9.MAGNETIZATION CHARATERISTICS OF D.C SHUNT GENERATOR

Aim :- To draw the open circuit characteristics of a DC Shunt generator, to find critical resistance and to find the critical speed when the field resistance is 250Ω.

Apparatus:-

S.NO	NAME OF THE EQUIPMENT	RANGE	TYPE	QUANTITY
1.	Voltmeter	0-300V	MC	1
2.	Ammeter	0-2A	MC	1
3.	Rheostat	500 Ω / 1A	Wire wound	2
4.	Tachometer		contact	1
5.	Connecting wires			As per need

Name Plate Details:

DC shunt motor

Power = 5HP

Voltage = 220V

Current = 20A

Speed = 1500 RPM

DC shunt Generator

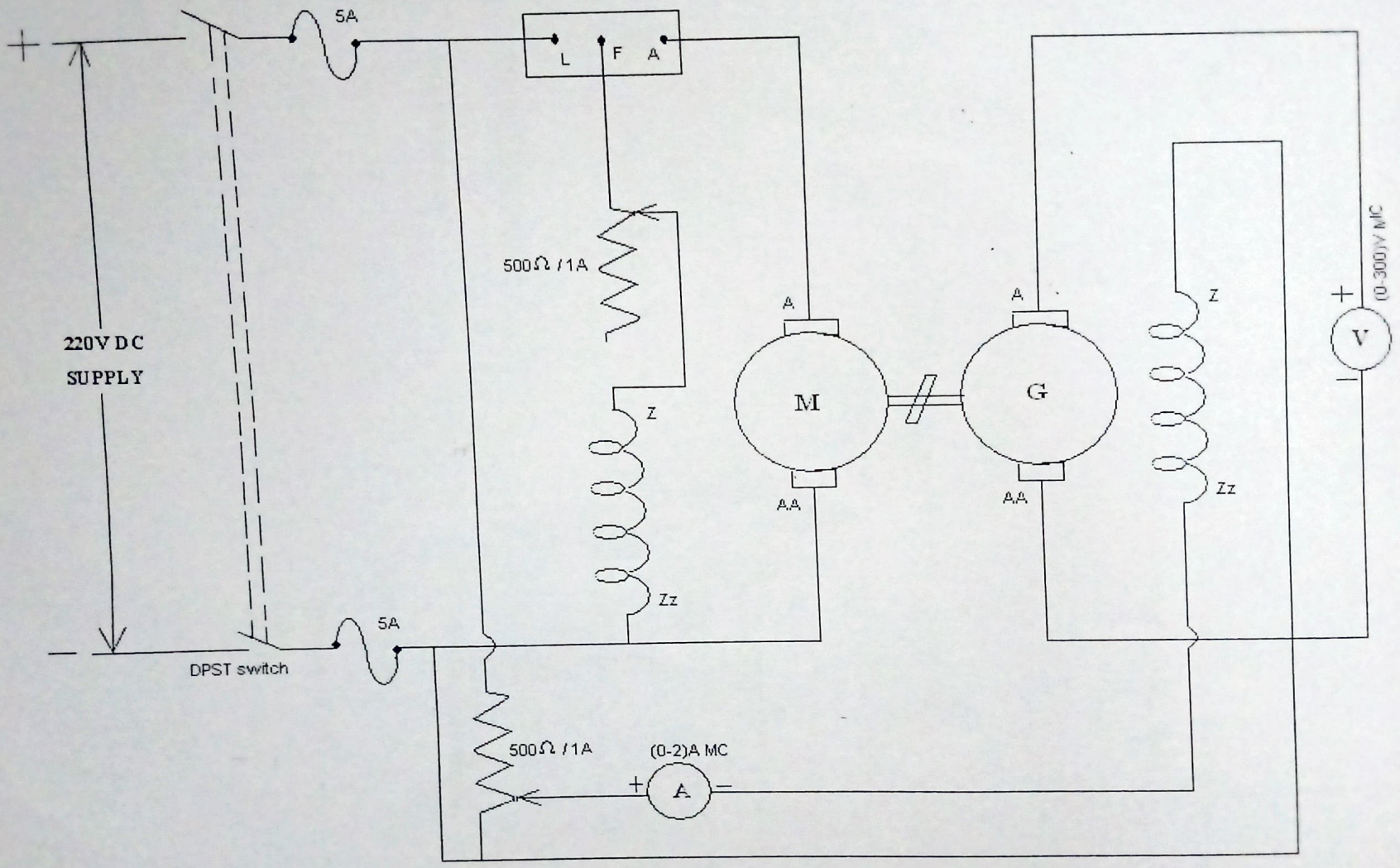
Power = 3kW

Voltage = 220V

Current = 13.6A

Speed = 1500 RPM

CIRCUIT DIAGRAM



Theory: Magnetization curve is relation between the magnetizing forces and the flux density B. this is also expressed as a relation between the field current and the induced emf , in a D.C machine. Varying the field current and noting corresponding values of induced emf can determine this.

For a self-excited machine the theoretical shape of the magnetization Curve is as shown in the figure. The induced emf corresponding to residual magnetism exists when the field current is zero. Hence the curve starts, a little above the origin on y-axis. The field resistance line Rsh is a straight-line passing through the origin.

Procedure :-

(1) All the connections are done as per the circuit diagram.

(2) Before giving the supply to the circuit the potential divider is kept at minimum output position and motor field rheostat is kept at minimum resistance position.

(3) Close the DPST switch and start the motor with the help of 3-point starter.

(1) Speed of the motor is adjusted to rated speed by using field rheostat of motor.

(2) Since generator is mechanically coupled to the motor, generator also runs at rated speed.

(3) Take the readings of Voltmeter at $I_f = 0$.

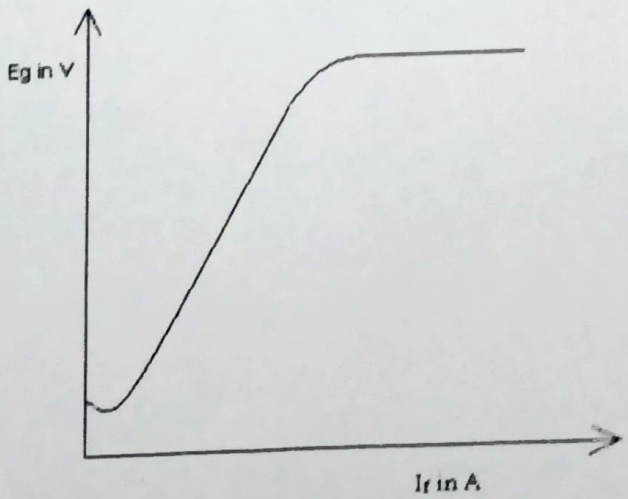
(4) By varying the potential divider, note down the readings of ammeter and voltmeter.

(5) Take the meter readings until voltmeter reads the rated voltage.

Tabular column:

S.NO	FIELD CURRENT I_f (A)	GENERATED EMF E_g (V)

Model graph:



Precautions:

1) Connections should be made tightly in order to avoid loose connections.
2) While performing the experiment the load should not be applied

Result:

Viva questions:

1.What is meant by critical field resistance?

2. What is meant by critical speed?

3. Residual magnetism is necessary for self excited generators or not?

4.Why this test is conducted at constant speed?

3.SPEED CONTROL OF DC SHUNT MOTOR

Aim: To obtain the speed control of a DC shunt motor above and below rated speed.

Apparatus:

S.NO	NAME OF THE EQUIPMENT	RANGE	TYPE	QUANTITY
1	Voltmeter	0-300V	MC	1
3	Ammeter	0-2A	MC	1
4	Rheostat	500Ω/1A	Wire wound	1
5	Rheostat	100Ω/5A	Wire wound	1
6	Tachometer		Digital contact	1
7.	Connecting wires			As per need

Name Plate Details:

DC shunt motor

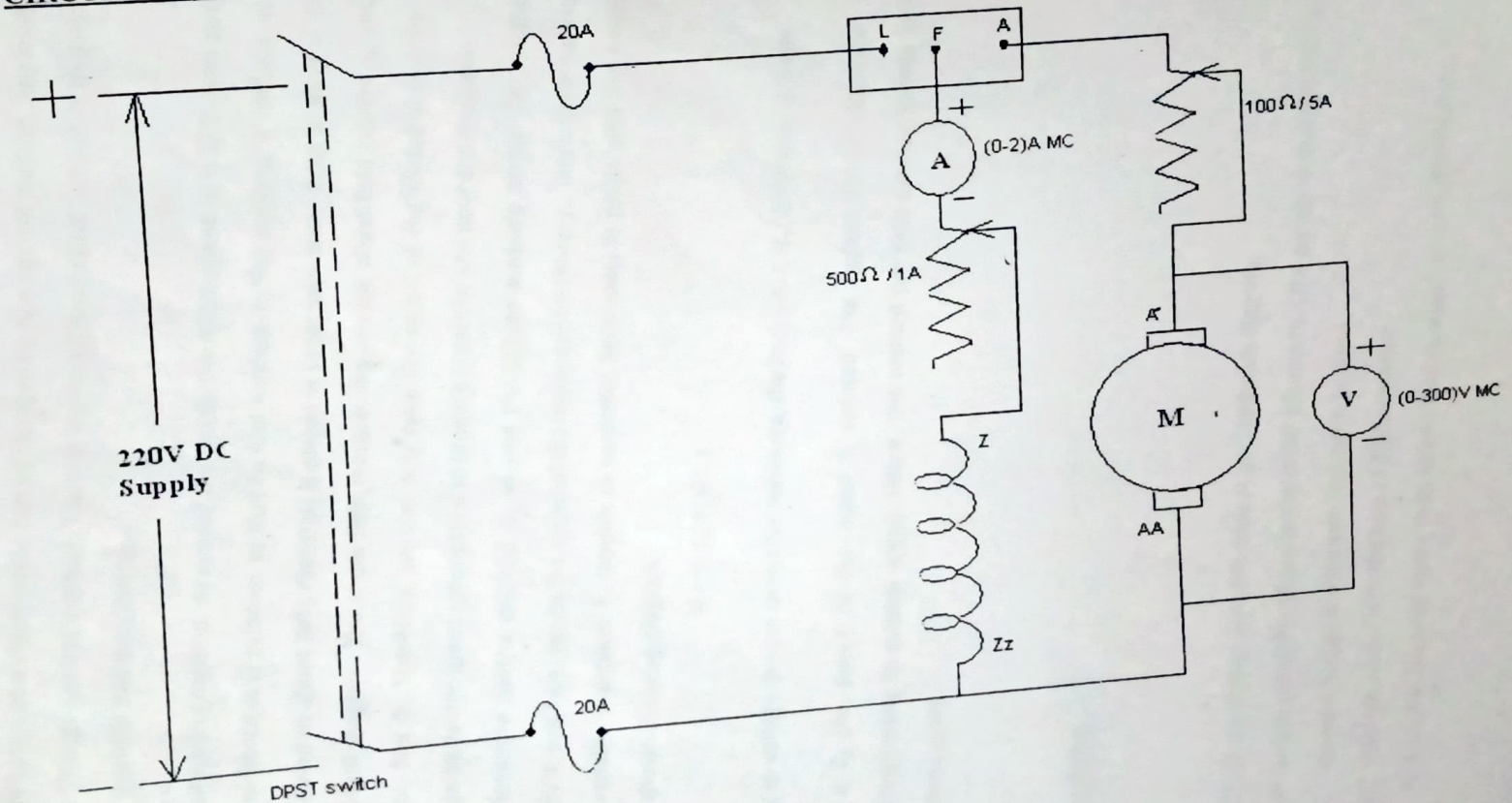
Power = 3HP

Voltage = 220V

Current = 12A

Speed = 1500 RPM

CIRCUIT DIAGRAM:



Theory:

The speed of a shunt motor can be changed by Flux control method, Armature control method, & Voltage control method. The first method (Flux control method is frequently used because it is simple and inexpensive.

1. *Flux control method:* By varying the flux Φ, the motor speed ($N \alpha 1/\Phi$) can be changed and hence it is referred as Flux control method. In this method, a variable resistance (known as shunt field rheostat) is placed in series with shunt field winding as shown in circuit diagram. The shunt field rheostat reduces the shunt field current I_{sh} and hence the flux Φ. Therefore, we can only raise the speed of the motor above the normal speed. wider speed ranges tend to produce instability and poor commutation.
2. *Armature control method:* By varying the voltage available across the armature, the back e.m.f and hence the speed of the motor can be changed. This is done by inserting a variable resistance R_c (known as controller Resistance) in series with the armature as shown in circuit diagram.

$$N \alpha V - I_a(R_a + R_c)$$

Due to voltage drop in controller resistance, the back e.m.f. (E_b) is decreased. Since

$N \alpha E_b$ the speed of the motor is reduced. The highest speed obtainable is that corresponding to normal speed. Hence, this method can only provide speeds below the normal speed.

Procedure:

(1) All the connections are done as per the circuit diagram.

(2) Before giving the supply to the circuit ensures that the armature rheostat and field rheostat is kept at minimum resistance position.

(3) Start the motor with the help of 3-point starter.

(4) Bring the speed of motor to its rated speed by adjusting the field rheostat.

(5) To obtain speed control above rated speed, adjust the field rheostat till the speed of motor is about 20% above its rated speed.

(6) Note down speed of motor and field current.

(7) Bring back the speed to rated speed by adjusting field rheostat.

(8) To obtain speed control below rated speed, adjust the armature rheostat till the speed of motor is about 20% below its rated speed.

(9) Note down speed of motor and armature voltage.

Graph:

The following 2 graphs can be plotted.

- For Armature control method: N versus V_a
- For field control method: N versus I_f.

Tabular column:

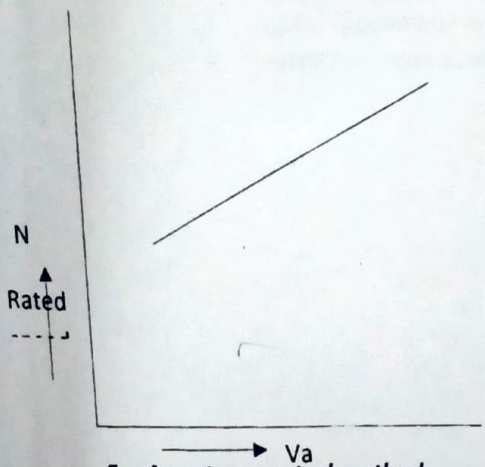
For Armature control method:

S.No	Speed (N) Rpm	Arm Voltage (Va) volts

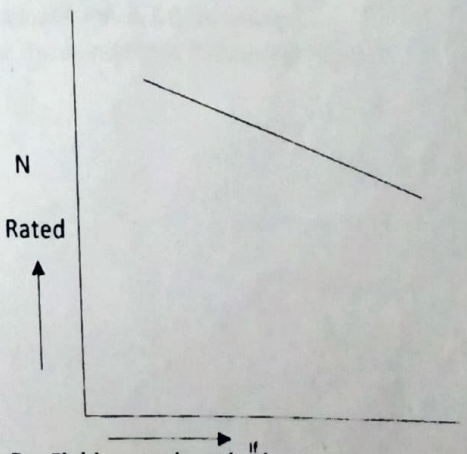
For Field control method:

S.No	Speed (N) rpm	Field Current (IF) amperes

Model Graph:



For Armature control method



For Field control method

Precautions:

2) Connections should be made tightly in order to avoid loose connections.
3) The field of a shunt motor in operation should never be opened because its speed will increase to an extremely high value.

Result:

Viva questions:

1. What are the different methods of controlling the speed of a DC motor?
2. Explain Flux control method? What are the advantages & Disadvantages?
3. Explain Armature control method? What are the advantages & Disadvantages?

10.SWINBURNE'S TEST ON DC SHUNT MACHINE

Aim:

To predetermine the efficiency of D.C shunt machine when it runs as a generator and as a motor by conducting Swinburne's test.

Apparatus:

S.NO	NAME OF THE EQUIPMENT	RANGE	TYPE	QUANTITY
1	Voltmeter	0-300V	MC	1
2	Ammeter	0-5A	MC	1
3	Ammeter	0-2A	MC	1
4	Rheostat	500Ω / 1A,100Ω/5A	Wire wound	1
5	Tachometer		Digital contact	1
6.	Connecting wires			As per need

Name Plate Details:

DC shunt motor

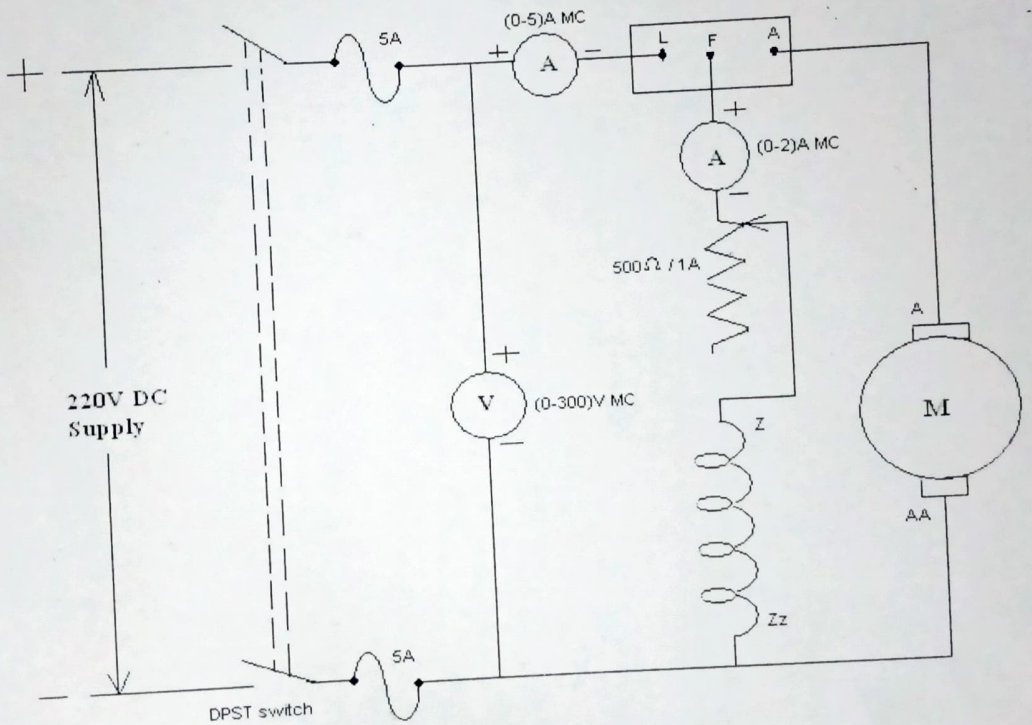
Power = 5HP

Voltage = 220V

Current = 12A

Speed = 1500 RPM

CIRCUIT DIAGRAM:



Theory:

It is simple & indirect method in which losses are measured separately and efficiency can be determined for any desired load. This test is applicable only to those DC machines in which the flux remains practically constant as in the case of d.c shunt machine and level compounding generator. Swinburne test is one such method wherein the machine is run at no load to find out no load losses which normally constitute constant losses. Copper losses can be calculated which is helpful in finding total losses & efficiency.

Procedure:

(1) All the connections are done as per the circuit diagram.
(2) Initially the shunt field rheostat of the motor is kept at minimum position.
(3) Supply is given to the circuit and start the motor with the help of 3-point starter.
(4) Bring the speed of motor to the rated speed by adjusting the field rheostat.
(5) After bringing the speed of the motor to the rated speed, note down the voltmeter and ammeter readings.
(6) Constant losses are to be calculated from the above reading.
(7) Calculate the efficiency of the machine both as a motor and Generator.

Graph:

Efficiency (η) versus Output (o/p) Graph can be plotted

Tabular column:

S.No	V (V)	Io (A)	IF (A)

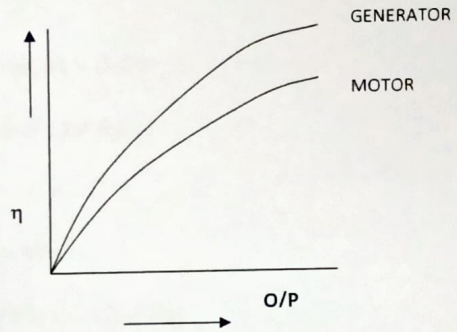
Machine running as Motor:

S.no	Current (I)	Input (VI)	Arm Cu Loss (Ia^2Ra)	Total loss (WT)	Output	Efficiency (η)

Machine running as Generator :

S.no	Current (I)	Input (VI)	Arm Cu Loss (Ia^2Ra)	Total loss (WT)	Output	Efficiency (η)

Model Graph:



Model Calculation:

V- Supply Voltage

Io – Motor Input Current.

Power Input = **V Io**

Constant Losses = **Wc** = V Io –(Io – IF)^2 Ra

=

Efficiency of a machine running as a Motor:

I be the load current at which efficiency has to be found.

Input = **VI** =

Armature current Ia = (I-IF)=

Armature Cu loss= Ia^2 Ra

=

Constant loss = **Wc** =

Total losses **WT** = Wc +(Ia^2.Ra)

=

Output = Input – Total Losses = **VI - WT**

Efficiency (η) of motor = Output/Input x 100

=

Efficiency of a machine running as a Generator:

I = Load current supplied by generator.

Output = VI

=

Armature Current Ia = (I+IF)=

Armature Cu loss= Ia^2 Ra

=

Constant loss = **Wc** =

Total losses **WT** = Wc +(Ia^2.Ra)

=

Input = Output + Total losses

= VI + WT=

Efficiency (η) of Generator = Output/Input x 100

=

Precautions:

1) Connections should be made tightly in order to avoid loose connections.
2) While performing the experiment the load should not be applied.

Result:

Viva questions:

1. For which machines swinburne's test is applicable to? Why?

2. What are the advantages and disadvantages of Swinburne's test?

3. What are the various types of losses occurring in a DC machine?

11.BRAKE TEST ON DC SHUNT MOTOR

Aim:

To determine the efficiency & to draw the performance Characteristics by performing brake test on a DC shunt motor.

Apparatus:

S.NO	NAME OF THE EQUIPMENT	RANGE	TYPE	QUANTITY
1	Voltmeter	0-300V	MC	1
2	Ammeter	0-20A	MC	1
3	Rheostat	500Ω/1A	Wire Wound	1
4	Tachometer		Digital contact	1
5.	Connecting wires			As per need

Name Plate Details:

DC shunt motor

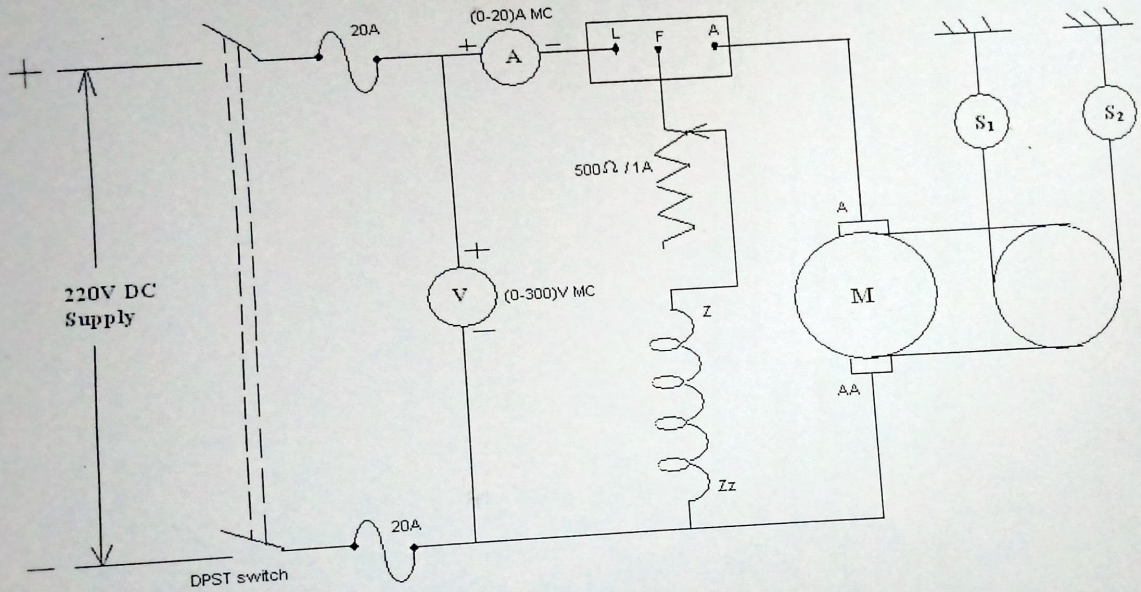
Power = 5HP

Voltage = 220V

Current = 12A

Speed = 1500 RPM

CIRCUIT DIAGRAM:



Theory:

The braking arrangements to conduct the brake test on DC motor are shown in circuit diagram. The Brake band is taken round the water cooled pulley & attached on both sides to spring balance S_1 & S_2.The belt tightening hand wheel works as a load adjuster.

This method is suitable for small machines which can be subjected to direct load test.

If **'R'** is the radius of the pulley in meter & **'N'** is the motor speed in r.p.s

Then shaft Torque 'T_{sh}' developed by the motor = $9.81 \times (S_1-S_2) R$ Kg-m

The motor output power = $2\Pi N T_{sh}/60 = 2\Pi N \times 9.81 \times (S_1-S_2) R /60$ watts

If **'V'** is the supply voltage and I is the full load current taken by the motor, then

Input power = VI watts

Efficiency (η) = Output/Input

Procedure:

1) All the connections are done as per the circuit diagram.
2) Before switching the supply ensure that there is no load on the motor.
3) Initially the shunt field rheostat of the motor is kept at minimum position.
4) Supply is given to the circuit and start the motor with the help of 3-point starter.
5) Bring the speed to the rated speed by varying field rheostat of motor.
6) Note down the no-load values of meters (Voltmeter & Ammeters.)
7) Now load the motor by tightening the belt and take the readings of S_1, S_2, voltmeter, ammeter and speed.
8) Repeat step 7 by gradually increasing the load till rated current of the motor is obtained.

Graph:

The followings graphs can be plotted

1) Efficiency (η) versus Output (o/p)

2)Speed(N) versus Output(o/p)

3) Torque(T) versus Output.(o/p).

Tabular column:

S.no	V (V)	I_L (A)	N (rpm)	S_1 (Kg)	S_2 (Kg)	I/p power VI_L	Torque T	O/p power $\frac{2\Pi N T}{60}$	%Efficiency (η)

Model Calculation:

Supply voltage, **V =**

Load current, **I =**

Radius of the pulley, **R=**

Motor speed, **N =**

Torque developed by the motor, T = 9.81 x (S_1-S_2) xR

=

The motor ***output power*** = 2Π N T_{sh} = 2Π NT / 60

=

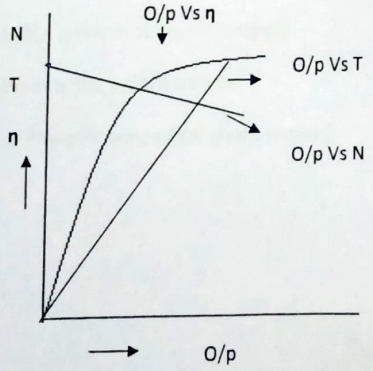
Input power = VI

=

% Efficiency (η) = Output/Input x 100

=

Model Graph:



Precautions:

1) Connections should be made tightly in order to avoid loose connections.
2) While applying the load cool the pulley by pouring water to reduce frictional heat.

Result:

Viva questions:

1.What is the torque and armature current relation in shunt motor?

2.Which type of load is applied on the motor?

3.What is the function of 3-point starter?

4.Why shunt motor is called constant speed motor?

5.What is the formula for torque?

6.What is the unit of torque?

7.Define efficiency of DC shunt motor?

13.LOAD TEST ON TRANSFORMER

Aim :- To conduct load test on Transformer and to determine the efficiency of the Transformer.

Apparatus :-

S.NO.	NAME OF THE EQUIPMENT	RANGE	TYPE	QUANTITY
1.	Voltmeter	0 - 150V	MI	1
2.	Voltmeter	0 - 30V	MI	1
3.	Ammeter	0 – 2A	MI	1
4.	Wattmeter	300V,10A	UPF	1
5.	Wattmeter	300V,10A	UPF	1
6.	Ammeter	0 – 20A	MI	1
7.	Transformer	3KVA(115/230V)	1-Φ	1
8.	Connecting wires			As per need

Name plate details:

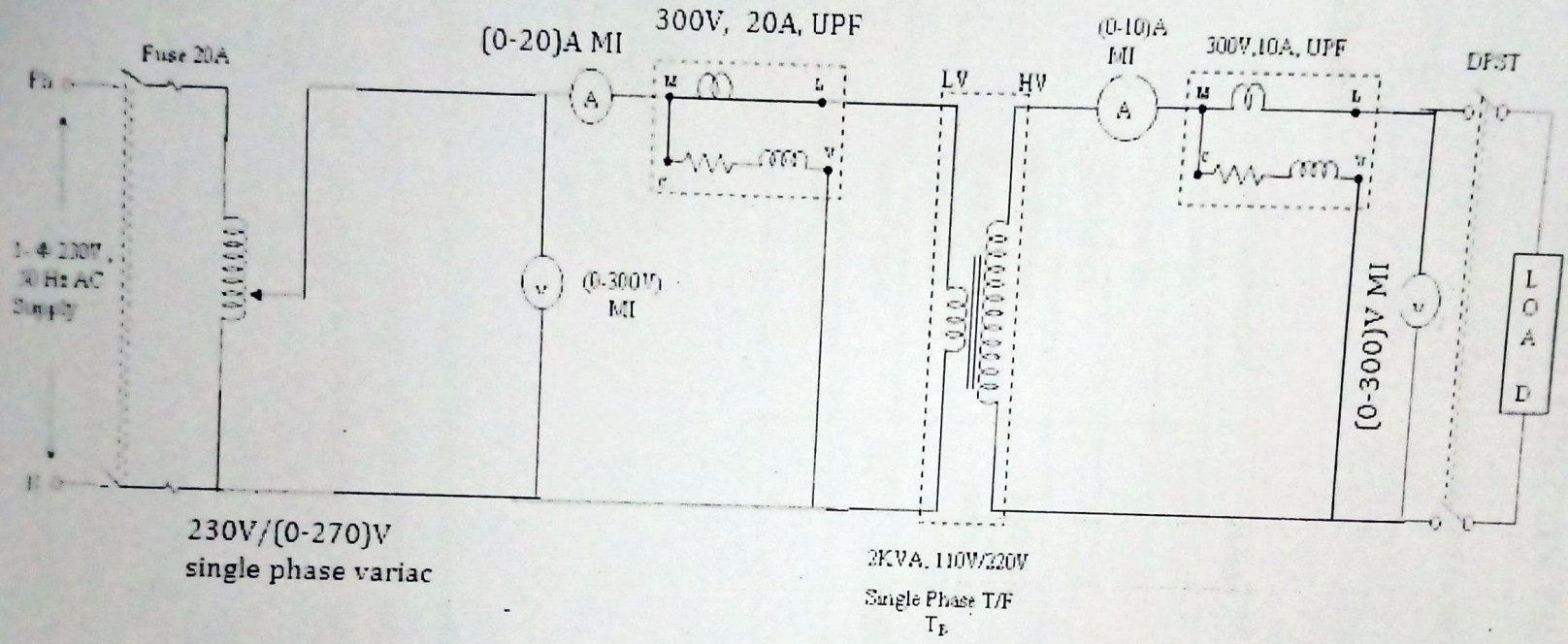
Voltage Ratio = 220/110V
Full load Current =13.6A
KVA RATING = 3KVA

Theory: The ac voltage is applied to the primary coil, the ac current in the primary coil gives rise to flux change. The change of flux induces emf in the secondary coil due to mutual induction. We can calculate the efficiency by using voltmeter and ammeter since we are using resistive load.

Procedure :-

1. Make all the connections according to the circuit diagram.
2. Keep the auto-transformer at minimum position.
3. Give the supply, close the DPST switch.

LOAD TEST ON TRANSFORMER



4. Now by varying the single phase auto-transformer adjust to rated voltage at primary side.
5. Now apply the load and varying the load take the readings upon the rated current.
6. From the above reading efficiency can be determined.

Tabular column:

S.NO.	$V_{1(V)}$	$I_{1(A)}$	$W_{1(W)}$	$V_{2(V)}$	$I_{2(A)}$	$W_{2(W)}$	$\%\eta = (W_2/W_1)*100$

Precautions :-

4. All the connections should be right and tight.
5. Take the readings without parallax error.
6. Do not exceed the rated current of Transformer.

Result :-

Viva questions:

1. What is the effect on the frequency in the transformer?
2. What is the medium for the energy conversion from the primary to secondary in the transformer?
3. What is the main reason for the generation of harmonics in the transformer?
4. Why are the ferrite cores used in the high frequency transformer?
5. What type of winding is used in the 3-phase shell type transformer?
6. What is increased in step up transformer?
7. What is the effect on voltage in step down transformer?
8. What is the formula of efficiency?
9. What is the function of bushings in the transformer?
10. What is the principal of transformer?