MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(Autonomous Institution – UGC, Govt. of India)

Electrical Machine - I Lab. Manual

Student Name:………………………………………………………

Roll No : …………………………………………………………………

Branch:……………………………..**Section**……………………

Year ………………………**Semester**………………………..

FACULTY INCHARGE

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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.
3. **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 and safety, and the cultural, societal, and environmental considerations.
4. **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.
5. **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.
6. **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.
7. **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.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.
11. **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 multi disciplinary environments.
12. **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.

MALLA REDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

II Year B.Tech.EEE-II Sem **L T/P/ D C**

- - / 3 /- 1.5

(R18A0282) ELECTRICAL MACHINES LAB – I

COURSE OBJECTIVES:

- To expose the students to the operationof DCGenerator.
- To expose the students to the operation of DCMotor.
- To examine the self excitation in DC Generators.

The following experiments are required to be conducted compulsory experiments:

1. Load test on DC shunt generator. Determination of characteristics.
2. Load test on DC series generator. Determination of characteristics.
3. Load test on DC compound generator. Determination of characteristics.
4. Determination of critical resistance and critical speed of D.C. shunt generator
5. Hopkinson's test on DC shunt machines. Predetermination of efficiency.
6. Fields test on DC series machines. Determination of efficiency.
7. Speed control of DC shunt motor
8. Brake test on DC compound motor. Determination of performance curves.
9. Retardation test on DC shunt motor. Determination of losses at rated speed.
10. Separation of losses in DC shunt motor

COURSE OUTCOMES:

After successfully studying this course, students will:

- Be able to systematically obtain the equations that characterize the performance of an electric Motor as well as Generator.
- Acknowledge the principles of operation and the main features of electricmachines and their applications.
- Acquire skills in using electrical measuring devices.

GENERAL SAFETY INSTRUCTIONS FOR THE STUDENTS

Read this section carefully before performing any experiment in Electrical Laboratory

1. While performing experiments in the Electrical Machine Laboratory, you must follow stringent safety rules and precautionary measures for your own safety as well as for safety of your co-workers. Always remember that you are working at voltage levels much higher compared to normal workingvoltage.
2. Don't attempt to enter the lab except when asked for and accompanied by concerned Lab Staff / Instructors.
3. Every student should obtain a set of instruction sheets entitled manufacturing processes Laboratory.
4. For reasons of safety, every student must come to the laboratory in shoes (covering the whole feet). It is unsafe for the students to come to the laboratory wearing garments with parts that that hang about loosely and as such the lab users are requested to avoid wearing garments with loose hanging parts. Students should preferably use half-sleeve shirts wherever possible. The Students should also ensure that floor around the machine is clear and dry (not oily) to avoid slipping. Please report immediately to the lab staff on seeing any coolant / oil spillage.
5. Instruments and tools will be issued from the Lab Staff / Instructors. Every student must produce his identity card for the purpose. Tools, etc. must be returned to the Lab Staff / Instructors on the same day after work hours.
6. The student should take the permission and guidance of the Lab Staff / Instructors before operating any machine. Do not attempt to operate any equipment yourself without permission of the concerned teachers / instructors. You should never be in casual while in the lab. Be careful that you don't operate any button etc. by mistake: it may lead to serious mal operation and hazards. Unauthorized usage of any machine without prior guidance may lead to fatal accidents and injury.
7. Always maintain sufficient distance from the live objects to avoid electrical shock due to induction.
8. Before taking entry in the lab, always double check that all the apparatus and equipment are disconnected from supply and are properly grounded.
9. Use the ground rod to earth all apparatus before putting hands on them.
10. The student will not lean on the machine or take any kind of support of the machine at any point oftime. If found leaning on a machine without proper reasons serious action would be taken.
11. Laboratory reports should be submitted on A4 size sheets. The students must submit report on next working day. These have associated some grades.
12. Reports will not be returned to the students. Students may see the graded reports while in the laboratory

LIST OF EXPERIMENTS

INTRODUCTION TO TEST PROCEDURE WITH COMPUTER SETUP:

- The machines laboratory is setup with the following new features.
    - The motors are controlled using a static electronic power drive unlike the conventional method of using 3-point starters and DC output power.
    - Further, the motors can be controlled either manually by directly using the electronic drive unit or through PLC/Micro controller unit(Data logger)
- Hence the general procedure for all experiments is given in both methods.
- First, the power is extended to the test bench by switching on the corresponding MCB in the mains panel. Then the test panel is energized by switching on the MCB on the panel (Before switching on the local MCB it is to be confirmed that the drive control pot meter is in minimum position).
- The computer is switched on and ***DIAVIEW*** software is executed from the desktop.
- The computer now displays either the SCADA display (in case of PLC controlled set ups) and Data logger display (in case of data logger/micro controller setup)

MANUAL MODE:

1. **METHOD OF STARTING THE MOTOR:**

- The field rheostat is kept in minimum resistance position.
- Then the pot meter is rotated in clock wise gradually thus increasing the speed.
- In maximum position of the pot meter, motor is expected to reach slightly lesser than its rated speed.
- Now the field is weakened by increasing the field rheostat and the speed is brought to the rated speed as required for the respective test setup.

2. **DATA READ OUT/RECORDING PROCEDURES:**

- Depending upon the test setup all the relevant data like voltages, currents, speed and force are read out from the respective panel meters and noted down.
- Even in the manual mode of control the same data whatever is available on the panel meters can also be seen on the computer mimic diagram if the computer and PLC/Micro controller are kept in ON condition.
- This data at the end of the experiment can also be exported to the system memory with the required student information for further analysis and records.

PLC/MICRO CONTROLLER MODE:

1. **METHOD OF STARTING THE MOTOR:**
    - The field rheostat is kept in minimum resistance position.
    - Then using the mouse and the curser,
        - PLC/CONTROLLER mode is selected from mimic diagram.
        - Then motor start button is pressed
        - Speed is increased gradually by increasing the drive output voltage till the rated armature voltage is reached as read by the respected panel meter and the computer display.
    - Now the field is weakened by increasing the field rheostat and the speed is brought to the rated speed as required for the respective test setup.
2. **DATA READ OUT/RECORDIND PROCEDURES:**
    - Depending upon the test setup all the relevant data like voltages, currents, speed and force are read out are available on the mimic display
    - The data at required instant of the experiment is logged by going to the data log in page and clicking on the data logger icon
    - After collecting relevant experimental data in the ***DIAVIEW*** screen , the file is exported to system memory with the required student information for further analysis and records.

EXP.NO: 01
DATE :

MAGNETIZATION CHARACTERISTICS OF DC SHUNT GENERATOR

AIM: To obtain magnetization characteristics of a DC shunt generator & to find its critical resistance at constant rated speed and critical speed

NAME PLATE DETAILS:

Term	D .C Shunt Motor	D.C Shunt Generator
Power	5 H.P , 3.7KW	3KW
Voltage	220V	220V
Current	19A	19A
Speed	1500RPM	1500RPM
Field current	1A	1A

FUSE RATING:

Motor side:

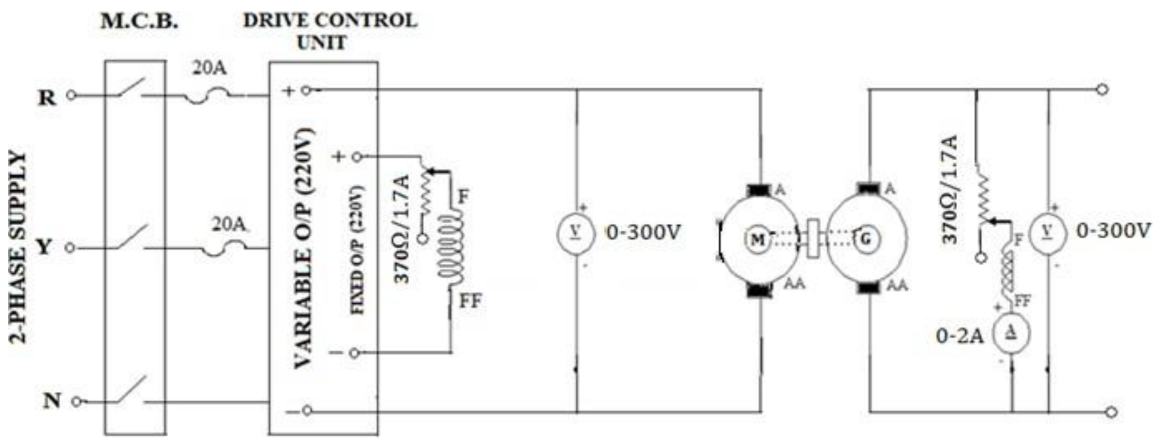
125% of rated current of DC Motor

125x19/100=23.75≈ 25 A

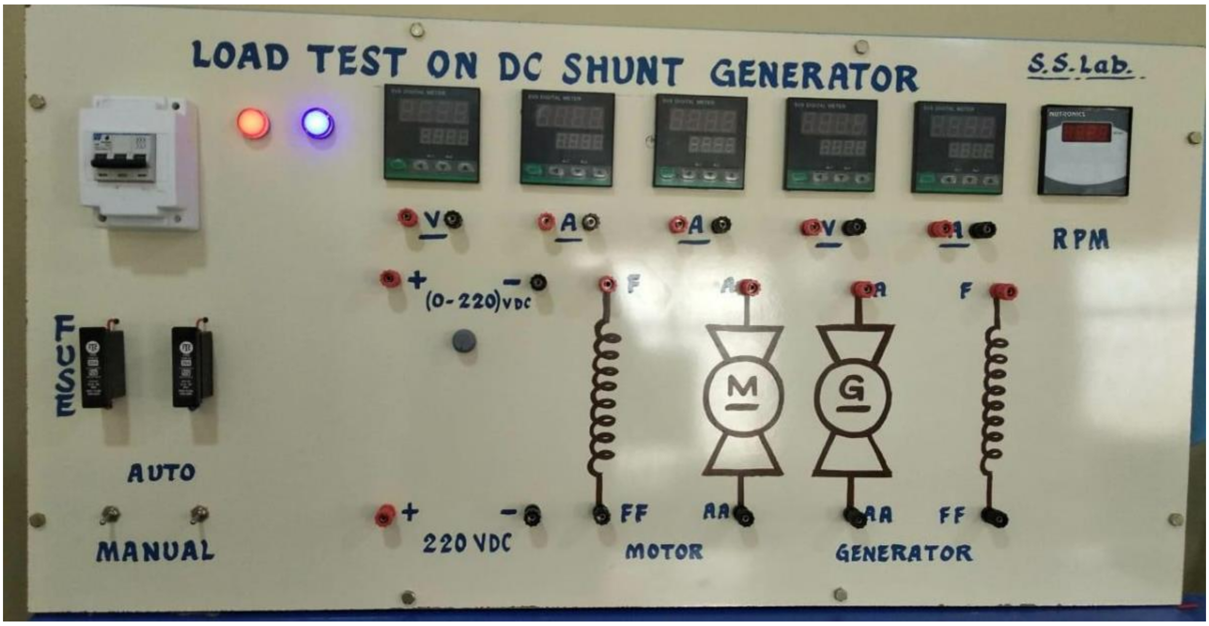
APPARATUS REQUIRED:

S. No	Name of the Apparatus	Range	Type	Quantity	Availability
1	Ammeter	(0-2)A	Digital	1	On Panel
2	Voltmeter	(0-300)V	Digital	1	On Panel
3	Rheostats	370Ω,1.7A	Wire Wound	2	External
4	RPM meter	(0-9999)rpm	Digital	1	On Panel
5	Connecting Wires	-	-	As Required	External

TEST SETUP:



PANEL:



PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Before starting the motor, ensure that both field rheostat and Pot meter of Drive Control Unit are in minimum position and the field rheostat of Generator should be in its maximum position. Similarly the load resistance connected to the Generator should be in its minimum position (No load).
3. Observing all the precautions, the motor is started using Drive Control Unit and the speed is increased until the rated armature voltage (of motor) is reached. At this instant the speed would be slightly lesser than the rated speed.
4. Now by adjusting the field rheostat, the motor is brought to the rated speed.
5. Now the field Rheostat of generator is varied and the field resistance is gradually decreased in steps thus increasing the field current. At each step the field current (I_f) and the corresponding induced EMF (Eg) are recorded in the tabular column. This procedure is continued until the generator voltage reaches its rated value.

   Note: While conducting the experiment the machine is maintained at constant speed.

6. After the experiment is completed the various rheostats are brought back to their original position in sequence and then main supply is switched off.

PRECAUTIONS:

1. The field rheostat of motor should be in minimum resistance position at the time of starting to start the machine from minimum speed.
2. The field rheostat of generator should be in maximum resistance position at the time of starting and stopping the machine.
3. Residual voltage should be taken under no field current.
4. The characteristics should be drawn at constant rated speed by adjusting the drive unit or motor filed resistance as required.

OBSERVATIONS:

R_{sh} = ohms

Sl. No	Field Current I_f (Amps)	Armature Voltage E_o (Volts)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

CRITICAL FIELD RESISTANCE:

It is that value of the field resistance at which the D.C. shunt generator will fail to excite.

Critical field resistance is obtained by plotting the OCC as in fig.1 and drawing a tangent to the linear position of the curve from the origin. Then critical resistance is given by the slope of that tangent. While drawing the tangent, the initial position of the O.C.C is neglected.

CRITICAL SPEED:

It is that speed for which the given shunt field resistance becomes the critical field resistance.

The shunt field resistance (R_{sh}) line is obtained by taking the point of intersection of the OCC at rated speed and the rated E_g line parallel to the I_f axis. The line joining the origin with this point of intersection is the (R_{sh}) line.

Then OCC's are obtained at reduced speeds by conducting the above experiment till the Rsh line (corresponding to rated speed and rated generated voltage)becomes tangential to the reduced speed OCC. That speed is called the critical speed. This is shown in fig.2,The lower speeds are obtained by reducing the controller unit pot meter (armature voltage control).

MODEL GRAPH:

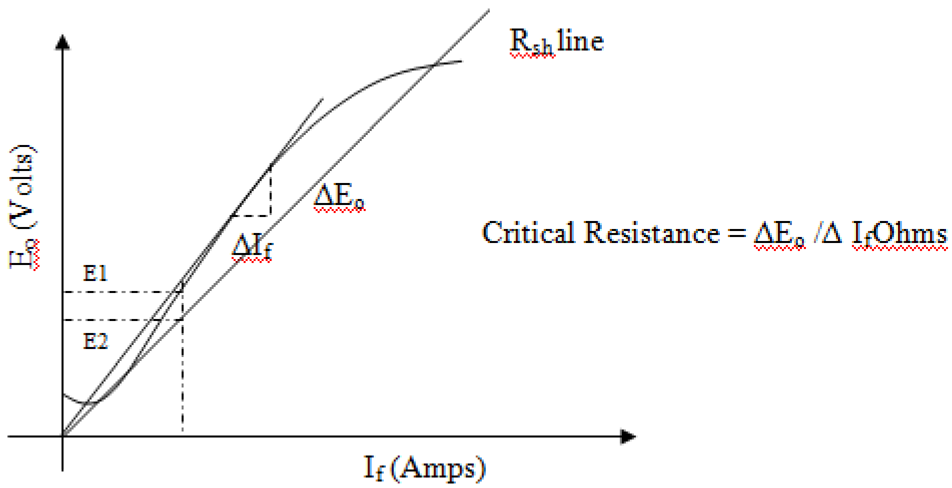


Fig.1

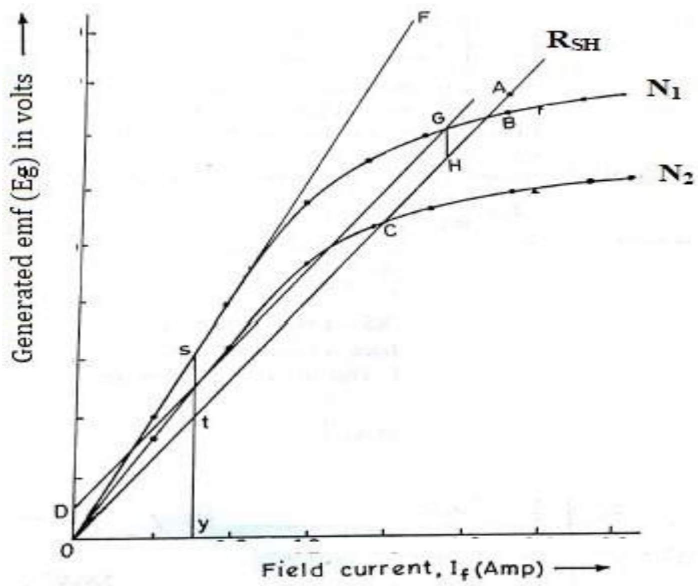


Fig.2

CALCULATIONS:

Critical resistance $R_c = \Delta E_0 / \Delta I_f$ = ohms

Critical speed $N_C = N_3 = N_1 \times \frac{VOLTAGE\ yt}{VOLTAGE\ ys}$ = rpm

VIVA QUESTIONS:

1. What is the principle of generator?
2. What is meant by residual magnetism?
3. What is critical field resistance?
4. What is meant by saturation?
5. What is the difference between a separately excited dc generator and shunt generator?
6. If a DC shunt generator fails to build up voltage, what may be the probable reasons?
7. What is SPST? What is its use in this experiment?
8. What is the reason for the presence of residual magnetism in the field poles?

RESULT:

EXP.NO: 02
DATE :

LOAD CHARACTERISTICS OF DC SHUNT GENERATOR

AIM: To obtain internal and external characteristics of DC shunt generator at constant rated speed.

NAME PLATE DETAILS:

Term	D .C Shunt Motor	D.C Shunt Generator
Power	5 H.P , 3.7KW	3KW
Voltage	220V	220V
Current	19A	19A
Speed	1500RPM	1500RPM
Field current	1A	1A

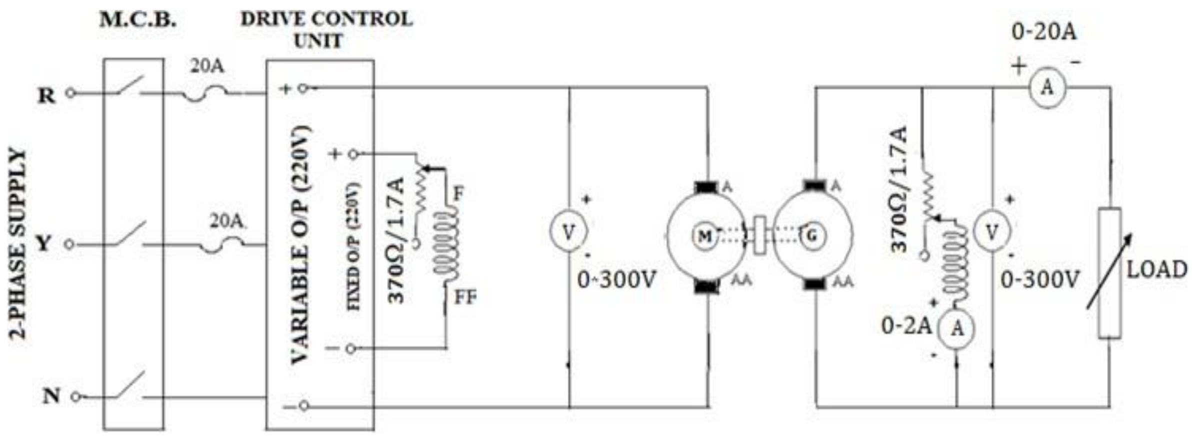
FUSE RATING

Motor and Generator side:
125% of rated current of DC Motor
125*19/100=23.75≈ 25 A

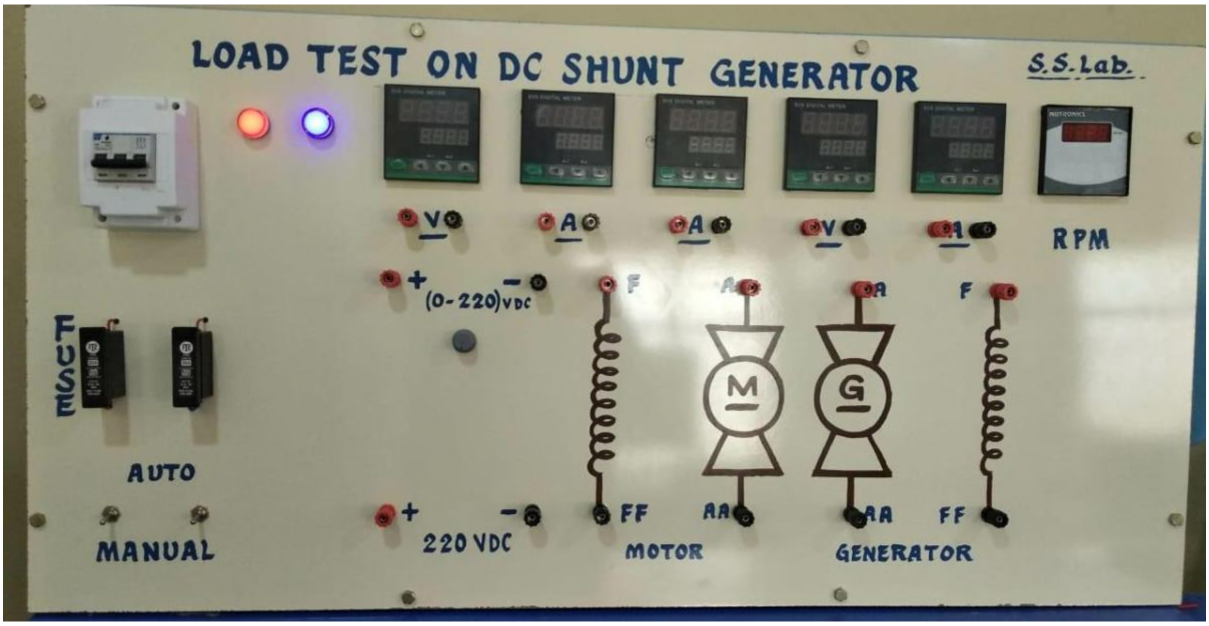
APPARATUS REQUIRED:

S.No:	Name of the Apparatus	Range	Type	Quantity	Availability
1	Ammeter	(0-2)A (0-20) A	Digital Digital	1 1	On Panel On Panel
2	Voltmeter	(0-300)V	Digital	1	On Panel
3	Rheostats	370Ω/1.7A	Wire Wound	2	External
4	Resistive load bank	20A	-	1	External
5	RPM meter	(0-9999)rpm	Digital	1	On Panel
6	Connecting Wires	-	-	As Required	External

TEST SETUP:



PANEL:



PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Before starting the motor, Ensure that the field rheostat and Pot meter of Drive Control Unit are in minimum position and the field rheostat of Generator should be in its maximum position. Similarly the load resistance connected to the Generator should be in its minimum position (No load).
3. Observing all the precautions, the motor is started using Drive Control Unit and the speed is increased until the rated armature voltage (of motor) is reached. At this instant the speed would be slightly lesser than the rated speed.
4. By adjusting the motor field rheostat, the motor is brought to rated speed.
5. Then the generator field rheostat is adjusted until the generator voltage reaches its rated value. The terminal voltage and the field current are noted in the tabular column.
6. Now the load on the generator is gradually increased in steps. At each step the speed of the generator is checked and maintained constant at its rated value by adjusting the field rheostat of the motor. After satisfying this condition on each loading, the terminal voltage (V_L), field current (I_F) of Generator and the load current (I_L) are noted down in the tabular column.
7. Then the generator is unloaded and the field rheostat of DC shunt generator is brought to maximum position and the field rheostat of DC shunt motor to minimum position and MCB is opened.

PRECAUTIONS:

1. The field rheostat of motor should be at minimum position.
2. The field rheostat of generator should be at maximum position.
3. No load should be connected to generator at the time of starting and stopping

OBSERVATIONS:

Sl. No:	Field Current I_f (Amps)	Load Current I_L (Amps)	Terminal Voltage (V_L) Volts	$I_a = I_L + I_f$ (Amps)	$E_g = V + I_a R_a$ (Volts)
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

FORMULAE & NOMENCLATURE:

$E_g = V + I_a R_a$ (Volts)

$I_a = I_L + I_f$ (Amps)

E_g: Generated emf in Volts

V: Terminal Voltage in Volts

I_a: Armature Current in Amps

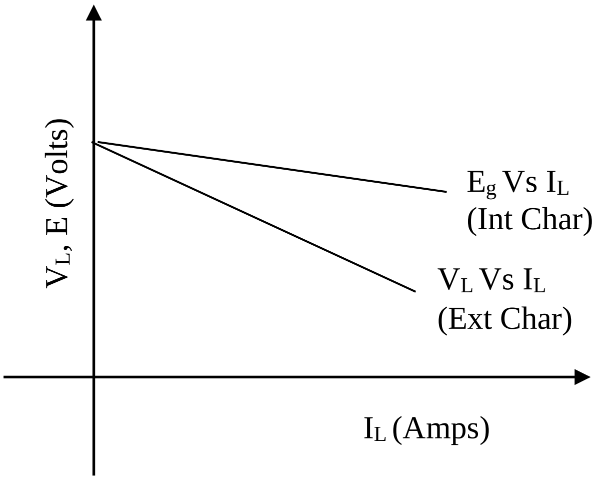
I_L: Line Current in Amps

I_f: Field Current in Amps

R_a: Armature Resistance in Ohms

CALCULATIONS:

MODEL GRAPH:



VIVA QUESTIONS:

1. What are the reasons for the drooping load characteristics?
2. Why does the terminal voltage decrease as the load current increases?
3. Why the load characteristics of dc shunt is having Drooping characteristics?
4. Why the Drooping of Dc Shunt Generator is more when compared to separately excited generator? (I_f independent of voltage.)
5. How can the external characteristics be drawn?
6. How can the internal characteristics be drawn from External characteristics?
7. What are the applications of shunt generator?
8. Shunt field winding of a dc machine consists of
    a. Many turns of thin wire
    b. Few turns of thick wire

RESULT:

EXP.NO: 03
DATE :

LOAD CHARACTERISTICS OF DC SERIES GENERATOR

AIM: To obtain internal and external characteristics of DC series generator

NAME PLATE DETAILS:

Term	D .C Shunt Motor	D.C Series Generator
Power	5 H.P , 3.7KW	3KW
Voltage	220V	220V
Current	19A	19A
Speed	1500RPM	1500RPM
Field current	1A	-

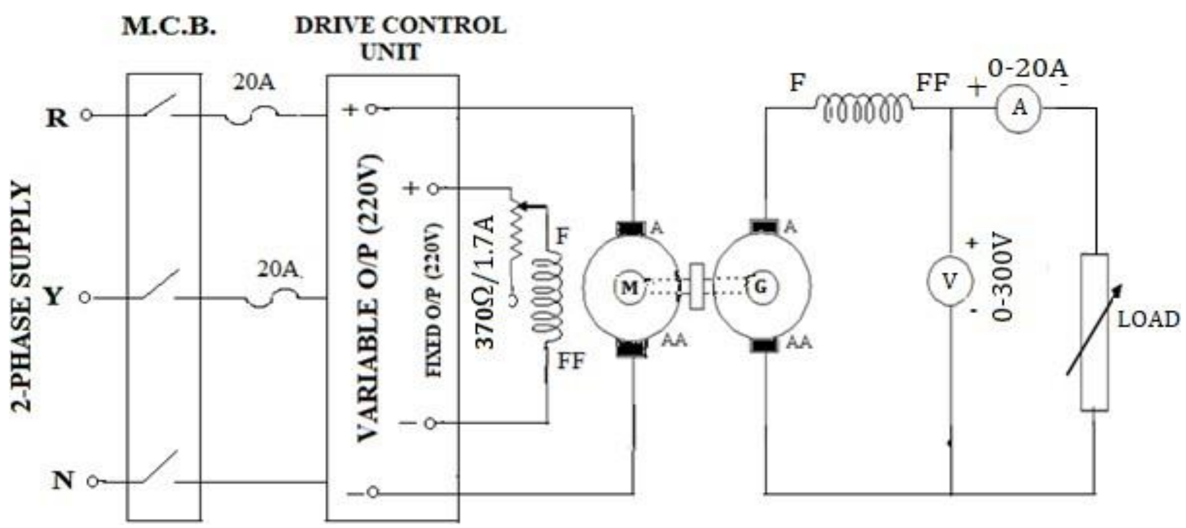
FUSE RATING

Motor and Generator side:
125% of rated current of DC Motor
125*19/100=23.75≈ 25 A

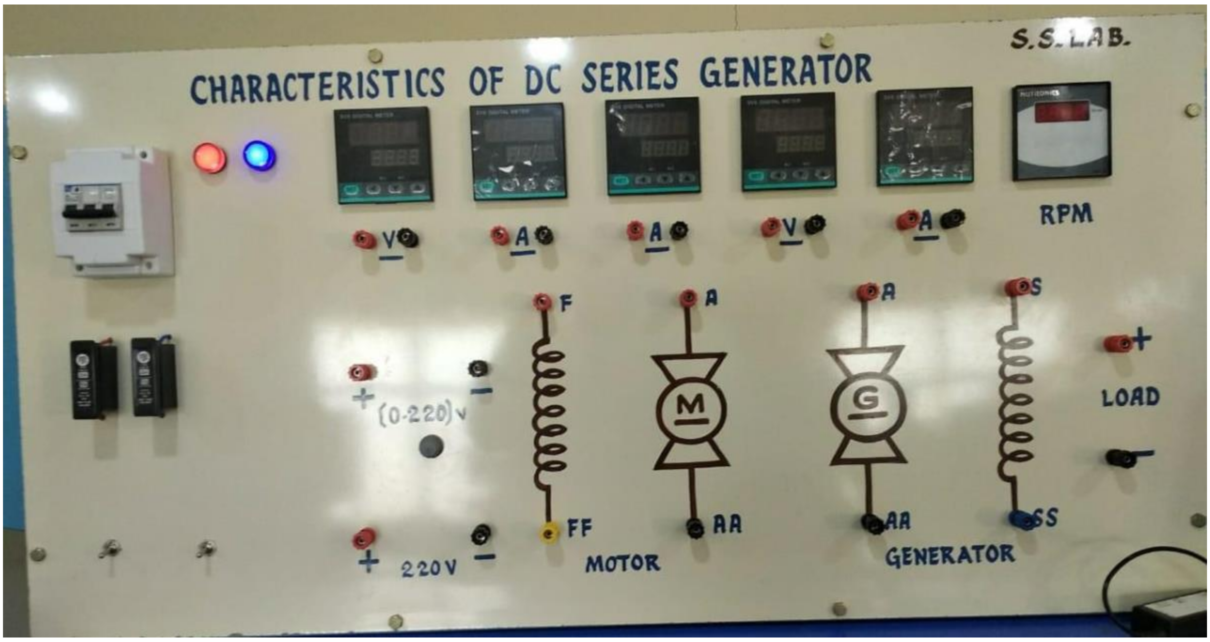
APPARATUS REQUIRED:

S. No:	Name of the Apparatus	Range	Type	Quantity	Availability
1	Ammeter	(0-20) A	Digital	1	On Panel
2	Voltmeter	(0-300)V	Digital	1	On Panel
3	Rheostats	370Ω/1.7A	Wire Wound	1	External
4	Resistive load bank	20A	-	1	External
5	RPM meter	(0-9999)rpm	Digital	1	On Panel
6	Connecting Wires	-	-	As Required	External

TEST SETUP:



PANEL:



PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Before starting the motor, Ensure that the field rheostat and Pot meter of Drive Control Unit are in minimum position and the field rheostat of Generator should be in its maximum position. Similarly the load resistance connected to the Generator should be in its minimum position (No load)
3. Observing all the precautions, the motor is started using Drive Control Unit and the speed is increased until the rated armature voltage (of motor) is reached. At this instant the speed would be slightly lesser than the rated speed.
4. By adjusting the motor field rheostat, the motor is brought to rated speed.
5. Under no load condition, Ammeter and Voltmeter readings are noted.
6. Now the load on the generator is gradually increased in steps. At each step the speed of the generator is checked and maintained constant at its rated value by adjusting the field rheostat of the motor. After satisfying this condition on each loading, the terminal voltage (V_L) and the load current (I_L) are noted down in the tabular column.
7. Then the generator is unloaded and the field rheostat of DC shunt motor is brought to minimum position and MCB is opened.

PRECAUTIONS:

1. The field rheostat of motor should be at minimum position.
2. No load should be connected to generator at the time of starting and stopping.

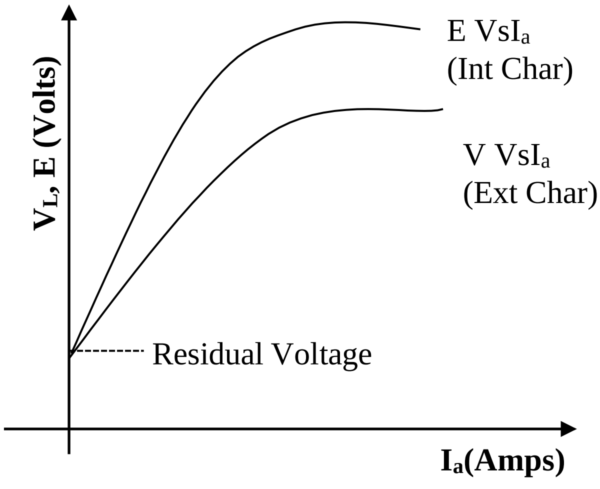
OBSERVATIONS:

R_a = Ω R_{se} = Ω R= (R_a+R_{se}) = Ω

(R_a & R_{se} are found by using DC multimeter)

Sl.No	Terminal Voltage (V_L) Volts	Armature current (I_a) or Load current (I_L)(Amps)	$E_g = V_L + I_a R$ (Volts)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

MODEL GRAPH:



FORMULAE:

E_g : $V_L + I_a (R_a + R_{se})$ (Volts)

E_g : Generated emf in Volts

V : Terminal Voltage in Volts

I_a : Armature Current in Amps

R_a : Armature Resistance in Ohms

R_{se} : Series Field Resistance in Ohms

VIVA QUESTIONS:

1. What is a DC series generator?
2. What are the factors on which the generated emf in a DC series generator depends?
3. Why is value of the series field resistance low?
4. Comment on the shapes of the load characteristics of DC series generator.
5. How does armature reaction affect the terminal voltage of a DC series generator at high load current?
6. What is the voltage at the terminals of a dc series generator running at rated rpm and no load will be?
7. What is the condition of a dc series generator to excite itself?
8. A dc series generator is provided with diverter and is delivering its rated current. If the diverter switch is opened then what is the terminal voltage?
9. When two series generators operating in parallel, what is the purpose of using equalizer bar?
10. A 230V dc series generator is driven at its rated speed. What is the no load voltage across its armature terminals would be?

RESULT:

EXP.NO: 04
DATE :

LOAD CHARACTERISTICS OF DC COMPOUND GENERATOR

AIM: To obtain internal and external characteristics of DC compound generator connecting as long shunt.

a.) Cumulative

b.) Differential

NAME PLATE DETAILS:

Term	D .C Shunt Motor	D.C Compound Generator
Power	5 H.P , 3.7KW	3KW
Voltage	220V	220V
Current	19A	19A
Speed	1500RPM	1500RPM
Field current	1A	1A

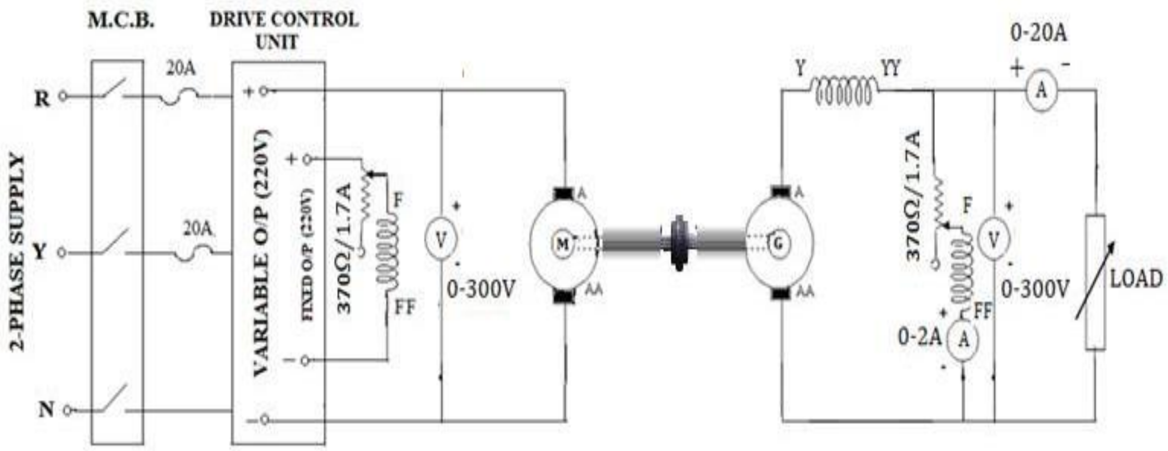
FUSE RATING:

Motor and Generator side:
125% of rated current of DC Motor
125*19/100=23.75≈ 25 A

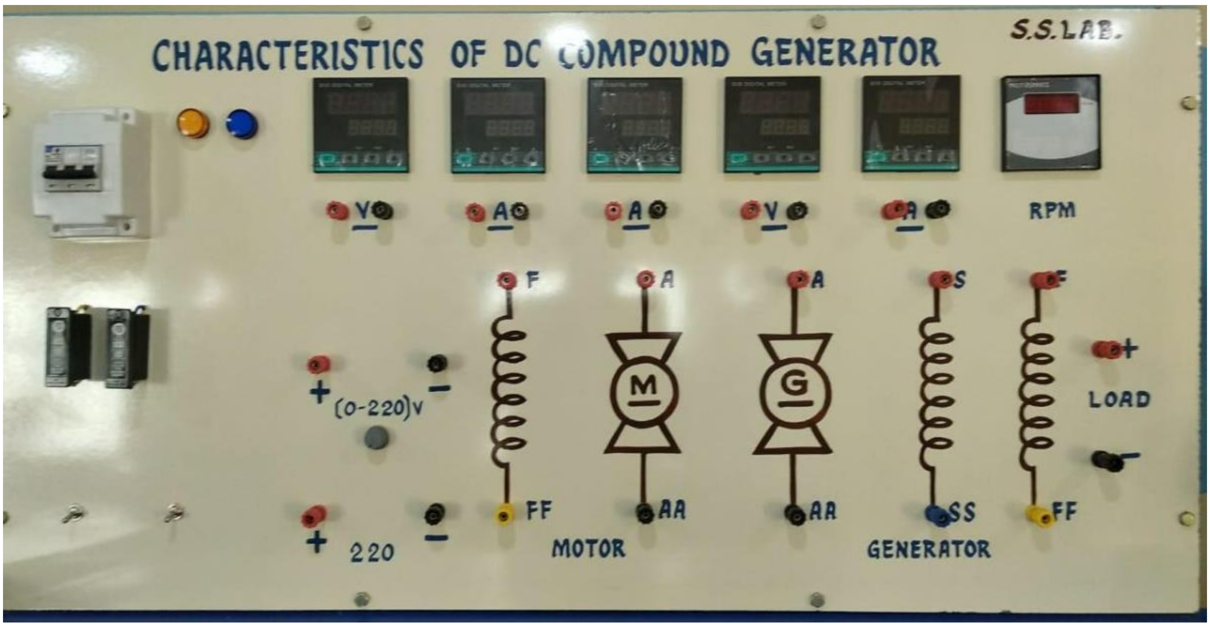
APPARATUS REQUIRED:

S.No:	Name of the Apparatus	Range	Type	Quantity	Availability
1	Ammeter	(0-2)A (0-20) A	Digital Digital	1 1	On Panel On Panel
2	Voltmeter	(0-300)V	Digital	1	On Panel
3	Rheostats	370Ω/1.7A	Wire Wound	2	External
4	Resistive load bank	20A	-	1	External
5	RPM meter	(0-9999)rpm	Digital	1	On Panel
6	Connecting Wires	-	-	As Required	External

TEST SETUP:



PANEL:



PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Before starting the motor, Ensure that the field rheostat and Pot meter of Drive Control Unit are in minimum position and the field rheostat of Generator should be in its maximum position. Similarly the load resistance connected to the Generator should be in its minimum position (No load).

3. Observing all the precautions, the motor is started using Drive Control Unit and the speed is increased until the rated armature voltage (of motor) is reached. At this instant the speed would be slightly lesser than the rated speed.
4. By adjusting the motor field rheostat, the motor is brought to rated speed.
5. Then the generator field rheostat is adjusted until the generator voltage reaches its rated value. The terminal voltage and the field current are noted in the tabular column.
6. Now the load on the generator is gradually increased in steps. At each step the speed of the generator is checked and maintained constant at its rated value by adjusting the field rheostat of the motor. After satisfying this condition of each loading, the terminal voltage (V_L), field current (I_F) and the load current (I_L) are noted down in the tabular column.
7. Then the generator is unloaded and the generator field rheostat is brought in to minimum resistance position and MCB is opened.

PRECAUTIONS:

1. The field rheostat of motor should be at minimum resistance position.
2. The field rheostat of generator should be at maximum resistance position
3. Load should not be connected to generator at the time of starting and stopping.

OBSERVATIONS:

CUMULATIVELY COMPOUND GENERATOR:

R_a= Ω R_{se}= Ω

(R_a & R_{se} are found by using DC multimeter)

Sl. No.	I_L Amps	I_f Amps	V_L Volts	$I_A=I_L+I_f$ Amps	$E_g=V_L+I_A(R_a+R_{se})$ Volts
1.					
2.					
3.					
4.					
5.					
6.					

DIFFERENTIALLY COMPOUND GENERATOR:

Sl. No.	I_L Amps	I_f Amps	V_L Volts	$I_A = I_L + I_f$ Amps	$E_g = V_L + I_A(R_a + R_{se})$ Volts
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					

VIVA QUESTIONS:

1. What are the types of DC Compound generators?
2. How can the compound Generator run as cumulative & differential mode?
3. How the different types of compounding can be done in DC Compound Generator.
4. What is the Voltage Regulation of Flat Compound Generator?
5. When compared to Series & differential compound Generators which is having better regulation?
6. Which Machine is having poorest voltage regulation?
7. What are the Applications of DC Cumulatively Compound Generator?
8. How will be the Resistance of Shunt Field winding? Why it is so?
9. How will be the Resistance of Series Field winding? Why it is so?
10. What are the factors Determining the Induced EMF in a Generator?

RESULT:

EXP.NO: 05
DATE :

HOPKINSON'S TEST ON DC SHUNT MACHINES

AIM: To conduct the Hopkinson's test on the given pair of DC machines and Predetermine the efficiency

NAME PLATE DETAILS:

Term	D .C Shunt Motor	D.C Shunt Generator
Power	5 H.P , 3.7KW	3KW
Voltage	220V	220V
Current	19A	19A
Speed	1500RPM	1500RPM
Field current	1A	1A

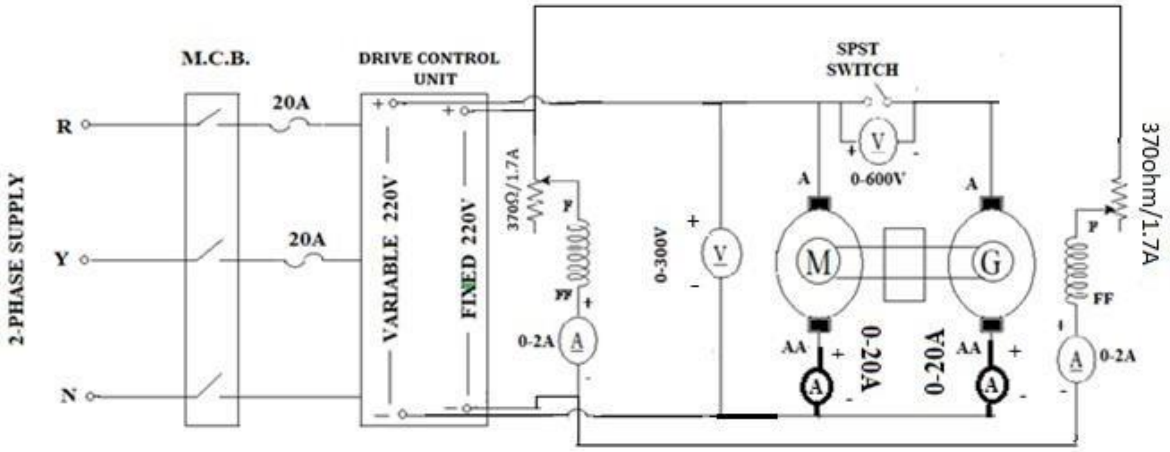
FUSE RATING:

Motor and Generator side:
125% of rated current of DC Motor
125*19/100=23.75≈ 25 A

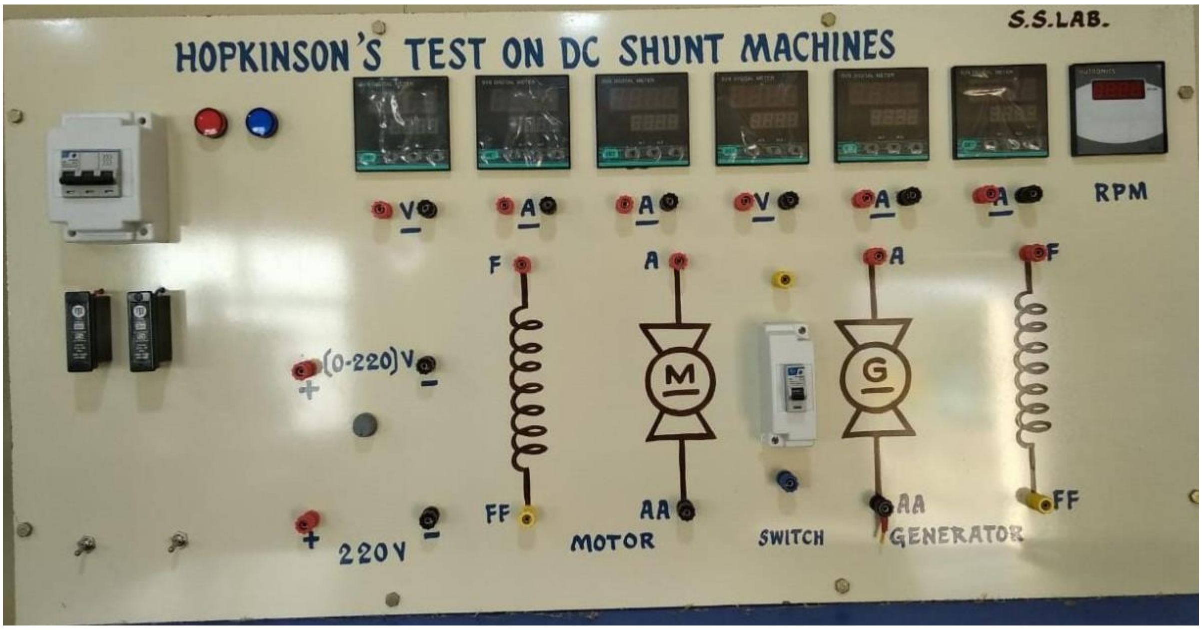
APPARATUS REQUIRED:

S.No:	Name of the Apparatus	Range	Type	Quantity	Availability
1	Ammeter	(0-2)A (0-20) A	Digital Digital	2 1	On Panel On Panel
2	Voltmeter	(0-300)V (0-600)V	Digital Digital	1 1	On Panel On Panel
3	Rheostats	370Ω/1.7A	Wire Wound	2	External
4	Resistive load bank	20A	-	1	External
5	RPM meter	(0-9999)rpm	Digital	1	On Panel
6	Connecting Wires	-	-	As Required	External

TEST SETUP:



PANEL:



PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Before starting the motor, Ensure that the field rheostat of motor and Pot meter of Drive Control Unit are in minimum position and the SPST switch is kept in open condition.
3. Observing all the precautions, the motor is started using Drive Control Unit and the speed is increased until the rated armature voltage (of motor) is reached. At this instant the speed would be slightly lesser than the rated speed.

4. By adjusting the motor field rheostat, the motor is brought to rated speed.
5. Then the generator field rheostat is adjusted until the volt meter connected across the SPST switch is zero.
6. The SPST switch is closed and all meter readings are noted
7. After the experiment is completed the various rheostats are brought back to their original position in sequence and then main supply is switched off.

PRECAUTIONS:

1. The field rheostat of the motor must be kept in minimum resistance position.
2. The field rheostat of the generator must be kept in maximum resistance position.
3. The SPST switch is kept open while starting the experiment and it is closed only when the voltmeter connected across the motor and generator shows zero reading.

FORMULAE & NOMENCLATURE:

Let I_a=Supply current to both the armatures from Drive Control Unit.

Then $I_{am} = I_a + I_{ag}$

where I_{am} & I_{ag} are motor and generator armature currents respectively.

Total input power to armature circuit = VI_a = Total Stray losses + Total copper losses (since net output from M-G set is zero)

Generator armature copper loss = $I_{ag}^2 R_{ag}$

Motor armature copper loss = $I_{am}^2 R_{am}$

Generator field copper loss = $I_{fg}^2 R_{fg}$

Motor field copper loss = $I_{fm}^2 R_{fm}$

Total Stray losses = Total input power - Total copper losses

$= VI_a - I_{ag}^2 R_{ag} - I_{am}^2 R_{am}$

Stray loss of each Machine = $\frac{\text{Total Stray losses}}{2}$

Total motor losses = P_{LM} = Stray losses of motor + $I_{fm}^2 R_{fm} + I_{am}^2 R_{am}$

Total generator losses = P_{LG} = Stray losses of generator + $I_{fg}^2 R_{fg} + I_{ag}^2 R_{ag}$

Motor input = $P_{in, M} = V I_{am} + I_{fm}^2 R_{fm}$

Generator output = $P_{out, G} = V I_{ag}$

Motor efficiency = $(P_{in, M} - P_{LM}) / P_{in, M}$

Generator efficiency = $(P_{out, G}) / (P_{out, G} + P_{LG})$

OBSERVATIONS:

Motor			Generator			Armature Cu Loss of Gen.	Armature Cu Loss of Motor	Shunt Cu loss of generator	Shunt Cu loss of motor	Efficiency of generator			Efficiency of motor		
V Vol	I_{am} Amps	I_{fm} Amps	V Volts	I_{ag} Amps	I_{fg} Amps	$I_{ag}^2 R_{ag}$	$I_{am}^2 R_{am}$	$I_{fg}^2 R_{fg}$ Watts	$I_{fm}^2 R_{fm}$ Watts	I/P	O/P	%η	I/P	O/P	%η

VIVA QUESTIONS:

1. What is the purpose of Hopkinson's test?
2. What are the advantages of Hopkinson's test?
3. What are the conditions for conducting the test?
4. How the power taken from the mains has to supply (is utilized) in this test?
5. Why the adjustments are done in the field rheostat of generator and motor?
6. If the voltmeter across the SPST switch reads zero, what does it indicate?
7. What is the draw back in this test?
8. Two DC **S**hunt machines 200KW each are tested by Hopkinson's. what is the power input in the order of.
9. What are the parameters obtain in the Hopkinson's test?

RESULT:

EXP.NO: 06
DATE :

SWINBURNE'S TEST AND SPEED CONTROL OF DC SHUNT MOTOR

AIM:

(a) To predetermine the efficiency of a DC shunt machine by conducting the Swinburne's Test
(b) To control the speed of DC shunt motor under loaded condition.

i. Field resistance control.
ii. Armature resistance control.

NAME PLATE DETAILS:

Term	D .C Shunt Motor
Power	5 H.P , 3.7KW
Voltage	220V
Current	20A
Speed	1500RPM
Field current	1A

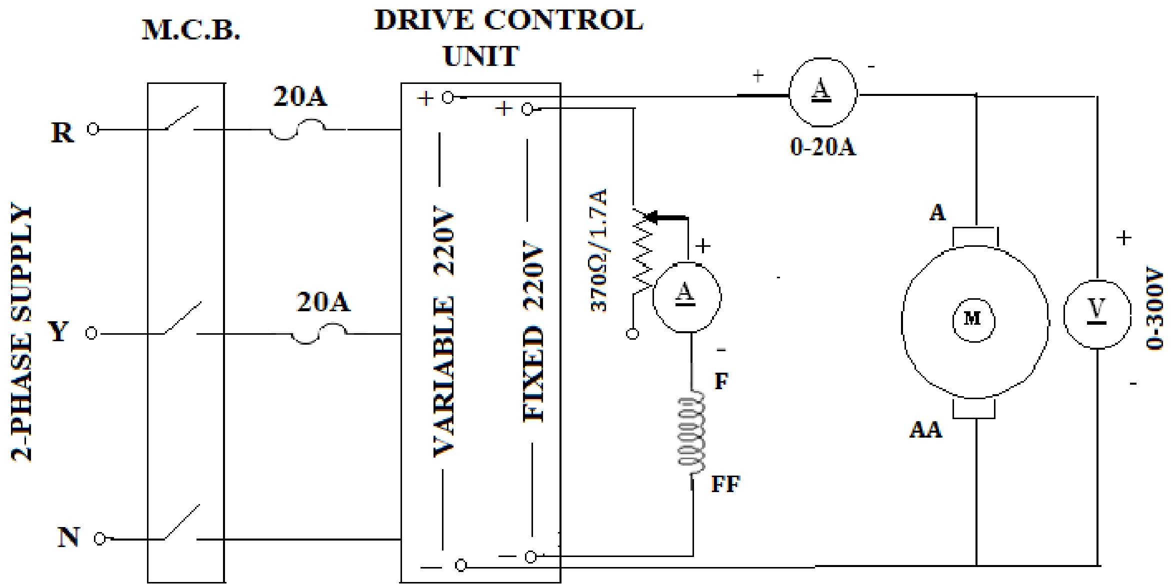
FUSE RATING:

Motor and Generator side:
125% of rated current of DC Motor
125*20/100= 25 A

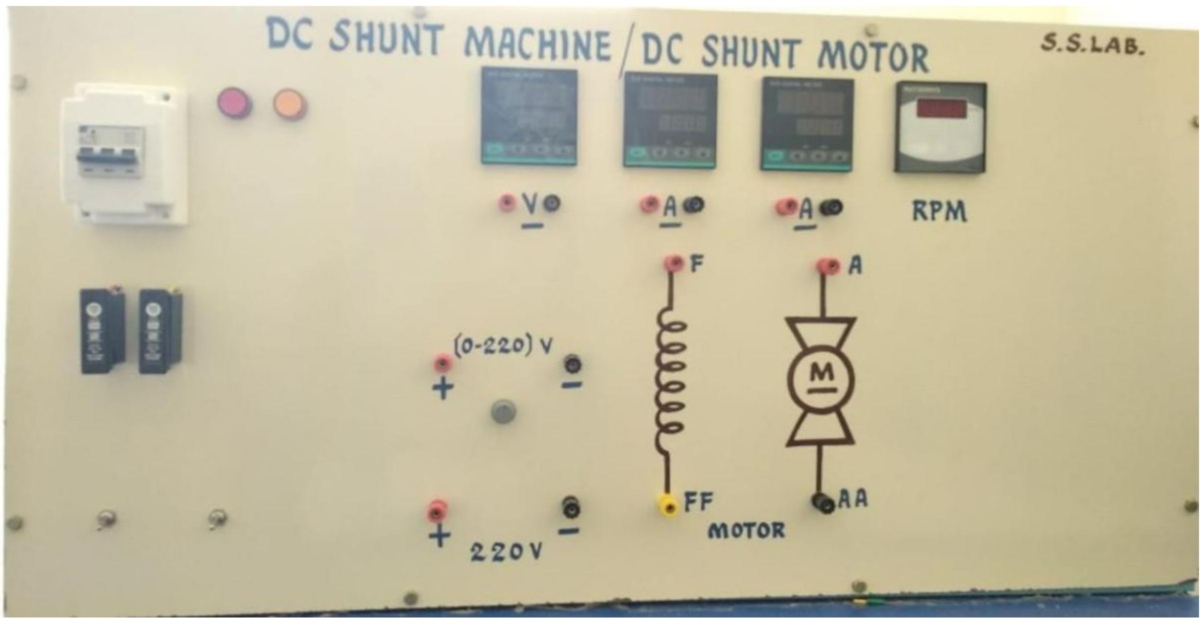
APPARATUS REQUIRED:

S.No:	Name of the Apparatus	Range	Type	Quantity	Availability
1	Ammeter	(0-2)A (0-20) A	Digital Digital	1 1	On Panel On Panel
2	Voltmeter	(0-300)V	Digital	1	On Panel
3	Rheostat	370Ω/1.7A	Wire Wound	1	External
4	RPM meter	(0-9999)rpm	Digital	1	On Panel
5	Connecting Wires	-	-	As Required	External

TEST SETUP:



PANEL:



PROCEDURE:

(a) Swinburne's Test

1. Connections are made as per the circuit diagram.
2. Before starting the motor, Ensure that the field rheostat and Pot meter of Drive Control Unit are in minimum position.

3. Observing all the precautions, the motor is started using Drive Control Unit and the speed is increased until the rated armature voltage (of motor) is reached. At this instant the speed would be slightly lesser than the rated speed.
4. The motor field rheostat is then adjusted until the motor runs at rated speed.
5. Then all the meters readings are tabulated. From this data no load losses are calculated and effieciency is estimated at various loads as explained below.
6. Then the field rheostat is brought to minimum resistance position and MCB is opened.

PRECAUTIONS:

1. Field Rheostat should be kept in the minimum resistance position at the time of starting and stopping the motor.

OBSERVATIONS:

SWINBURNE'S TEST:

V_S Volts	I_a Amps	I_f Amps	Speed (N) RPM

FORMULAE & NOMENCLATURE:

Calculation of constant losses in Swinburne's test :

Input to the motor on no load = $V_S I_a + I_f^2 R_f$

Variable losses = Armature Cu loss = $I_a^2 R_a$

Total losses on no load= *Input – output*

But output=0

So, total loss on no load=Input at no load

Then, Constant Losses = P_{CL} = I/P-Armature copper loss at no load

$$P_{CL} = V_S I_a + I_f^2 R_f - I_a^2 R_a$$

(Constant loss includes iron loss, mechanical loss and field cu loss)

Predetermination of the performance of the machine when it works as a generator

Let load current on generator = I_L

Let Vg be the rated terminal voltage of the generator

Then Output power = Vg*I_L Watts

Then, $I_A = I_L + I_f$ Amps

Armature cu loss= $I_A^2 R_A$ Watts

Total loss = Constant losses (P_{CL})+ Armature cu loss Watts

I/P = Output + Total losses watts

$$\%\eta = \frac{O/P}{I/P} * 100$$

Predetermination of the performance of the machine when it works as a motor

Let I_A = Armature current

I_F = Rated Field current

Then Supply current (I_S) = $I_A + I_F$

Let V_M be the rated terminal voltage of the motor

Input = $V_S * I_S$

and

Looses = Constant losses + Armature cu losses = $P_{CL} + I_A^2 R_A$

Output = Input – Losses = $V_S * I_S - (P_{CL} + I_A^2 R_A)$

$$\%\eta = \frac{O/P}{I/P} * 100$$

$$= [\{ V_S * I_S - (P_{CL} + I_A^2 R_A) \} / (V_S * I_S)] * 100$$

PREDETERMINATION OF LOSSES AND EFFICEINCY AT DIFFERENT LOADS:

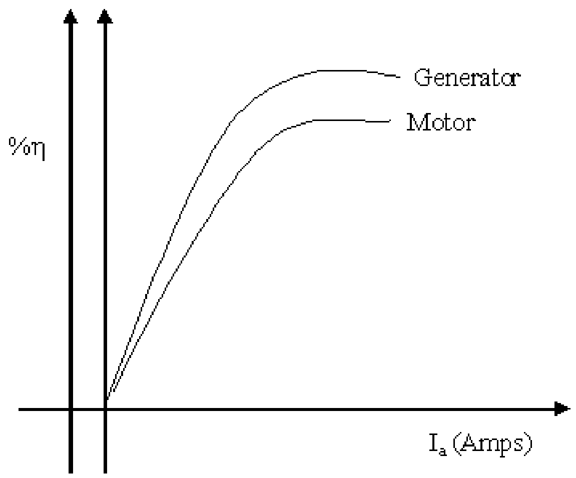
As a Motor:

Sl.No	Rated Supply Voltage V_S (Volts)	Armature Current I_A (Amps)	Field Current I_F (Amps)	Supply Current $I_S = I_A + I_F$ (Amps)	Arm. Copper losses $I_A^2 R_A$ (Watts)	Total losses ($P_{CL} + I_A^2 R_A$) (Watts)	Input Power $V_S I_S$ (Watts)	Output Power I/P - losses (Watts)	Efficiency η %
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									

As a Generator:

Sl.No	Rated Terminal Voltage V_g (Volts)	Load Current I_L (Amps)	Field Current I_F (Amps)	Arm. Current $I_A = I_L + I_F$ (Amps)	Arm. Copper losses $I_A^2 R_A$ (Watts)	Total losses $(P_{CL} + I_A^2 R_A)$ (Watts)	output Power $V_g I_L$ (Watts)	Input Power O/P + losses (Watts)	Efficiency η %
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									

MODEL GRAPH:



(b) Speed Control

i. Armature Voltage Control

1. Connections are made as per the circuit diagram.
2. Before starting the motor, Ensure that the field rheostat and Pot meter of Drive Control Unit are in minimum position.
3. Observing all the precautions and the motor is started using drive control unit and the speed is increased until the rated armature voltage is reached
4. The motor field rheostat is then adjusted until the motor runs at rated speed
5. The motor is now ready to work at rated armature voltage and rated speed.
6. Now to get variable speeds by AVC method, the field current (I_f) is kept constant value and the potentiometer of drive control unit is adjusted to get various below base speeds.
7. Note down the corresponding armature voltages and motor speeds.
8. This procedure is repeated for different values of field current.

ii. Field Control

1. The pot meter of Drive Control Unit is adjusted to maintain constant rated armature voltage.
2. Now the field rheostat is varied in steps so as to decrease the field current. Corresponding motor speeds and field currents are noted.
3. This procedure is repeated for reduced armature voltage (Lesser than the rated armature voltage).
4. After the experiment is completed the various rheostats are brought back to their original position in sequence and then main supply is switched off.

OBSERVATIONS:

ARMATURE VOLTAGE CONTROL:

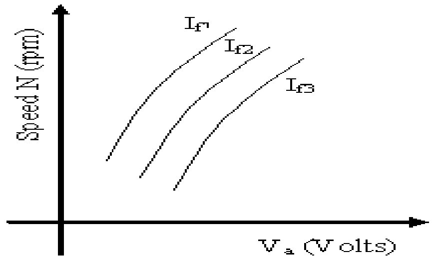
Sl. No:	I_{f1} =		I_{f2} =	
	Armature Voltage V_a (Volts)	Speed N (rpm)	Armature Voltage V_a (Volts)	Speed N (rpm)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

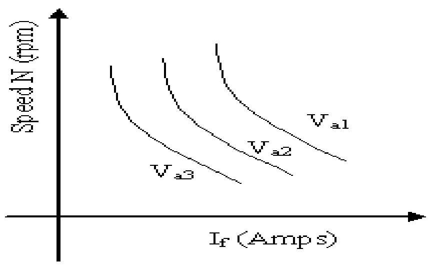
FIELD CONTROL:

Sl. No:	V_{a1} =		V_{a2} =	
	Field Current I_f (A)	Speed N (rpm)	Field Current I_f (A)	Speed N (rpm)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

MODEL GRAPHS:

i) Armature Voltage Control
ii) Field Control





VIVA QUESTIONS:

1. What is the purpose of Swinburne's test?
2. What are the losses that constitute constant losses in a DC machine?
3. What are the assumptions made in Swinburne's test?
4. In this test the shunt machine has to run as a------------?
5. The efficiency of DC machine is generally higher when it works as a generator than works as a motor. Is this statement true or false? Justify your answer with proper reasons.
6. What are Factors determining the Speed of a Dc Motor?
7. How the speed control can be achieved by above rated speed control method?
8. What is the minimum speed limit of given machine
9. How the speed control can be achieved by below rated speed control method?
10. In Swinburne method for the determination of a efficiency of a dc machine
    a, the no load losses are measured and copper losses are calculated
    b, the no load losses are calculated and copper losses are measured.

RESULT:

EXP.NO: 07
DATE :

BRAKE TEST ON DC COMPOUND MOTOR

AIM: To obtain performance characteristics of DC compound motor as

1. Cumulative compound motor
2. Differential compound motor

NAME PLATE DETAILS:

Term	D .C Compound Motor
Power	3 H.P , 2.2KW
Voltage	220V
Current	12A
Speed	1500RPM
Field current	1A

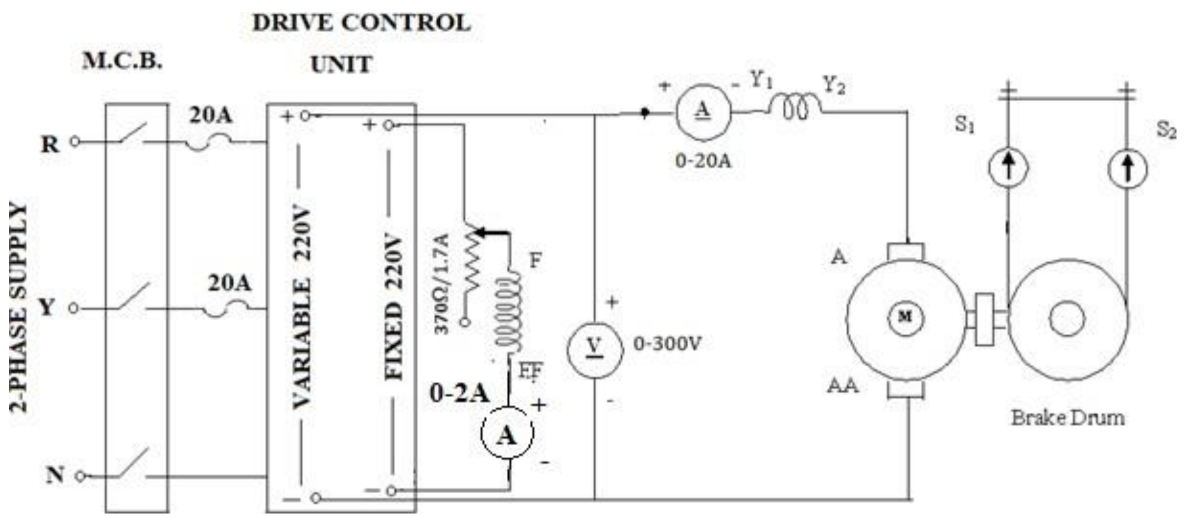
FUSE RATING:

125% of rated current=125*12/100=15 A

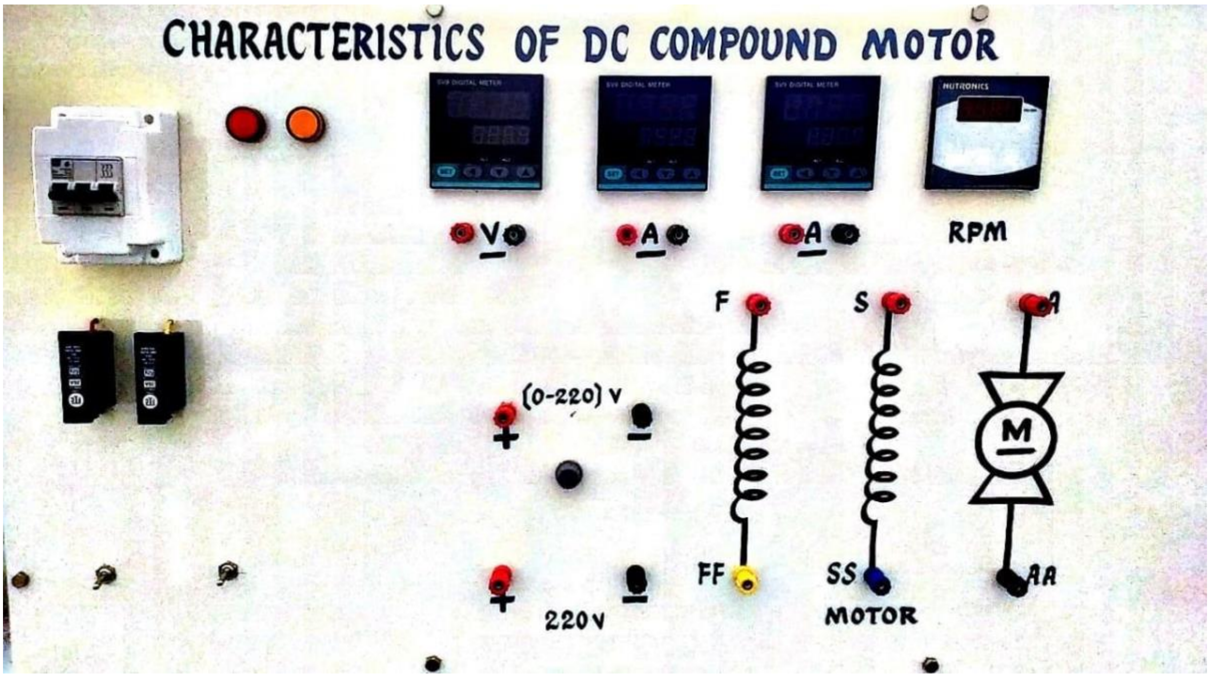
APPARATUS REQUIRED:

S. No	Name of the Apparatus	Range	Type	Quantity	**Availability**
1	Ammeter	(0-2)A (0-20) A	Digital Digital	1 1	On Panel On Panel
2	Voltmeter	(0-300)V	Digital	1	On Panel
3	Rheostat	370Ω/1.7A	Wire Wound	1	External
4	Tachometer	(0-9999)rpm	Digital	1	On Panel
5	Connecting Wires	-	-	As Required	External

TEST SETUP:



PANEL:



PROCEDURE:

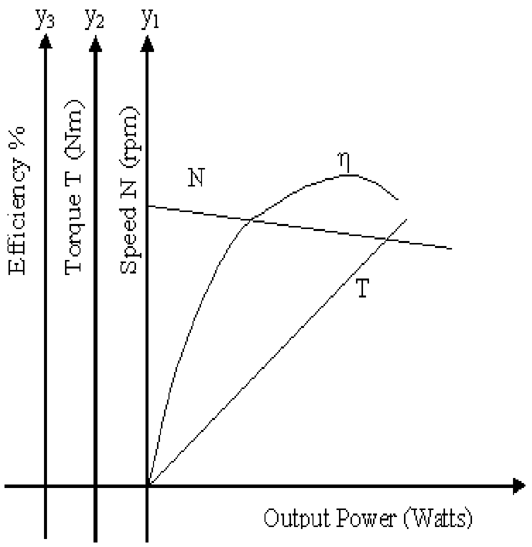
1. Connections are made as per the circuit diagram.(To obtain differential compounding the connections of Y1 and Y2 terminals are interchanged)
2. Before starting the motor, Ensure that the field rheostat and Pot meter of Drive Control Unit are in minimum position. Similarly mechanical loading is also kept in minimum condition.
3. Observing all the precautions, the motor is started using Drive Control Unit and the speed is increased until the rated armature voltage (of motor) is reached. At this instant the speed would be slightly lesser than the rated speed

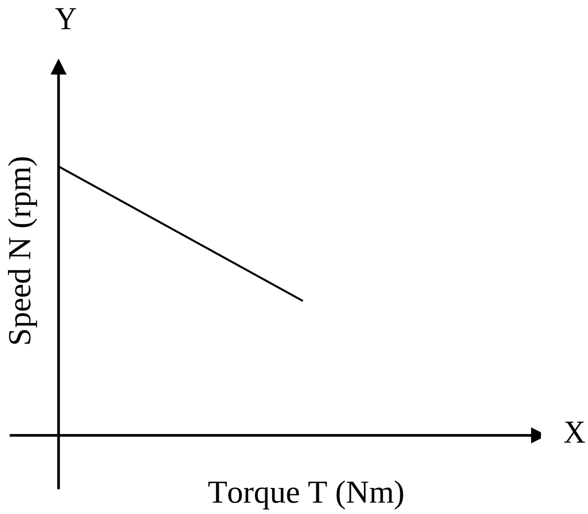
4. By adjusting the motor field rheostat, the motor is brought to rated speed.
5. The no load readings are tabulated.
6. The load is applied with the help of Mechanical Loading arrangement with Load cell, gradually in small steps and at each step, the readings of ammeter, voltmeter and load cells are taken.
7. The motor is then brought to no load condition and field rheostat to minimum position, then MCB is opened.

PRECAUTIONS:

1. The field rheostat of motor should be at minimum resistance position.
2. There should not be any load on the motor (brake drum) while starting and stopping.

MODEL GRAPHS:





FORMULAE:

Torque= T = S*9.81*r N-m

Where S is the differential force i.e. difference between the two load cells (Kgf)

Input = $V_S*I_A + I_{SH}^2R_{SH}$ Watts

$$O/P = \frac{2\pi NT}{60} \text{ Watts}$$

$$\%\eta = \frac{O/P}{I/P}*100$$

OBSERVATIONS:

DIFFERENTIALLY COMPOUND:

S.NO.	V_S (Volts)	I_A (Amps)	I_{SH} (Amps)	N (rpm)	S KG	I/P (Watts)	T (N-m)	O/P (Watts)	% EFFIECIENCY
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

CUMULATIVE COMPOUND:

S.NO.	V_S (Volts)	I_A (Amps)	I_{SH} (Amps)	N (rpm)	S KG	I/P (Watts)	T (N-m)	O/P (Watts)	% EFFIECIENCY
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

VIVA QUESTIONS:

1. What are types of Dc compound motor?
2. How can the same compound motor run as cumulative & differential compound mode?
3. Why speed Decreases as load increases in Cumulative compound motor?
4. Why Speed Increases as load Increases in Differential compound motor?
5. What are the applications of DC Cumulative compound Motors?
6. What is the necessity of Starter?
7. In what way 4.point is different from 3.point starter?
8. What is back emf? What is its significance?
9. What are the best suitable applications of cumulative compound motor?
10. A DC cumulative compound motor delivers rated load torque at rated speed. If the series field is shorted circuited, then what will be the armature current and speed?

RESULT:

EXP.NO: 08
DATE :

BRAKE TEST ON DC SHUNT MOTOR

AIM: To obtain performance characteristics of DC Shunt motor.

NAME PLATE DETAILS:

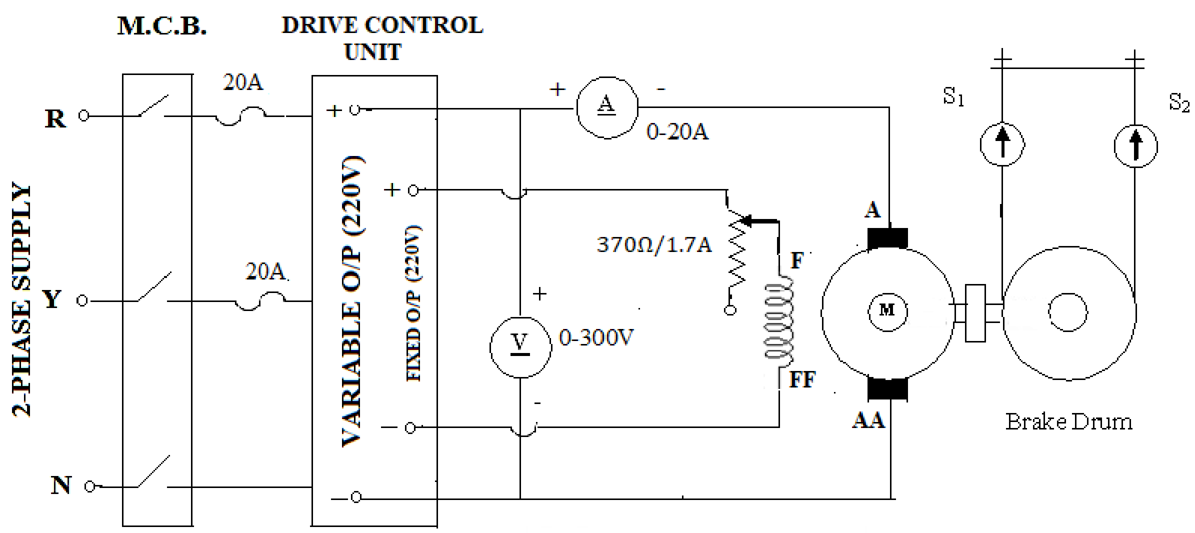
Term	D .C Shunt Motor
Power	5 H.P , 3.7KW
Voltage	220V
Current	20A
Speed	1500RPM
Field current	1A

FUSE RATING:
125% of rated current=125* 20/100=25 A

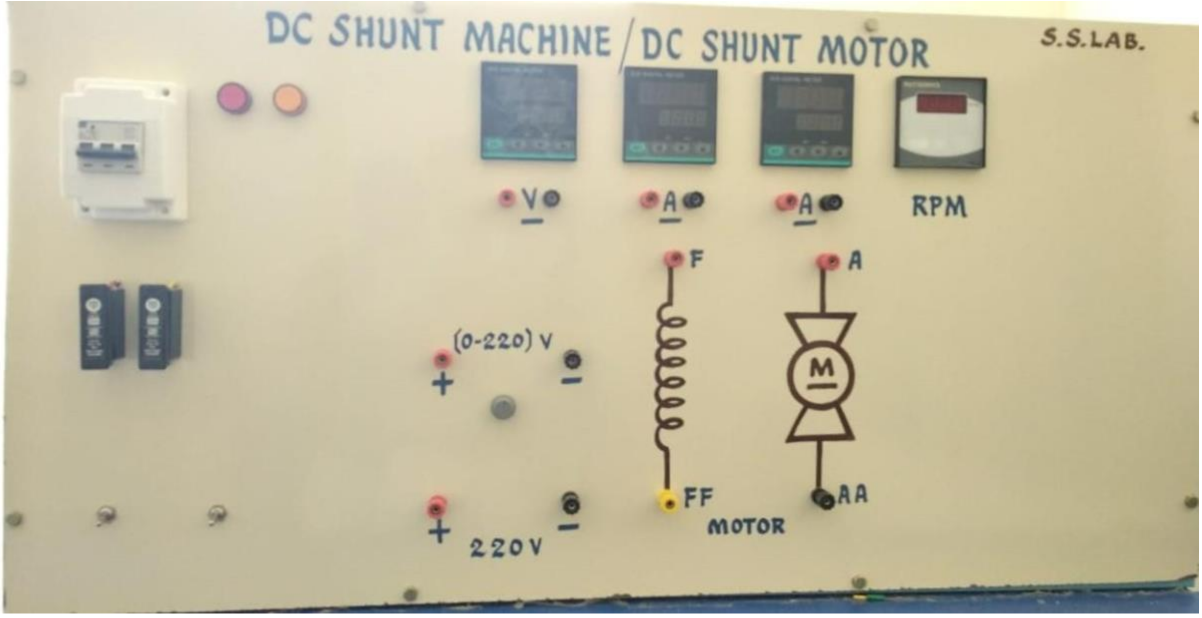
APPARATUS REQUIRED:

S.No:	Name of the Apparatus	Range	Type	Quantity	Availability
1	Ammeter	(0-20)A	Digital	1	On Panel
2	Voltmeter	(0-300)V	Digital	1	On Panel
3	Rheostat	370Ω/1.7A	Wire Wound	1	External
4	RPM meter	(0-9999) rpm	Digital	1	On Panel
5	Connecting Wires	-	-	As Required	External

TEST SETUP:



PANEL:



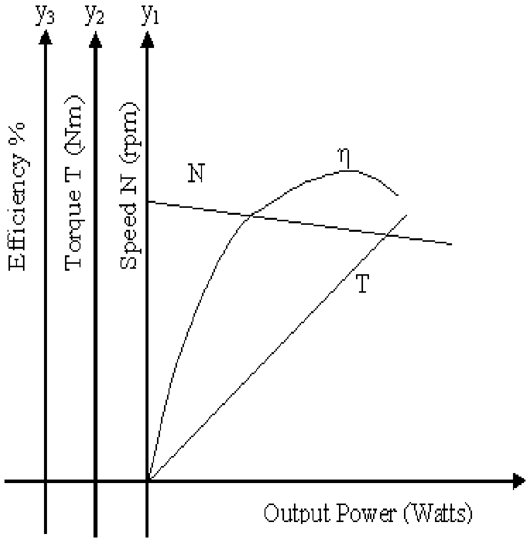
PROCEDURE:

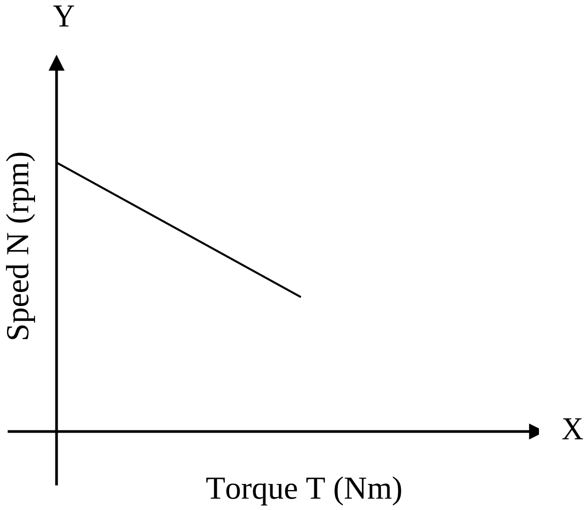
1. Connections are made as per the circuit diagram
2. Before starting the motor, Ensure that the field rheostat and Pot meter of Drive Control Unit are in minimum position.
3. Observing all the precautions, the motor is started using Drive Control Unit and the speed is increased until the rated armature voltage (of motor) is reached. At this instant the speed would be slightly lesser than the rated speed.
4. By adjusting the motor field rheostat, the motor is brought to rated speed.
5. The no load readings are tabulated.
6. The load is applied with the help of Mechanical Loading arrangement with Load cells, gradually in small steps and each step, take the reading of ammeters, voltmeter and load cells.
7. The motor is then brought to no load condition and field rheostat to minimum position and MCB is opened.

PRECAUTIONS:

1. The field rheostat of motor should be at minimum resistance position.
2. There should not be any load on the motor (brake drum) while starting and stopping.

MODEL GRAPHS:





FORMULAE:

Torque= $T = S*9.81*r$ N-m

Input = $V_S*I_A + I_{SH}^2R_{SH}$ Watts

$$O/P = \frac{2\pi NT}{60} \text{ Watts}$$

$$\%\eta = \frac{O/P}{I/P}*100$$

OBSERVATIONS:

D = 2πr =

S.NO.	V_S (Volts)	I_A (Amps)	I_{SH} (Amps)	N (rpm)	S (KG)	I/P (Watts)	T (N-m)	O/P (Watts)	% EFFIECIENCY
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

VIVA QUESTIONS:

1. Why should the field rheostat be kept in the position of minimum resistance?
2. What is the loading arrangement used in a dc motor?
3. How can the direction of rotation of a DC shunt motor be reversed?
4. What are the mechanical and electrical characteristics of a DC shunt motor?
5. What are the applications of a DC shunt motor?
6. Why the DC Motor is said to be constant speed Motor?
7. What is the speed of the shunt motor from no load the full load?
8. In what way the speed of a dc shunt motor can be increased above its normal speed?
9. What is the method for the determination of the efficiency of a dc machine in brake test?

RESULT:

EXP.NO: 09
DATE :

SEPARATION OF LOSSES IN DC SHUNT MOTOR

AIM: To separate the no load losses in a DC Machine as iron losses and mechanical losses.

NAME PLATE DETAILS:

Term	D .C Shunt Motor
Power	5 H.P , 3.7KW
Voltage	220V
Current	19A
Speed	1500RPM
Field current	1A

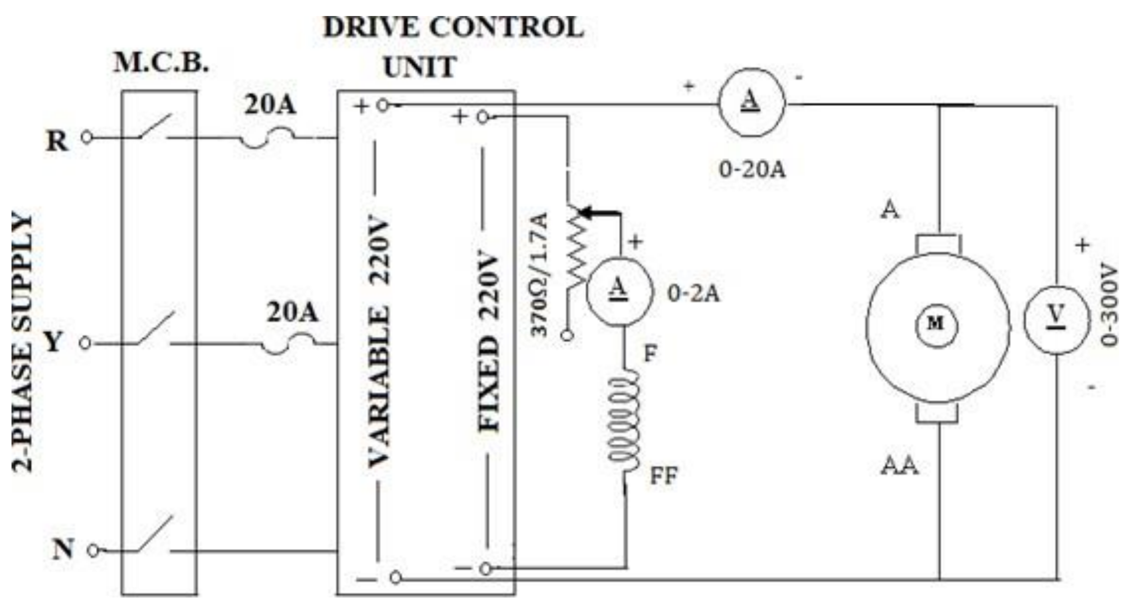
FUSE RATING:

125% of rated current=125* 19/100=23.75A≈25 A

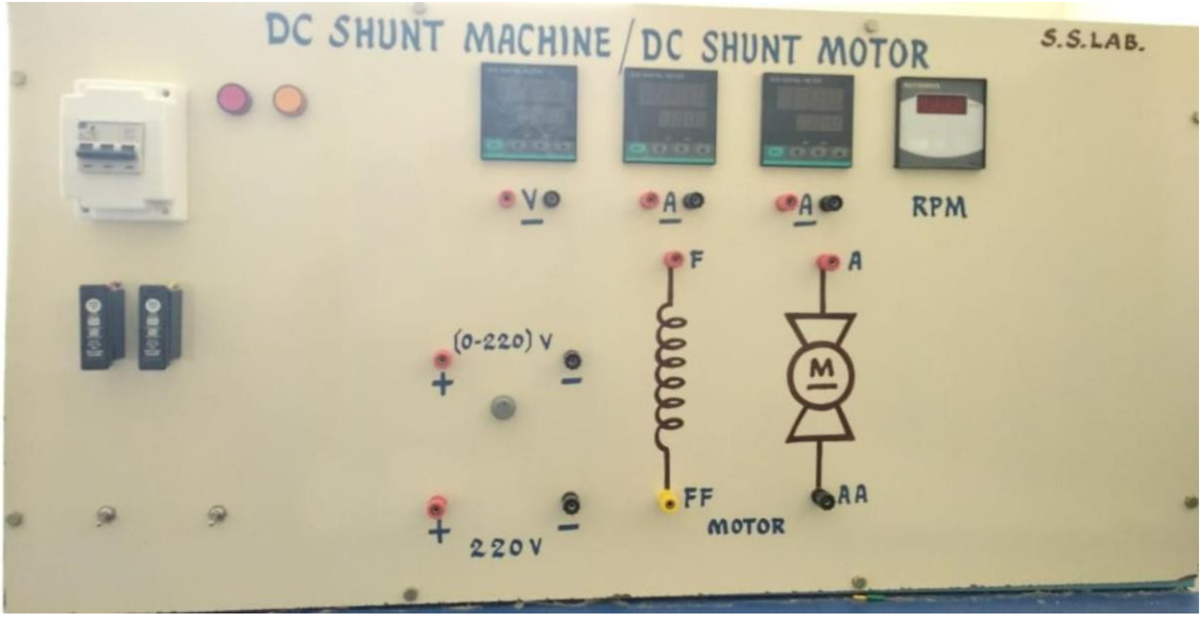
APPARATUS REQUIRED:

SL.NO	APPARATUS	RANGE	TYPE	QTY	Availability
1.	Voltmeter	0 – 300 V	Digital	1	On Panel
2	Ammeter	0 – 20 A	Digital	1	On Panel
3.	Ammeter	0 – 2 A	Digital	1	On Panel
4.	Rheostat	370Ω/1.7A	WW	2	External
5.	RPM meter	(0-9999)rpm	Digital	1	On Panel
6.	Connecting Wires	-	-	As Required	External

TEST SETUP:



PANEL:



PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Before starting the motor, Ensure that the field rheostat and Pot meter of Drive Control Unit are in minimum position.
3. Observing all the precautions, the motor is started using Drive Control Unit and the speed is increased until the rated armature voltage (of motor) is reached. At this instant the speed would be slightly lesser than the rated speed.
4. The field rheostat is adjusted to obtain the rated speed.
5. The readings of the voltmeter and ammeter are noted.
6. Armature voltage is gradually reduced by adjusting the Pot meter of Drive Control Unit. The readings of the voltmeter and the ammeter are noted in the tabular column.
7. Repeat the above procedure at some other field current.
8. After the experiment is completed the various rheostats are brought back to their original position in sequence and then the main supply is switched off.

PRECAUTIONS:

1. Field Rheostat should be kept in the minimum resistance position at the time of starting and stopping the motor.
2. Armature Rheostat should be kept in the maximum resistance position at the time of starting and stopping the motor.
3. There should not be any load on the motor (brake drum)

OBSERVATIONS:

FIELD CURRENT I_{SH} =

V_S (Volts)				
I_A (Amps)				
N (rpm)				
W				
W/N				

REDUCED FIELD CURRENT I^1_{SH} =

V_S (Volts)				
I_A (Amps)				
N (rpm)				
W				
W/N				

CALCULATION OF LOSSES:.

Friction losses = AN Watts
Windage losses = BN^2 Watts
Hysteresis losses = CN Watts
Eddy current losses = DN^2 Watts; Where N = speed.
For a motor on no load, power input to the armature is the sum of the armature copper losses and the above losses.

Power input to the motor = VI_A watts
Armature copper losses = $Ia^2.Ra$ watts
Input = Output + Total Losses.
Since Output = 0, Total Losses = Input.
Hence Constnat losses = Input – Armature copper losses
$VI_A – I_A^2.Ra = (A + C)N + (B + D)N^2 = W$
W/N = (A+C) + (B+D)N.

A+C=OP=
U1=B+D=

W/N =$(A+C^I) +(B+D^I)$

$OR=A+C^{I}=$
$U_2= B+D^{I}=$

$OP-OR=C-C^{I}=$

$U_I - U_2 = D-D^{I} =$

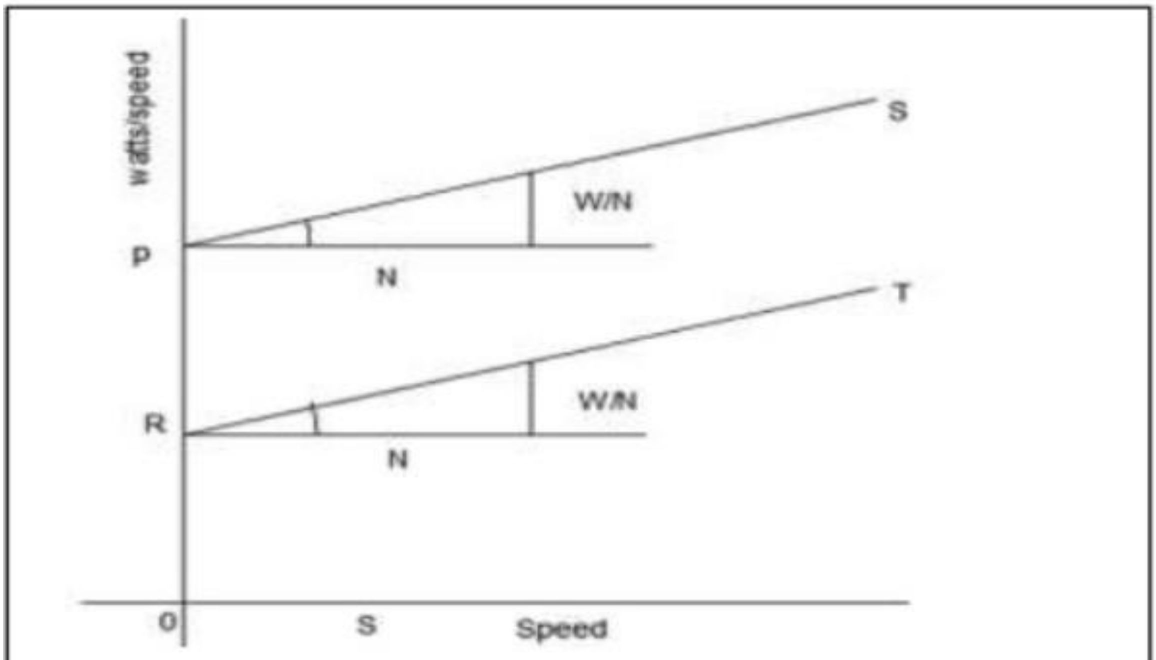
$C/C^{I}= (E_{b1}/E_{b2})^{1.6} =$ $D/D^{I}=$

$C^{I}=$ $D^{I}=$
$C=$ $D=$
$A=$ $B=$

$W_f =$
$W_w=$
$W_u =$
$W_h = W_e=W_i=W_e+W_h=$
$Ws = W_U+W_i=$

FORMULAE & NOMENCLATURE:

MODEL GRAPH:



VIVA QUESTIONS:

1. What are the losses in a DC machine?
2. What are the constant losses and variable losses?
3. Why and how the core loss and ohmic losses occurs in dc machine?
4. Why is the field copper loss negligible at no load?
5. What is the need of separation of losses?
6. Why does the armature resistance increase when the motor is running?
7. How can the mechanical losses be reduced?
8. How can the core losses be minimized?
9. What is the effect of losses on the efficiency of the machine?
10. What are the mechanical losses in dc machine?

RESULT:

EXP.NO: 10
DATE :

FIELD TEST ON TWO IDENTICAL SERIES MACHINES

AIM: To determine the efficiency of two mechanically coupled series machines by conducting field test.

NAME PLATE DETAILS:

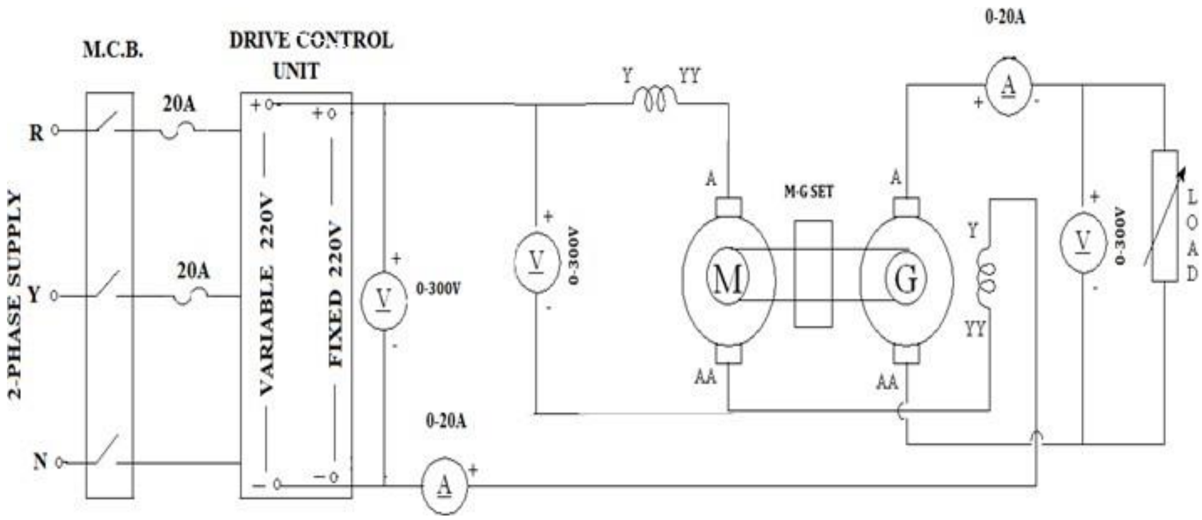
Term	D.C Series Motor	D.C Series Generator
Power	3KW	3KW
Voltage	220V	220V
Current	19A	19A
Speed	1500RPM	1500RPM
Field current	-	-

FUSE RATING:
Fuse rating = 125 % of rated current
= 125/100 * 19 = 23.75 A ≈ 25 A

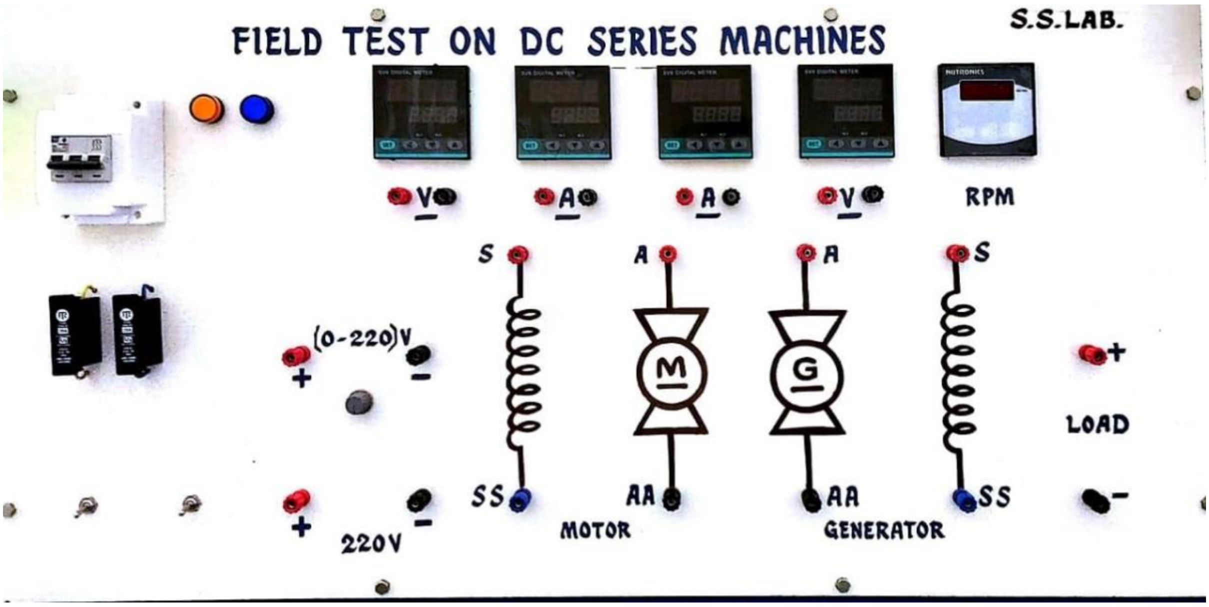
APPARATUS REQUIRED:

SL.NO	APPARATUS	RANGE	TYPE	QTY	Availability
1	Voltmeter	0 – 300 V	Digital	2	On Panel
2	Ammeter	0 – 20 A	Digital	2	On Panel
3	RPM meter	--	Digital	1	On Panel
4	Resistive load Bank	20A	-	1	External
5	Connecting Wires	-	-	As Required	External

TEST SETUP:



PANEL:



PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Before starting the motor, Ensure that the Pot meter of Drive Control Unit is in minimum position.
3. Observing all the precautions, the motor is started using Drive Control Unit and the speed is increased until the rated armature voltage (of motor) is reached. At this instant the speed would be slightly lesser than the rated speed.
4. One machine runs normally as a Motor and other acting as generator whose output is wasted in a variable load R.
5. Then the load on the generator is adjusted until the motor current reaches its rated value, note the Ammeter and voltmeter readings and calculate efficiency.

PRECAUTIONS:

1. Ensure that the motor field and generator field are connected in series.
2. There should be a load on the generator, while starting and stopping.

OBSERVATIONS:

MOTOR (Ra= Ω Rse= Ω) GENERATOR (Ra= Ω Rse= Ω)

Sl. No.	Input to Motor V_1Volts	Motor current I_1Amps	Generator Voltage V_2Volts	Generator current I_2Amps
1				

FORMULAE & NOMENCLATURE:

Let,

'V_1'= Supply voltage

I_1= Motor current.

V_2= Terminal potential difference of Generator.

I_2= Load Current.

Input of whole set=$V_1 I_1$=

Output = $V_2 I_2$=

Total losses in the set (w_t) = ($V_1 I_1$ - $V_2 I_2$) =

Armature & Field copper losses (w_{cu}) = (R_a + 2 R_{se}) I_1^2 + $I_2^2 R_a$ =

Stray Losses in Two Machines = (w_t - w_{cu}) =

Stray Losses for each Machine =

Motor Efficiency:

Motor Input = $V_1 I_1$=

Motor Losses = I_1^2 (R_a + Rse) +C/2=

% Motor Efficiency = { [$V_1 I_1$ - (I_1^2 (R_a + R_{se}) + C/2)] / $V_1 I_1$ } * 100=

Generator Efficiency:

Generator output = $V_2 I_2$=

Generator Losses = $I_1^2 R_{se}$ + $I_2^2 R_a$ + C/2 =

% Generator Efficiency = {$V_2 I_2$ / [$V_2 I_2$ + ($I_1^2 R_{se}$+ $I_2^2 R_a$ + C/2)] } * 100 =

VIVA QUESTIONS:

1. Field Test is conducted for ……. Machine in order to determine the efficiency
2. What are the Advantages &disadvantages of Field Test.?
3. How the machines are loaded in Field's test?
4. What will happen if the field of one machine get shorted?
5. Can the Series Motor be run under no-load? Justify the answer?
6. How the Series Motor can Develop High Starting Torque?
7. What are the Applications of DC Series Motors?
8. What type of Starter is used to start a dc series motor?
9. Will the Generator action takes place in DC Motor?
10. In field test in two series machines
    a. armature voltage of generator is more than the armature voltage of motor
    b. generator field current is more than motor field current
    c. generator field current is equals to motor field current
    Choose the correct and give the reason

RESULT:

EXP.NO: 11
DATE :

RETARDATION TEST ON DC SHUNT MOTOR

AIM: To find the stray losses or rotational losses by running down test or retardation test.

NAME PLATE DETAILS:

Term	D .C Shunt Motor
Power	5 H.P , 3.7KW
Voltage	220V
Current	19A
Speed	1500RPM
Field current	1A

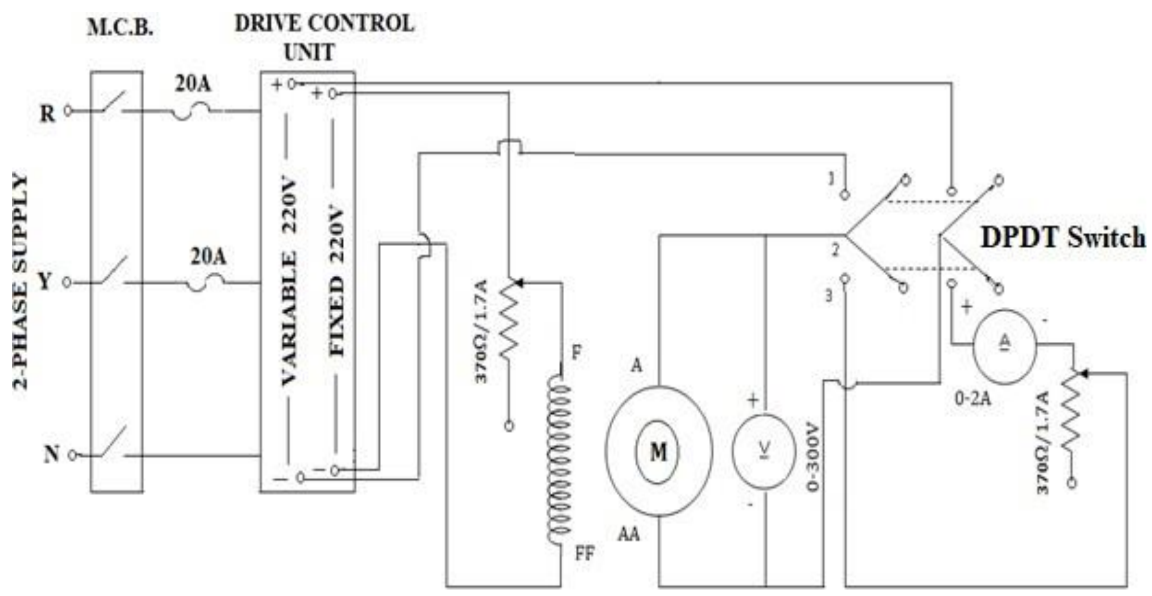
FUSE RATING:

125% of rated current=125* 19/100=23.75A≈25 A

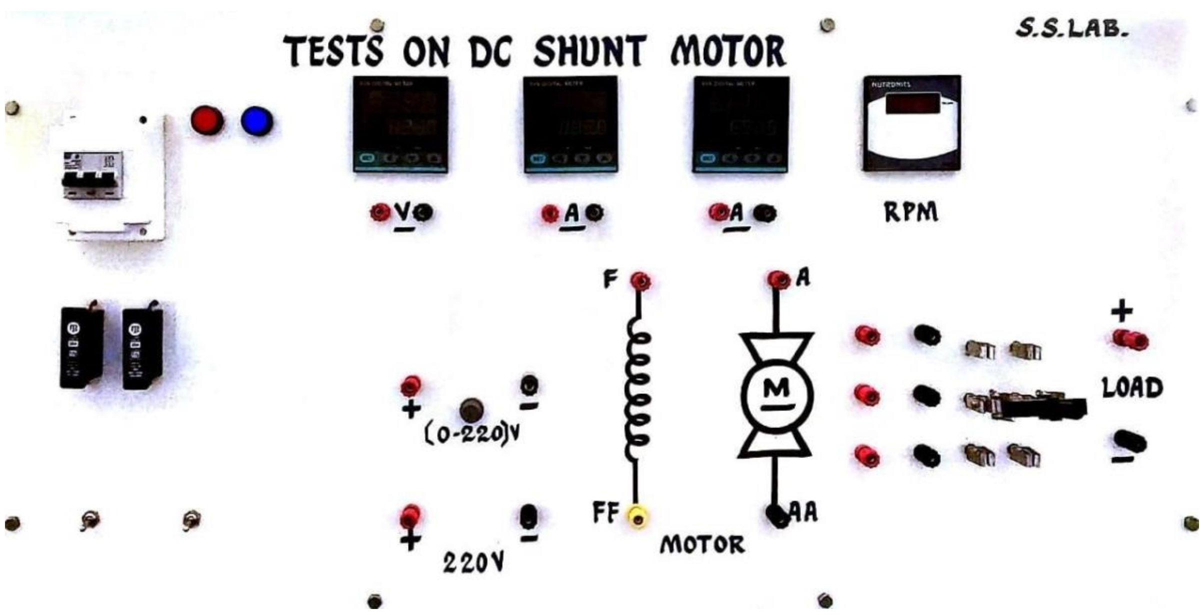
APPARATURS REQUIRED:

S.No	Apparatus Required	Range	Type	Quantity	Availability
1	Ammeter	(0-2)A	MC	1	On Panel
2	Voltmeter	(0-250)V	MC	1	On Panel
3	Rheostat	0-370Ω/1.7A	Wire wound	1	On Panel
4	DPDT switch	-	-	1	On Panel
5	SPST switch	-	-	1	On Panel
6	Connecting Wires	-	-	As Required	External

TEST SETUP:



PANEL:



PROCEDURE:

Connections are given as per the circuit diagram.

Case (i):

1. The DPDT switch is connected to the first terminal.
2. Before starting the motor, Ensure that the field rheostat and Pot meter of Drive Control Unit are in minimum position.
3. Observing all the precautions, the motor is started using Drive Control Unit and the speed is increased until the rated armature voltage (of motor) is reached. At this instant the speed would be slightly lesser than the rated speed.
4. The motor is brought to above rated speed (like 1600 rpm) with the help of pot meter and also with field rheostat.
5. Open the DPDT switch and note the time after the speed reached to below rated speed like 1250 rpm.
6. Then repeat the same procedure for other readings if required.

Case (ii):

1. Repeat the first step as case (i).
2. The motor is brought to the rated speed (like 1500 rpm).
3. Then connect the DPDT switch to third terminal, simultaneously note down the Corresponding readings like time, voltmeter and ammeter readings. Now the speed reduces fastly. At that speed which equals the same difference speed of first case(ie., 1600-1200=400) like here 1100 (ie, 1500-400=1100) rpm note down again the voltmeter and ammeter readings.
4. Repeat the same procedure for other readings if required.

Case (iii):

1. Repeat the first step as in case (i).
2. The motor is brought to the rated speed (like 1500 rpm).
3. The DPDT and SPST switches are opened and simultaneously when the speed reaches below rated speed like 1200 rpm and note down the corresponding time.
4. Repeat the same procedure for other readings if required.

TABULAR COLUMNS:

Case (i) field winding and without load

S.no	Rated speed	Full speed	Time (t1)
1			

Case (ii) with field winding and load

S.no	N_1 (speed)	N_2 (speed)	T_2 Time	V_1 (v)	V_2 (v)	I_1 (v)	I_2 (v)
1							

Case (iii) without load

S.no	Rated speed	Full speed	Time (t1)
1			

FORMULAE & NOMENCLATURE:

W= rotational losses

w=rate of losses of kinetic energy

$=1/2\ d/dt\ (w^2)$

$W=I(2\Pi/60)^2\ IN\ dN/dt$

With field excited and without load

$W= (2\Pi/60)^2\ IN\ dN/dt$

With field winding excited and electrical load connected.

$W_1+W_2=(2\Pi/60)^2\ IN\ dN/dt$

$W=W_2\ t_2/(t_1-t_2)$

With field winding disconnected and load is not connected

$W=(2\Pi/60)^2$ IN dN/dt

$W_\epsilon=((V_1+V_2)/2)\ ((I_1+I_2)/2)$

N_1=rated speed down

N_2=rated speed down

T_1=time taken to full speed N_1-N_2

$K_\epsilon=1/2\ I\ w^2$

w_s=stray losses

W_e= Iron losses; W_m= mechanical losses

$W_s=W_m+W_i$

I= moment of inertia

Case (ii)

W_o=d/dt(Ke)

=d/dt ((1/2)w^2)

=0.5*2*w*dw/dt

=I (2ΠN/60) (2N/60) dN/dt

$W_s=(2\Pi/60)^2$ IN .dN/dt_1 1

$W_s+W_c=(2\Pi/60)^2$ IN.dN/dt_2 2

Solve 1 & 2

$((W_s+We)/W_s)=t_1/t_2$

$1+(W_e/W_s)=t_1/t_2$

$(W_e/W_s)=t_1/t_2-1$

$W_e=W_s((t_1-t_2)/t_2)$

Case (iii)

$W_m=(2\Pi/60)^2$ IN .dN/dt_3

$W_i=W_s-W_m$

$W_m=W_s+W_f$

W_f=AN $W_M=BN^2$

$W_{m2}=AN_x+BN^2$

$N_x=((N_1+N_2)/2)$

Case (iv)

$W_{mg}=AM_g+BM_g$

$M_g((N_1+N_2)/2)$

VIVA QUESTIONS:

1. What is the purpose of retardation test?
2. what is the another name for this test?
3. What is the procedure of this test?
4. What is the importance of DPDT& SPST switches in the circuit?
5. On what other machines can this experiment possible
6. What is the difference between experiments of separation of losses and this experiment?
7. What are the cases used in this experiments?
8. What is the equation of W when field winding excited and electrical load connected**.**
9. Is there any difference in speed in all three conditions? Why?
10. What is the limit of maximum speed and minimum speed?

RESULT: