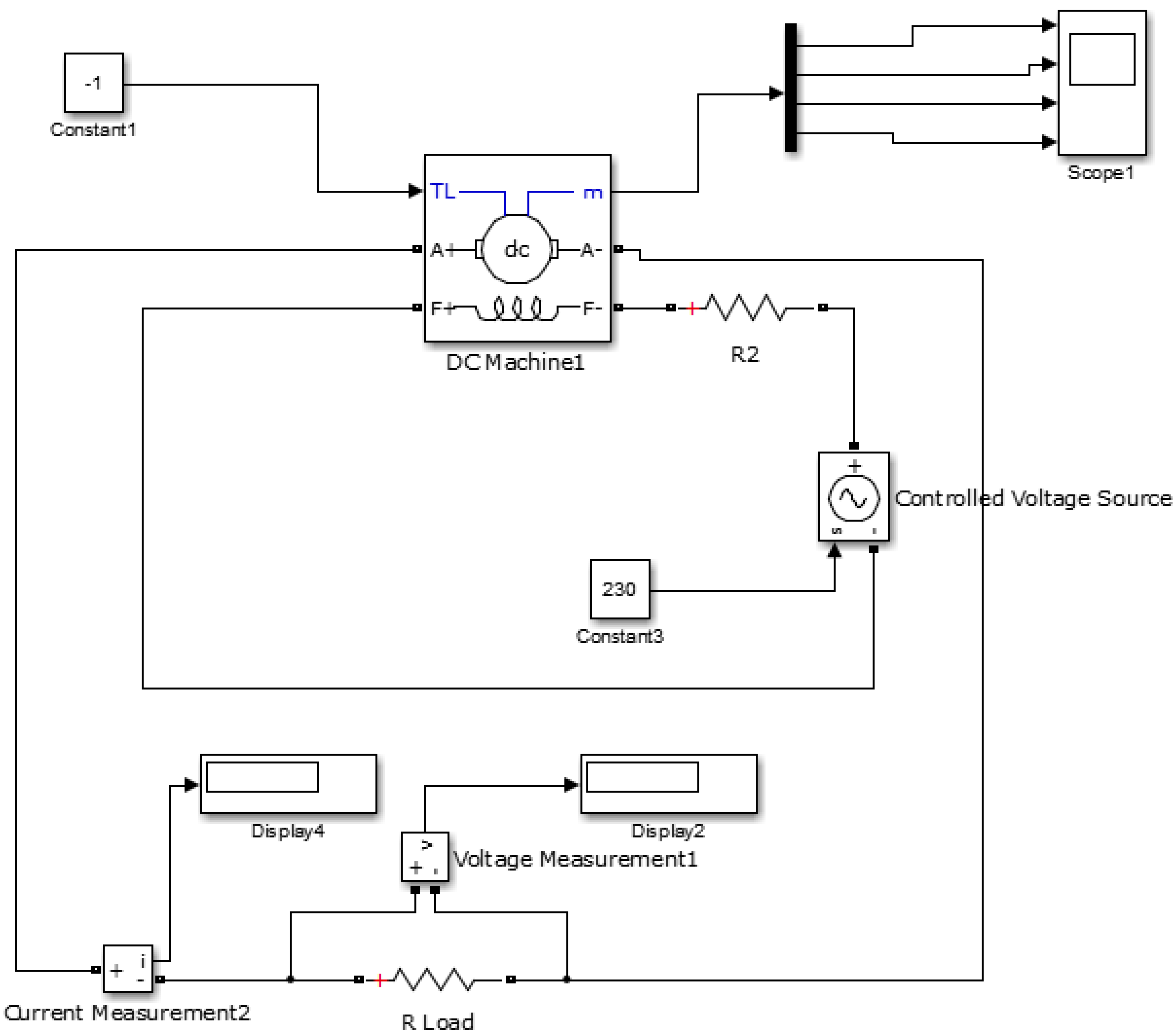


Fig - 13.1Circuit Diagram of Open Circuit Characteristics of Dc Shunt Generator

13.4 PROCEDURE:

1. Connect the circuit as per the figure 13.1 using simscape power systems.
2. Note down the readings of ammeter and voltmeter by varying R load in steps.
3. Draw the external characteristics between load current and load voltage.

13.5 TABULAR COLUMN:

S.No	I_L(Amp)	V_L(Volt)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

13.6 MODEL GRAPH:

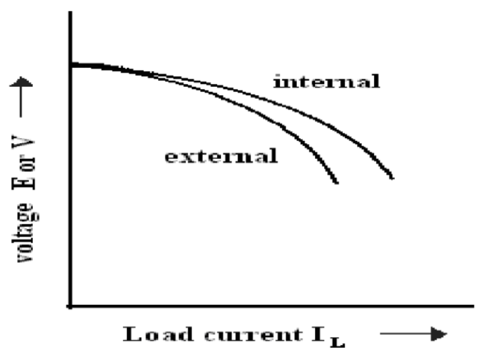


Fig – 13.2 Generated Voltage Vs Field Current

13.6 RESULT:

13.7 PRE LAB VIVA QUESTIONS:

1. Why is the generated emf not constant even though the field circuit resistance is kept unaltered
2. Find out the voltage drop due to full load armature reaction?
3. State the conditions required to put the D.C shunt generator on load.
4. How do you compensate for the armature reaction?
5. What happens if shunt field connections is reversed in the generator?
6. The E.M.F. induced in armature conductors of a D.C shut generator is A.C or D.C?

13.8 POST LAB VIVA QUESTIONS:

1. Specify the applications of D. C. shunt Generators.
2. Differentiate between D. C. Shunt Motor and D. C. shunt Generator.
3. Which method is suitable for testing of high rating DC Generator?
4. Why the terminal voltage decreases when load is increased on the generator?

EXPERIMENT - 14

(A) SPEED CONTROL OF DC SHUNT MOTOR USING PLC

14.1 AIM:

To Start and Control the Speed of DC Motor using Programmable Logic Controller

14.2 APPRATUS:

S. No.	Equipments	QUANTITY
1	Diode	8
2	Fan Capacitor	1
3	Auxiliary Contactor	1
4	Relay	5
5	SMPS	1
6	Push Buttons	2
7	PLC Trainer Kit	1

14.3 THEORY:

A simplified approach for speed control of a separately excited DC motor using Programmable Logic Controller (PLC) is presented. This approach is based on providing a variable dc voltage to armature circuit of dc motor from a fixed dc supply voltage via a PLC which is used as a dc/dc chopper.

The methods of speed control of DC motors are normally simpler and less expensive than that of ac drives. Due to the commutators, dc motors are not suitable for very high speed applications and require more maintenance than ac motors. Controlled rectifiers provide a variable dc output voltage from a fixed ac voltage, whereas choppers can provide a variable dc voltage from a fixed dc voltage. Due to their ability to supply a continuously variable dc voltage, controlled rectifiers and dc choppers made a revolution in modern industrial control equipment and variable-speed drives A Programmable Logic Controller (PLC) is an industrially hardened computer-based unit that performs discrete or continuous control functions in a variety of processing plant and factory environments. In the world of control, the use of PLC is ever increasing. Industrial process control is one of the very important areas where the PLC is extensively used

14.4 LADDER CIRCUIT:

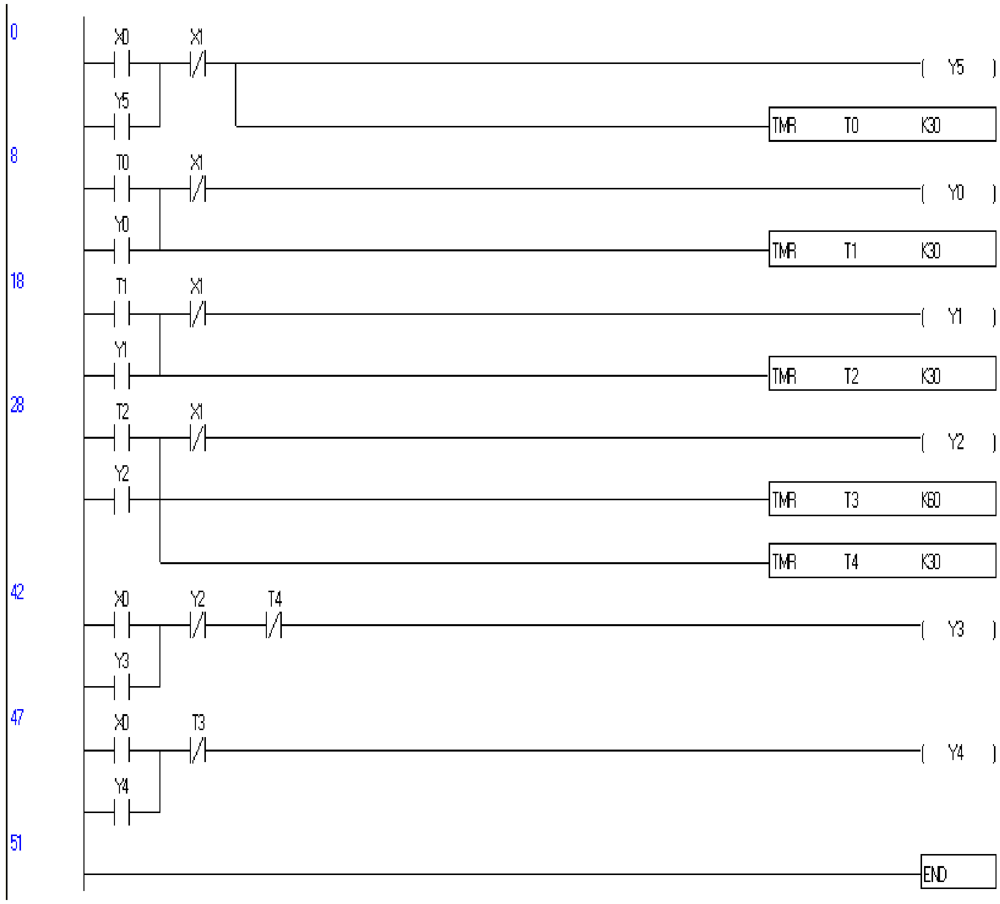


Fig 14.1 Ladder Diagram

14.5 PROCEDURE:

1. Press the start button
2. Click on the program folder
3. Click on the WPL soft
4. Execute WPL2
5. After the 'RUN' operation what operated next is the WPL window will show up.
6. After WPL soft is activated we are to undertake the creating of new documents.
7. After the setting is completed, three windows will show up: one is the ladder diagram mode window, the other is the command mode window and the third one is the SFC editing mode.
8. Users are to choose the editing mode of their interests to proceed with the program editing.
9. The ladder diagram mode :(after the diagram is edited , convert the ladder diagram to the command mode and the SFC diagram through c

10. The command mode (after the command is edited, convert it to the ladder and the SFC diagram through compiling)
11. The SFC mode: (after the SFC diagram is edited convert it to the command code through compiling and to convert it to the ladder diagram, users have to go through the command code compiling in order to achieve the ladder diagram conversion.)
12. When WPL soft is activated, the first image to show up is; there are five selections on the function panel: File (F), communication(C), option (o), window (W), Help (H).
13. Click on ‘New’ under ‘’File’’, and the following image will show up; there will be some other selections listed on the function panel: Edit (E), Compile (P), Comment (L), Search(S), View (V).

14.6 PROGRAM DESCRIPTION:

The PLC has 8 inputs, and 6 outputs and two relays which are mainly used to provide clock signal or PWM.

In this experiment 230 volts AC supply is converted to approximately 230 V DC supply by using the bridge rectifier and capacitor is connected to parallel. Before starting the experiment resistance switches are open so that current flows through the resistors and the voltage drop is more. Due to this effect Speed is less.

To Increase the speed, resistance switches should be close so the line is shorted and current flows through the line, no drop is present, and obviously speed is more i.e., rated speed is obtained.

These procedure is done by using rheostat manually, to overcome manual operations PLC Program is used to the operate automatically. Similarly, same operation is done in field side.

The PLC program is affected by using push buttons and the auxiliary contactor or the main contractor. This SMPS is connected to PLC Device. 230V AC supply is converted to 24V AC by using SMPS.

14.7 RESULT:

14.6 PRE LAB VIVA QUESTIONS

1. What is the purpose of using resistors in armature circuit?
2. What is the purpose of using resistors in field circuit?
3. What are the disadvantages of starting and speed control using resistors.
4. How does PLC simplify automation and control?

14.7 POST LAB VIVA QUESTIONS

1. How do we increase the speed of Dc motor?
2. Suggest improvements to this program to switch the resistors.
3. How do you prevent field winding in a Dc motor?

14-B: SPEED CONTROL OF DC SHUNT MOTOR USING LAB VIE

14.1 AIM:

Speed control of shunt motor by using LAB VIEW

14.2 APPARATUS:

S. No	Software	Desktop
1	LAB VIEW	1

14.3 CIRCUIT DIAGRAM:

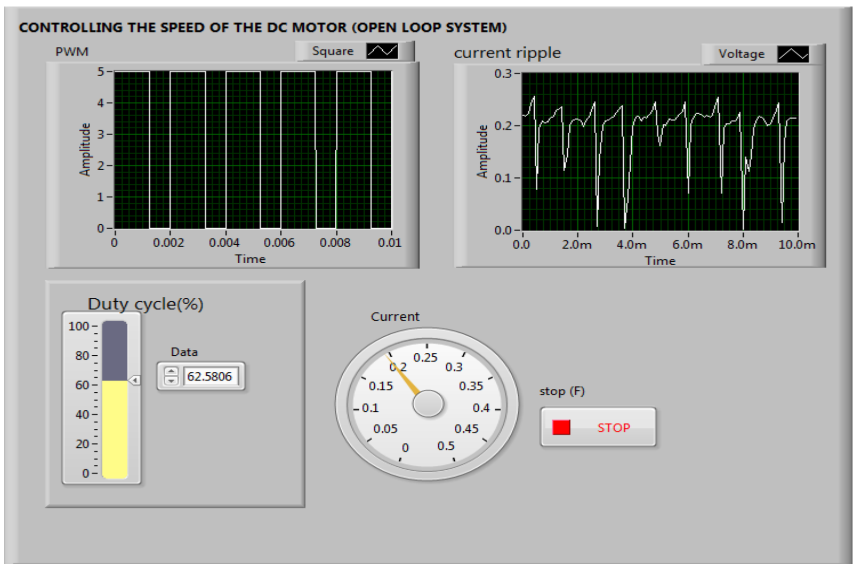


Fig - 14.1 - Front Panel of Open Loop Control of DC Motor

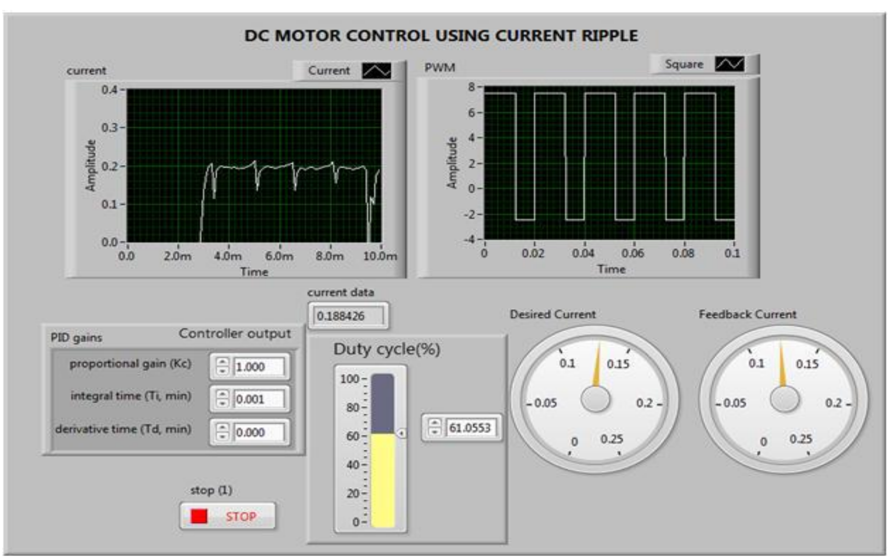


Fig - 14.2 Closed loop controlling of DC motor

14.4 WORKING:

The connections are given as per the circuit diagram shown below.

A resistor is connected between the analog output voltage pins and analog ground. The resistor is used to produce the Ripple current of a motor. My DAQ analog output voltage pins AI0+, AI0- and AGND is given across the resistor.

The motor driver circuit is given an external power supply for its working and My DAQ is connected to the PC via USB Cable

The above figure shows the connection between my DAQ device, the motor driver circuit and the motor. The

Connections are to given only to the respective pins in my DAQ device. Else output is not obtained.

The above figure shows the front panel of the VI developed for open loop control system of the motor.

As said earlier, duty cycle is given as the input to the system. The PWM and the ripple current are viewed with the help of a graph. The PWM signals have a fixed frequency and only the width of the pulses changes to alter the Average power of the signal. As the changes are given in the duty cycle the ripple current also changes and is indicated in the gauge.

14.5 TABULAR COLOUMN:

1. OPEN LOOP:

S. No.	Duty Cycle (% Input)	Current at no load Condition (mA)	Current at External load Condition (mA)
1			
2			
3			
4			
5			
6			

2. CLOSED LOOP:

SI.NO.	DESIRED CURRENT (SETPOINT) (mA)	DUTY CYCLE (%) (OUTPUT)	FEEDBACK CURRENT (mA) (OUTPUT)
1			
2			
3			
4			
5			
6			

14.6 RESULT:

14.7 PRE LAB VIVA QUESTIONS:

1 Explain why the graph of armature speed control of motor is linear?
2 Comment on the efficiency calculated by this method.
3 Why do you need a starter in a dc motor?
4 What is meant by rated speed?
5 Can we start the dc shunt motor and series motor without load?
6 What is meant by speed regulation?
7 Can we operate a dc motor an ac supply?
8 What are the other methods of controlling the speed of dc shunt motor?

14.8 POST LAB VIVA QUESTIONS:

1. How do you change the direction of rotation of a D.C. motor?
2. What is the disadvantage of using armature control of speed on load?
3. What are the limitations of shunt field control?
4. Can we conduct continuity test on ac supply?
5. While running if the field winding gets disconnected, what will happen?
6. What is the shape of the curve of field control of method motor speed? Explain why is it so?