SSM

INSTITUTE OF ENGINEEERING AND TECHNOLOGY

DINDIGUL - 624002.

EE8353

ELECTRICAL ENGINEERING LABORATORY

NAME OF STUDENT :..

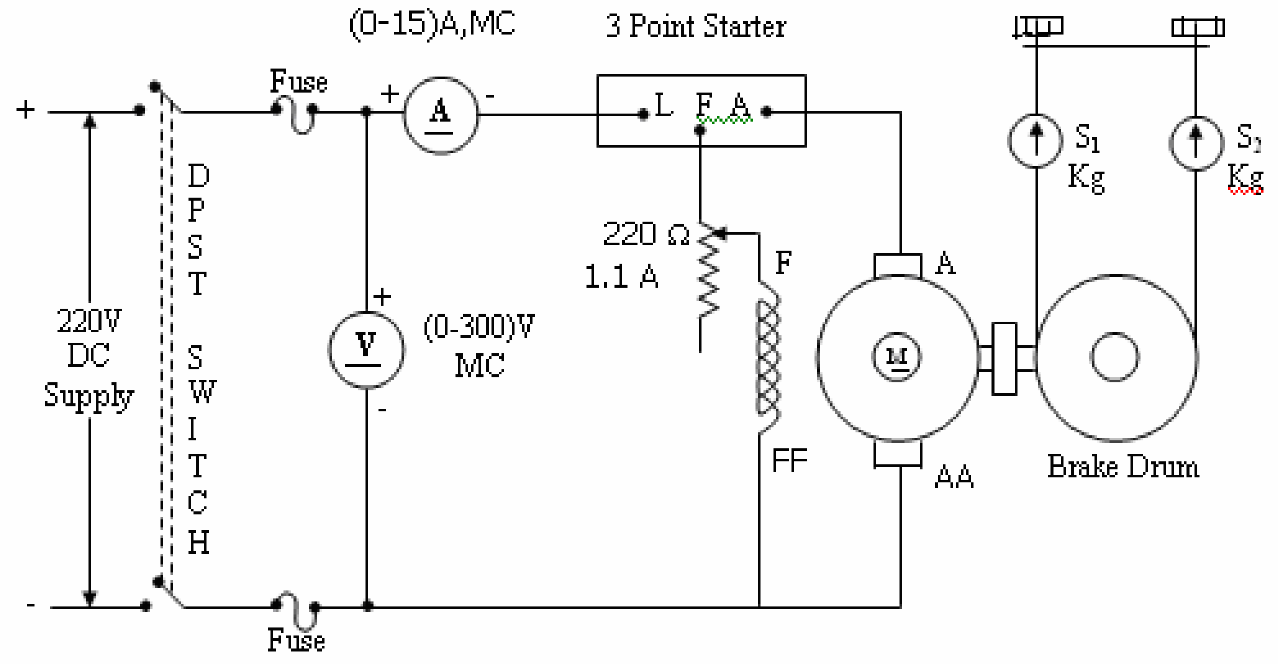
REG. NUMBER :..

DEPT.- SEM.-SEC :..

LIST OF EXPERIMENTS

S.NO	DATE	TITLE	Page No.	Marks	Signature
1		(A) Load test on DC Shunt Motor			
		(B) Load test on DC Series motor			
2		(A) O.C.C & Load characteristics of DC Shunt generator			
		(B) O.C.C & Load characteristics of DC Series generator			
3		Speed control of DC shunt motor (Armature, Field control)			
4		Load test on single phase transformer			
5		O.C & S.C Test on a single phase transformer			
6		Regulation of an alternator by EMF & MMF methods.			
7		V curves and inverted V curves of synchronous Motor			
8		Load test on three phase squirrel cage Induction motor			
9		Speed control of three phase slip ring Induction Motor			
10		Study of DC & AC Starters			
		Average Marks			

CIRCUIT DIAGRAM:



FUSE RATING:

125% of rated current

$$\frac{125 \times}{100} =$$

NAME PLATE DETAILS:

Rated Voltage : 220V
Rated Current :
Rated Power :
Rated Speed : 1500 RPM

Ex.No.1-A **Date:………………**

LOAD TEST ON DC SHUNT MOTOR

AIM:

To conduct load test on DC shunt motor and to find efficiency.

APPARATUS REQUIRED:

S.No.	Apparatus	Range	Type	Quantity
1	Ammeter	(0-30)A	MC	1
2	Voltmeter	(0-300)V	MC	1
3	Rheostat	220Ω, 1.1A	Wire Wound	1
4	Tachometer	(0-10000) rpm	Digital	1
5	Connecting Wires	2.5sq.mm.	Copper	Few

FORMULAE:

$$R = \frac{\text{Circumference}}{100 \times 2\pi} \text{ m}$$

Torque $T = (S_1 \sim S_2) \times R \times 9.81$ Nm

Input Power $P_i = VI$ Watts

$$\text{Output Power } P_m = \frac{2\pi NT}{60} \text{ Watts}$$

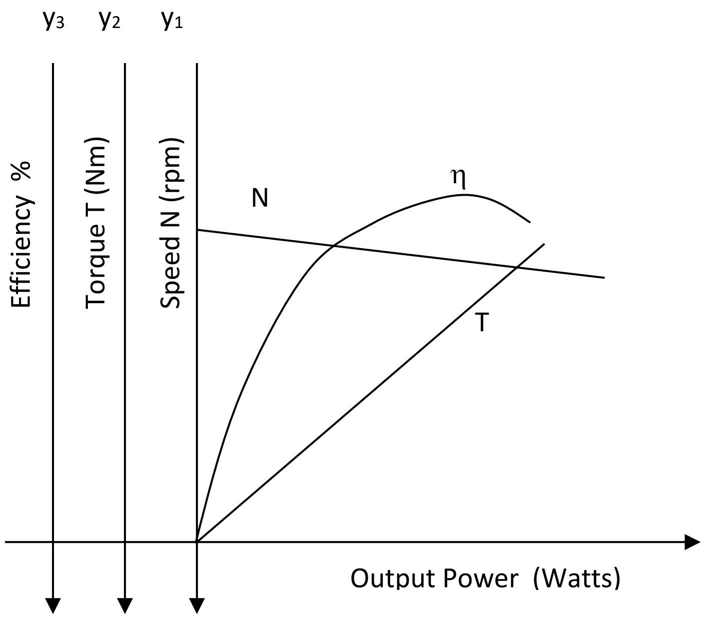
$$\text{Efficiency } \eta\ \% = \frac{\text{Output Power}}{\text{Input Power}} \times 100\%$$

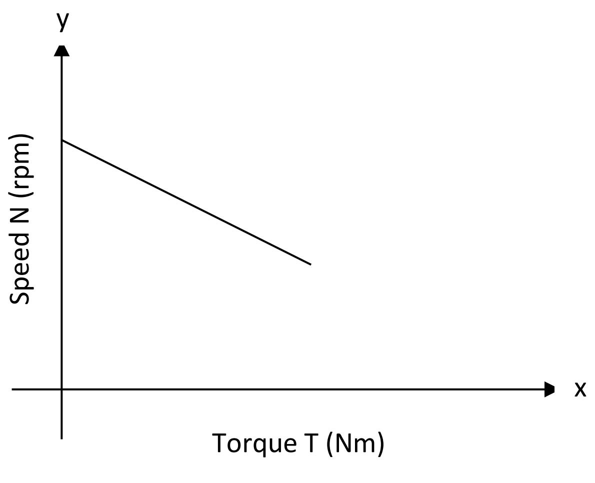
TABULAR COLUMN:

S.No.	Voltage V (Volts)	Current I (Amps)	Spring Balance Reading		(S_1~ S_2) Kg	Speed N (rpm)	Torque T (Nm)	Output Power Po (Watts)	Input Power P_i (Watts)	Efficiency η%
			S_1(Kg)	S_2(Kg)						
1										
2										
3										
4										
5										
6										

Circumference of the Brake drum = in meter

MODEL GRAPHS:





PRECAUTIONS:

1. DC shunt motor should be started and stopped under no load condition.
2. Field rheostat should be kept in the minimum position.
3. Brake drum should be cooled with water when it is under load.

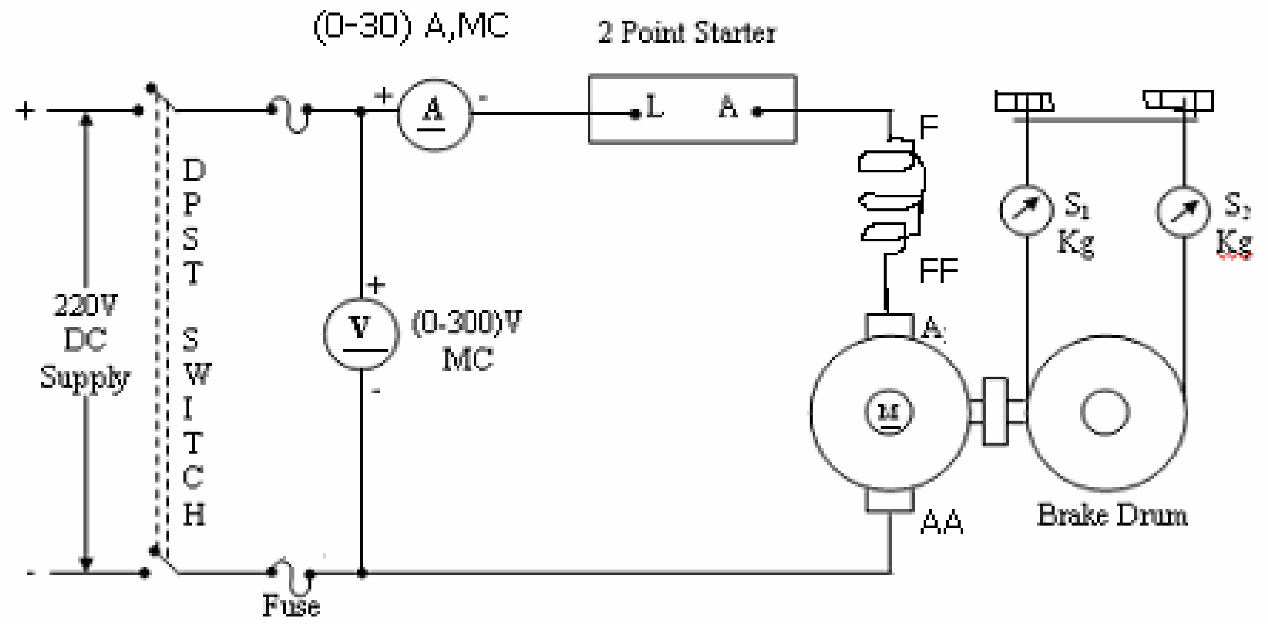
PROCEDURE:

1. Connections are made as per the circuit diagram.
2. After checking the no load condition, and minimum field rheostat position, DPST switch is closed and starter resistance is gradually removed.
3. The motor is brought to its rated speed by adjusting the field rheostat.
4. Ammeter, Voltmeter readings, speed and spring balance readings are noted under no load condition.
5. The load is then added to the motor gradually and for each load, voltmeter, ammeter, spring balance readings and speed of the motor are noted.
6. The motor is then brought to no load condition and field rheostat to minimum position, then DPST switch is opened.

RESULT:

Thus load test on DC shunt motor is conducted and its efficiency is determined.

CIRCUIT DIAGRAM:



FUSE RATING:

125% of rated current

$$\frac{125 \times}{100} =$$

NAME PLATE DETAILS:

Rated Voltage : 220V
Rated Current :
Rated Power :
Rated Speed : 1500 RPM

Ex.No.1-B **Date:………………**

LOAD TEST ON DC SERIES MOTOR

AIM:

To conduct load test on DC Series Motor and to find efficiency.

APPARATUS REQUIRED:

S.No.	Apparatus	Range	Type	Quantity
1	Ammeter	(0-30)A	MC	1
2	Voltmeter	(0-300)V	MC	1
3	Tachometer	(0-10000) rpm	Digital	1
4	Connecting Wires	2.5sq.mm.	Copper	Few

FORMULAE:

$$R = \frac{\text{Circumference}}{100 \times 2\pi} \text{ m}$$

Torque $T = (S_1 \sim S_2) \times R \times 9.81$ Nm

Input Power $P_i = VI$ Watts

$$\text{Output Power } P_m = \frac{2\pi NT}{60} \text{ Watts}$$

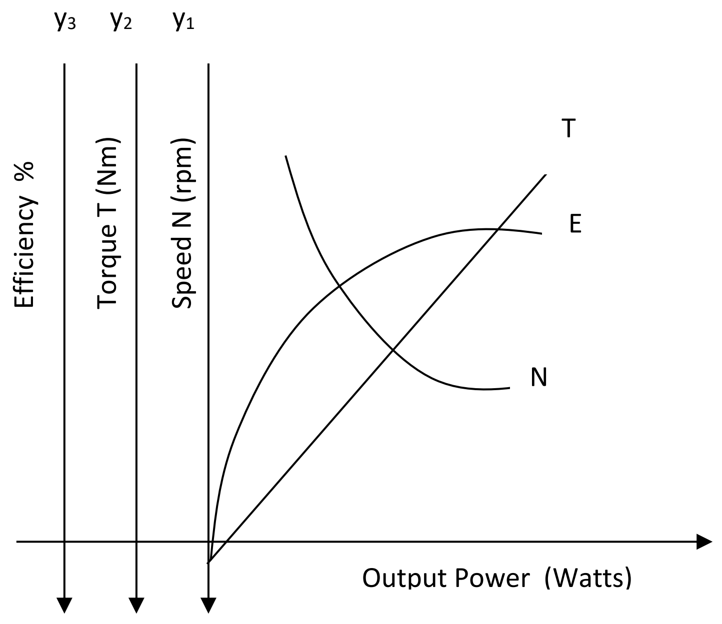
$$\text{Efficiency } \eta \% = \frac{\text{Output Power}}{\text{Input Power}} \times 100\%$$

TABULAR COLUMN:

S.No.	Voltage V (Volts)	Current I (Amps)	Spring Balance Reading		$(S_1 \sim S_2)$Kg	Speed N (rpm)	Torque T (Nm)	Output Power Pm (Watts)	Input Power P_i (Watts)	Efficiency η%
			S_1(Kg)	S_2(Kg)						
1.										
2.										
3.										
4.										
5.										
6.										

Circumference of the Brake drum = in m.

MODEL GRAPH:



PRECAUTIONS:

1. The motor should be started and stopped with load
2. Brake drum should be cooled with water when it is under load.

PROCEDURE:

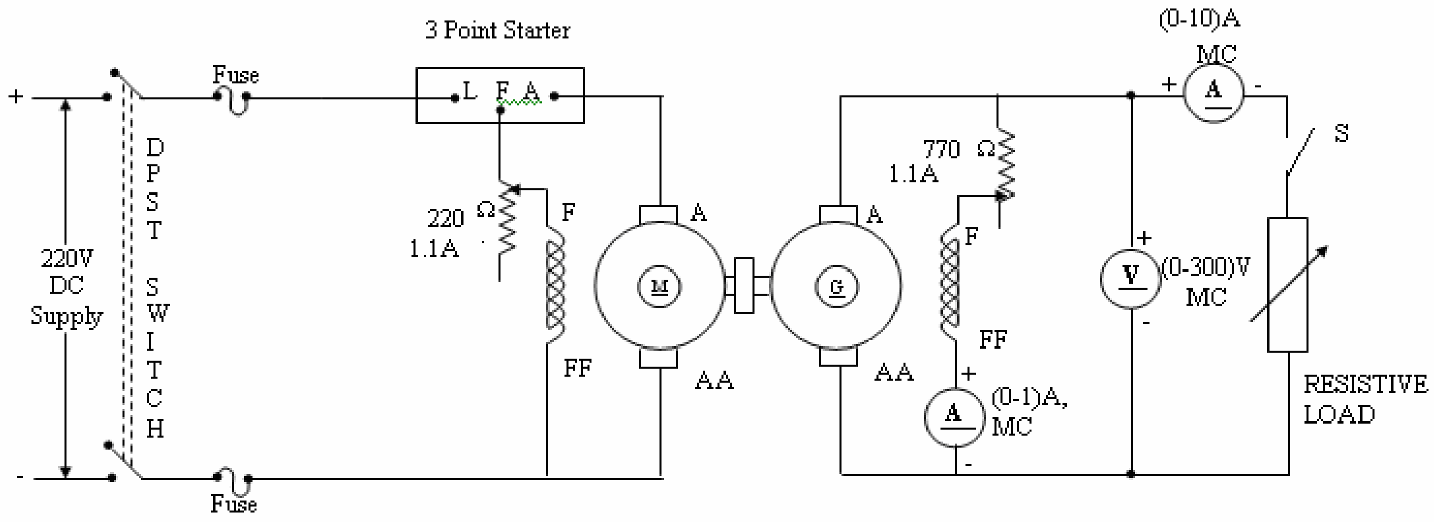
1. Connections are made as per the circuit diagram.
2. After checking the load condition, DPST switch is closed and starter resistance is gradually removed.
3. For various loads, Voltmeter, Ammeter readings, speed and spring balance readings are noted.
4. After bringing the load to initial position, DPST switch is opened.

RESULT:

Thus load test on DC series motor is conducted and its efficiency is determined.

OPEN CIRCUIT AND LOAD CHARACTERISTICS OF SELF EXCITED DC SHUNT GENERATOR

CIRCUIT DIAGRAM:



FUSE RATING:

125% of rated current

$$\frac{125 \times}{100} =$$

NAME PLATE DETAILS:

	Motor	Generator
Rated Voltage :	220V	220V
Rated Current :		
Rated Power :		
Rated Speed :	1500 RPM	1500 RPM

Ex.No.2-A1

OPEN CIRCUIT AND LOAD CHARACTERISTICS OF SELF EXCITED DC SHUNT GENERATOR

AIM:

To obtain open circuit characteristics of self excited DC shunt generator and to find its critical resistance. To obtain internal and external characteristics of DC shunt generator.

APPARATUS REQUIRED:

S.No.	Apparatus	Range	Type	Quantity
1	Ammeter	(0-1)A	MC	1
2	Ammeter	(0-10)A	MC	1
3	Voltmeter	(0-300)V	MC	1
4	Rheostats	770 Ω, 1.1A	Wire Wound	1
5	Rheostats	220 Ω, 1.1A	Wire Wound	1
6	Loading Rheostat	5KW, 230V	-	1
7	Tachometer	(0-10000)rpm	Digital	1
8	SPST Switch	-	-	1
9	Connecting Wires	2.5sq.mm.	Copper	Few

FORMULAE:

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

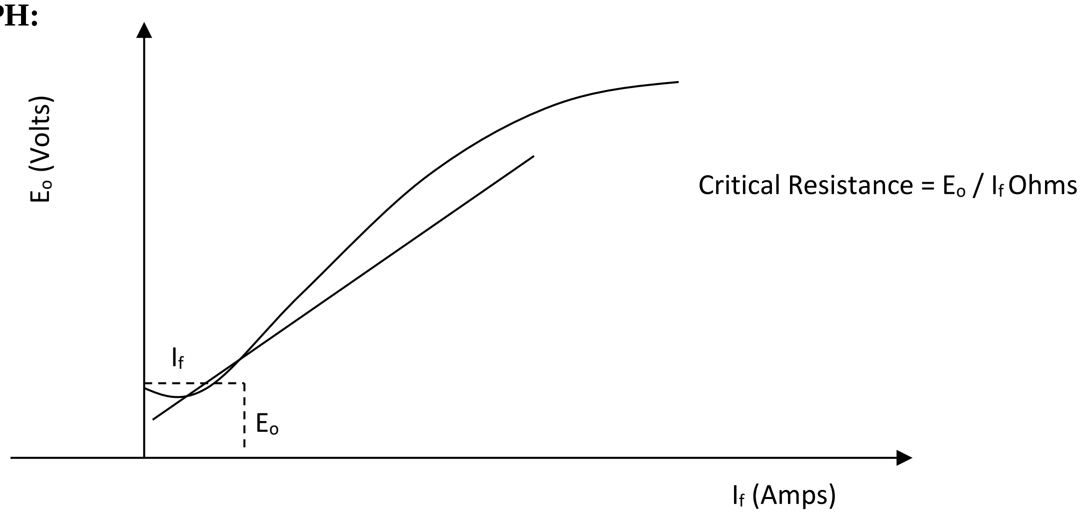
I_f : Field Current in Amps

R_a : Armature Resistance in Ohms

TABULAR COLUMN: OPEN CIRCUIT TEST

S.No.	Field Current I_f (Amps)	Armature Voltage E_o (Volts)
1.		
2.		
3.		
4.		
5.		

MODEL GRAPH:



TABULAR COLUMN: LOAD TEST

S.No.	Field Current I_f (Amps)	Load Current I_L (Amps)	Terminal Voltage (V) Volts	Armature current $I_a = I_L + I_f$ (Amps)	Generated Voltage $E_g = V + I_a R_a$ (Volts)
1.					
2.					
3.					
4.					
5.					
6.					

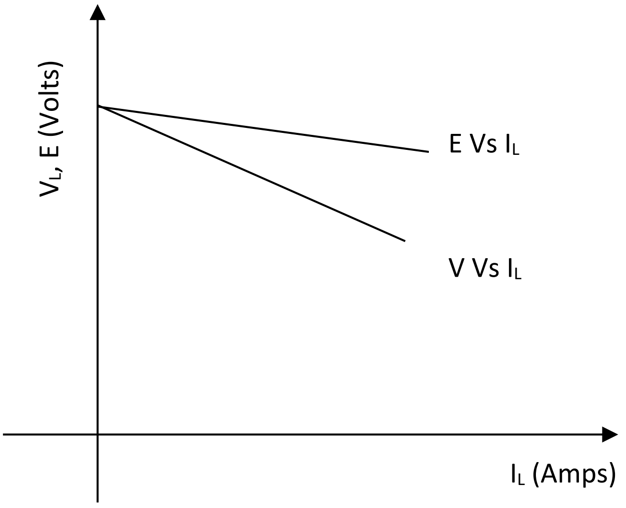
PRECAUTIONS:

1. The field rheostat of motor should be in minimum resistance position at the time of starting and stopping the machine.
2. The field rheostat of generator should be in maximum resistance position at the time of starting and stopping the machine.
3. SPST switch is kept open during starting and stopping.
4. No load should be connected to generator at the time of starting and stopping.

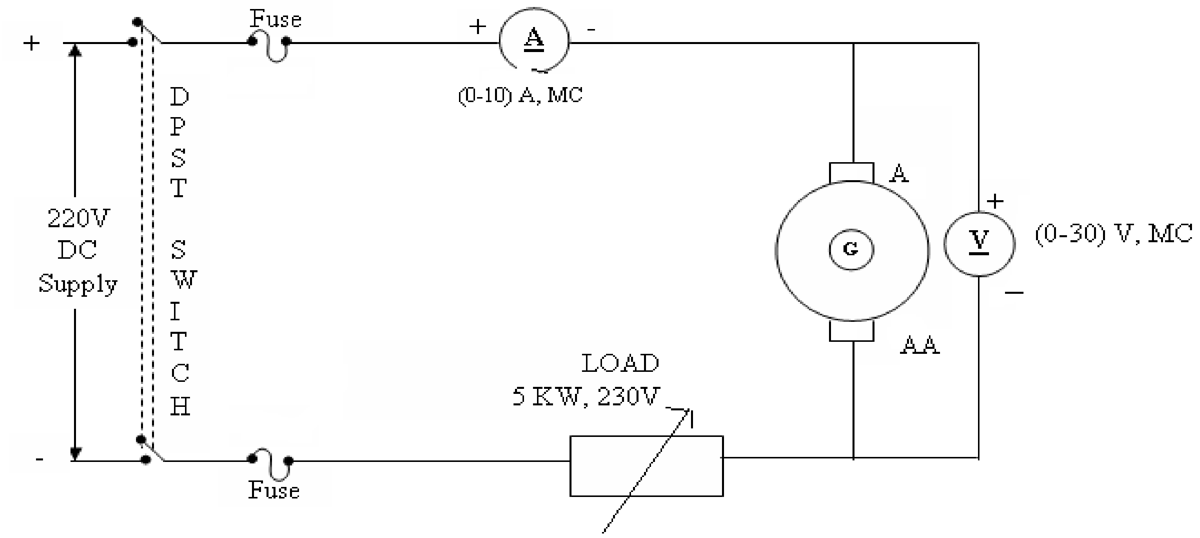
PROCEDURE:

1. Connections are made as per the circuit diagram.
2. After checking minimum position of motor field rheostat, maximum position of generator field rheostat, DPST switch is closed and starting resistance is gradually removed.
3. By adjusting the field rheostat, the motor is brought to rated speed.
4. Voltmeter and ammeter readings are taken when the SPST switch is kept open.
5. After closing the SPST switch, by varying the generator field rheostat, voltmeter and ammeter readings are taken.
6. Under no load condition, Ammeter and Voltmeter readings are noted, after bringing the voltage to rated voltage by adjusting the field rheostat of generator.
7. Load is varied gradually and for each load, voltmeter and ammeter readings are noted.
8. 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, SPST switch is opened and DPST switch is opened.

MODEL GRAPH: Load Test



DETERMINATION OF ARMATURE RESISTANCE:



TABULAR COLUMN:

S.No.	Voltage V (Volts)	Current I (Amps)	Armature Resistance R_a (Ohms)

R_a = Ohms

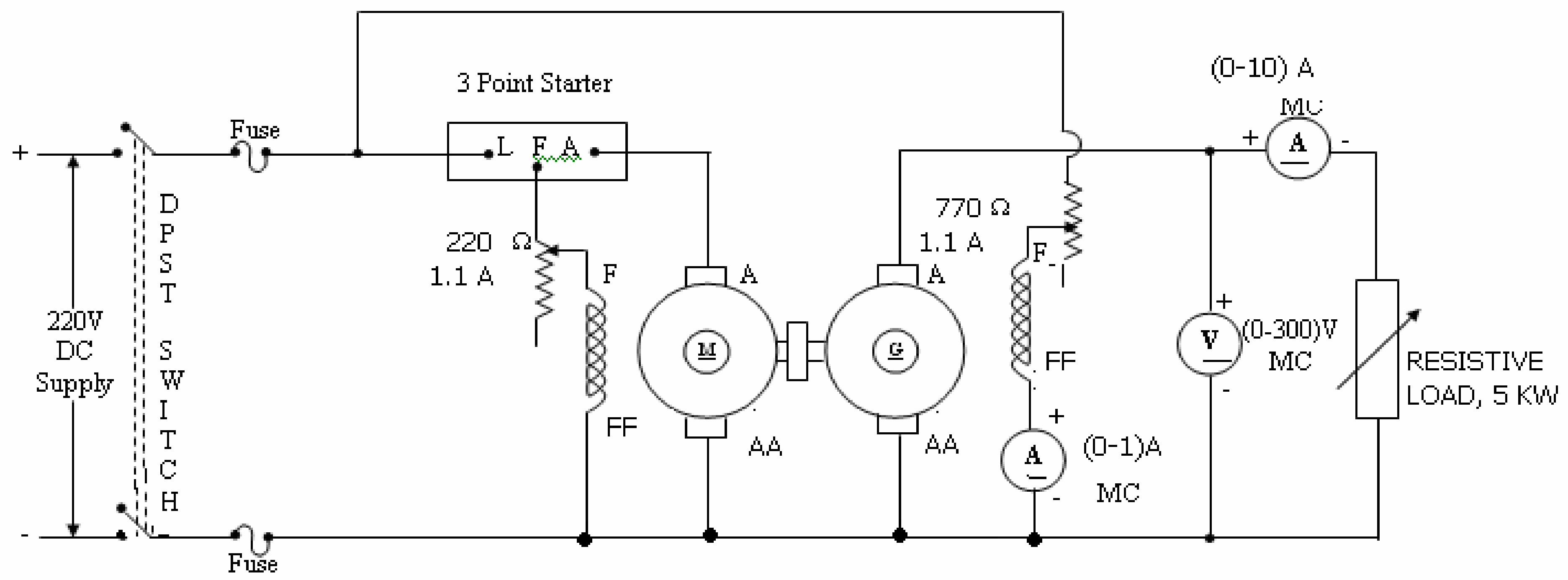
PROCEDURE: TO FIND ARMATURE RESISTANCE

1. Connections are made as per the circuit diagram.
2. Supply is given by closing the DPST switch.
3. Readings of Ammeter and Voltmeter are noted.
4. Armature resistance in Ohms is calculated as $R_a = (V x 1.5) / I$

RESULT:

Thus open circuit and the load characteristics of self excited DC shunt generator are obtained and its critical resistance is determined.

CIRCUIT DIAGRAM:



FUSE RATING:

125% of rated current

$$\frac{125 \times}{100} =$$

NAME PLATE DETAILS:

	Motor	**Generator**
Rated Voltage :	220V	220V
Rated Current :		
Rated Power :		
Rated Speed :	1500 RPM	1500 RPM

Ex.No.2-A2 **Date:……………**

OPEN CIRCUIT AND LOAD CHARACTERISTICS OF SEPARATELY EXCITED DC SHUNT GENERATOR

AIM:

To obtain open circuit characteristics of separately excited DC shunt generator. To obtain internal and external characteristics of DC shunt generator.

APPARATUS REQUIRED:

S.No.	Apparatus	Range	Type	Quantity
1	Ammeter	(0-1)A	MC	1
2	Ammeter	(0-10)A	MC	1
3	Voltmeter	(0-300)V	MC	1
4	Rheostats	770 Ω, 1.1A	Wire Wound	1
5	Rheostats	220 Ω, 1.1A	Wire Wound	1
6	Loading Rheostat	5KW, 230V	-	1
7	Tachometer	(0-10000)rpm	Digital	1
8	Connecting Wires	2.5sq.mm.	Copper	Few

FORMULAE:

$E_g = V + I_a R_a$ (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

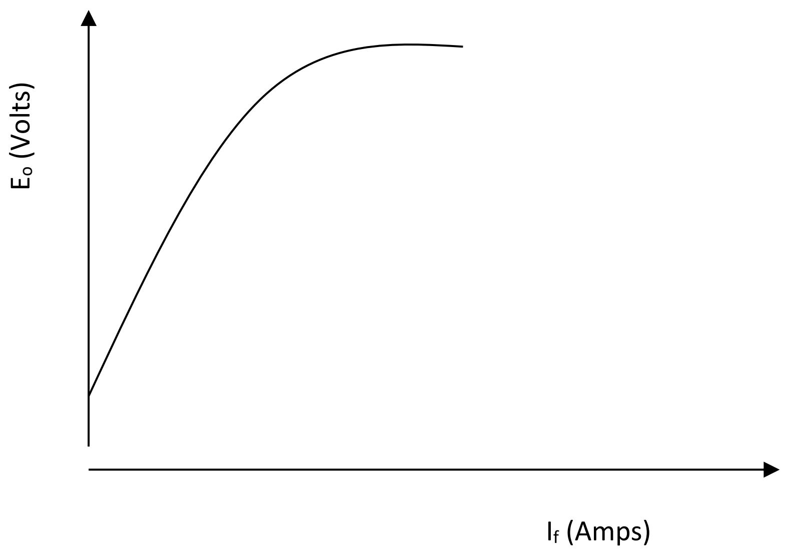
I_f : Field Current in Amps

R_a : Armature Resistance in Ohms

TABULAR COLUMN: OPEN CIRCUIT TEST

S.No.	Field Current I_f (Amps)	Armature Voltage E_o (Volts)
1.		
2.		
3.		
4.		
5.		
6.		
7.		

MODEL GRAPH:



PRECAUTIONS:

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

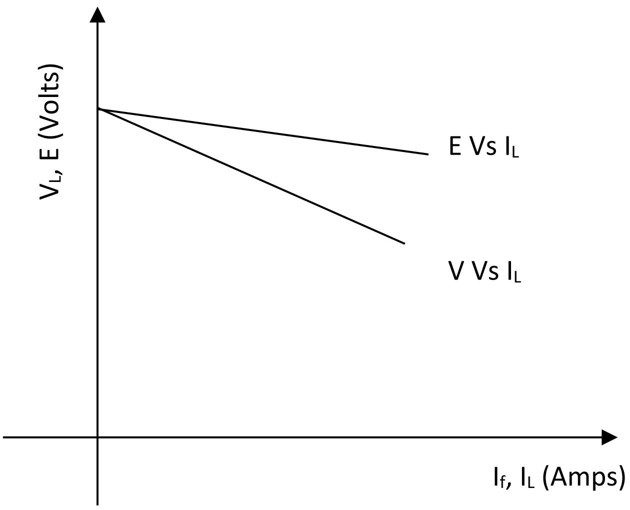
PROCEDURE:

1. Connections are made as per the circuit diagram.
2. After checking minimum position of motor field rheostat, maximum position of generator field rheostat, DPST switch is closed and starting resistance is gradually removed.
3. By adjusting the field rheostat, the motor is brought to rated speed.
4. By varying the generator field rheostat, voltmeter and ammeter readings are taken.
5. Under no load condition, Ammeter and Voltmeter readings are noted, after bringing the voltage to rated voltage by adjusting the field rheostat of generator.
6. Load is varied gradually and for each load, voltmeter and ammeter readings are noted.
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, DPST switch is opened.

TABULAR COLUMN: LOAD TEST

S.No.	Field Current I_f (Amps)	Load Current I_L (Amps)	Terminal Voltage (V) Volts	Armature current $I_a = I_L + I_f$ (Amps)	Generated Voltage $E_g = V + I_a R_a$ (Volts)
1.					
2.					
3.					
4.					
5.					
6.					
7.					

MODEL GRAPH:

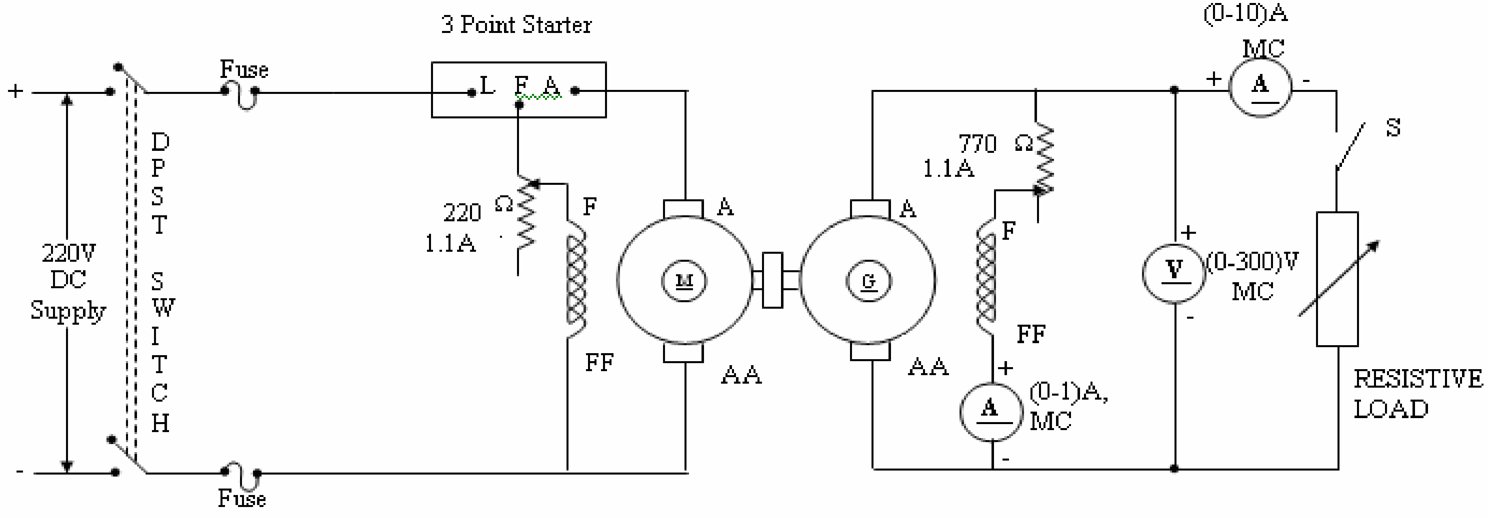


RESULT:

Thus open circuit and the load characteristics of separately excited DC shunt generator are obtained .

LOAD CHARACTERISTICS OF SELF EXCITED DC SERIES GENERATOR

CIRCUIT DIAGRAM:



FUSE RATING:

125% of rated current

$$\frac{125 \times}{100} =$$

NAME PLATE DETAILS:

	Motor	Generator
Rated Voltage :	220V	220V
Rated Current :		
Rated Power :		
Rated Speed :	1500 RPM	1500 RPM

Ex.No.2-B **Date:…………**

LOAD CHARACTERISTICS OF DC SERIES GENERATOR

AIM:

To obtain open circuit characteristics of DC series generator and to find its critical resistance. To obtain internal and external characteristics of DC series generator

APPARATUS REQUIRED:

S.No.	Apparatus	Range	Type	Quantity
1	Ammeter	(0-10)A	MC	1
2	Voltmeter	(0-300)V	MC	1
3	Voltmeter	(0-30)V	MC	1
4	Rheostats	220 Ω, 1.1A	Wire Wound	1
5	Loading Rheostat	5KW, 230V	-	1
6	Tachometer	(0-10000)rpm	Digital	1
7	SPST Switch	-	-	1
8	Connecting Wires	2.5sq.mm.	Copper	10

FORMULAE:

$E_g = V + I_a R_a$ (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

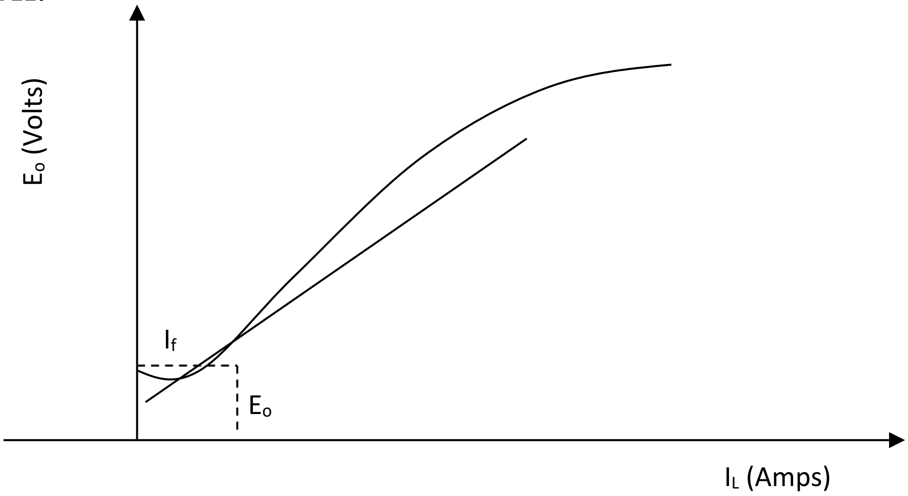
I_f : Field Current in Amps

R_a : Armature Resistance in Ohms

TABULAR COLUMN: LOAD TEST

S.No.	Load Current I_L (Amps)	Terminal Voltage (V) Volts	Armature current $I_a = I_L$ (Amps)	Generated Voltage $E_g = V + I_a (R_a + R_{se})$ (Volts)
1.				
2.				
3.				
4.				
5.				
6.				

MODEL GRAPH:



PRECAUTIONS:

1 The field rheostat of motor should be in minimum resistance position at the time of starting and stopping the machine.
2 The field rheostat of generator should be in maximum resistance position at the time of starting and stopping the machine.
3 SPST switch is kept open during starting and stopping.
4 No load should be connected to generator at the time of starting and stopping.

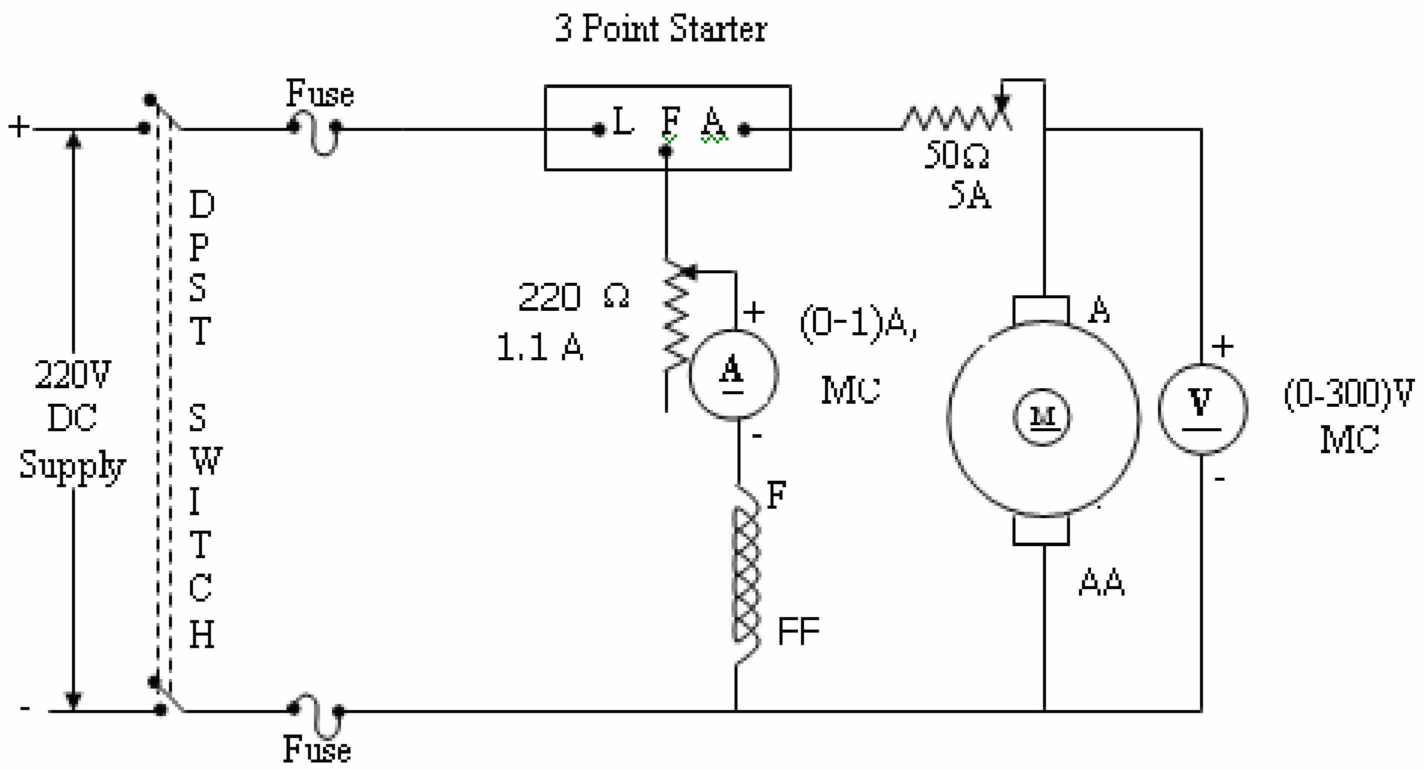
PROCEDURE:

1 Connections are made as per the circuit diagram.
2 After checking minimum position of motor field rheostat, maximum position of generator field rheostat, DPST switch is closed and starting resistance is gradually removed.
3 By adjusting the field rheostat, the motor is brought to rated speed.
4 Under no load condition, Ammeter and Voltmeter readings are noted.
5 Load is varied gradually and for each load, voltmeter and ammeter readings are noted.
6 This is repeated till the DC series generator reaches rated voltage.
7 Then the generator is unloaded and the field rheostat of DC shunt motor is brought to minimum position, DPST switch is opened.

RESULT:

Thus open circuit and the load characteristics of DC series generator are obtained and verified.

CIRCUIT DIAGRAM:



<u>FUSE RATING:</u>

125% of rated current

$$\frac{125 \times}{100} =$$

<u>NAME PLATE DETAILS:</u>

Rated Voltage :	220V
Rated Current :	
Rated Power :	
Rated Speed :	1500 RPM

Ex.No. 3 **Date:…………**

SPEED CONTROL OF DC SHUNT MOTOR

AIM:

To obtain speed control of DC shunt motor by

a. Varying armature voltage with field current constant.
b. Varying field current with armature voltage constant

APPARATUS REQUIRED:

S.No.	Apparatus	Range	Type	Quantity
1	Ammeter	(0-1) A	MC	1
2	Voltmeter	(0-300) V	MC	1
3	Rheostats	220Ω, 1.1A ; 50Ω, 3.5A	Wire Wound	Each 1
4	Tachometer	(0-10000) rpm	Digital	1
5	Connecting Wires	2.5sq.mm.	Copper	Few

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.

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. After checking the maximum position of armature rheostat and minimum position of field rheostat, DPST switch is closed

(i) Armature Control:

1. Field current is fixed to various values and for each fixed value, by varying the armature rheostat, speed is noted for various voltages across the armature.

a. Field Control:

1. Armature voltage is fixed to various values and for each fixed value, by adjusting the field rheostat, speed is noted for various field currents.

2. Bringing field rheostat to minimum position and armature rheostat to maximum position DPST switch is opened.

TABULAR COLUMN:

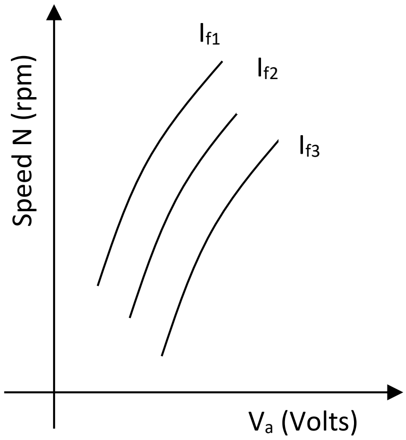
(i) Armature Voltage Control:

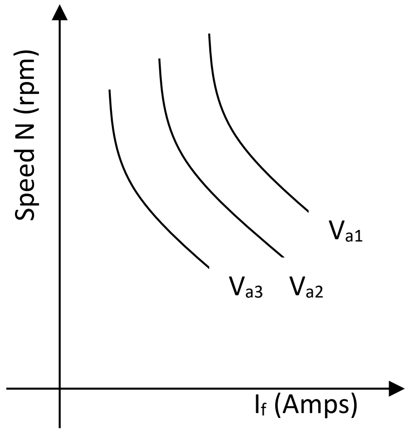
S.No.	I_{f1} =		I_{f2} =		I_{f3} =	
	Armature Voltage V_a (Volts)	Speed N (rpm)	Armature Voltage V_a (Volts)	Speed N (rpm)	Armature Voltage V_a (Volts)	Speed N (rpm)

(ii) Field Control:

S.No.	V_{a1} =		V_{a2} =		V_{a3} =	
	Field Current I_f (A)	Speed N (rpm)	Field Current I_f (A)	Speed N (rpm)	Field Current I_f (A)	Speed N (rpm)

MODEL GRAPHS:

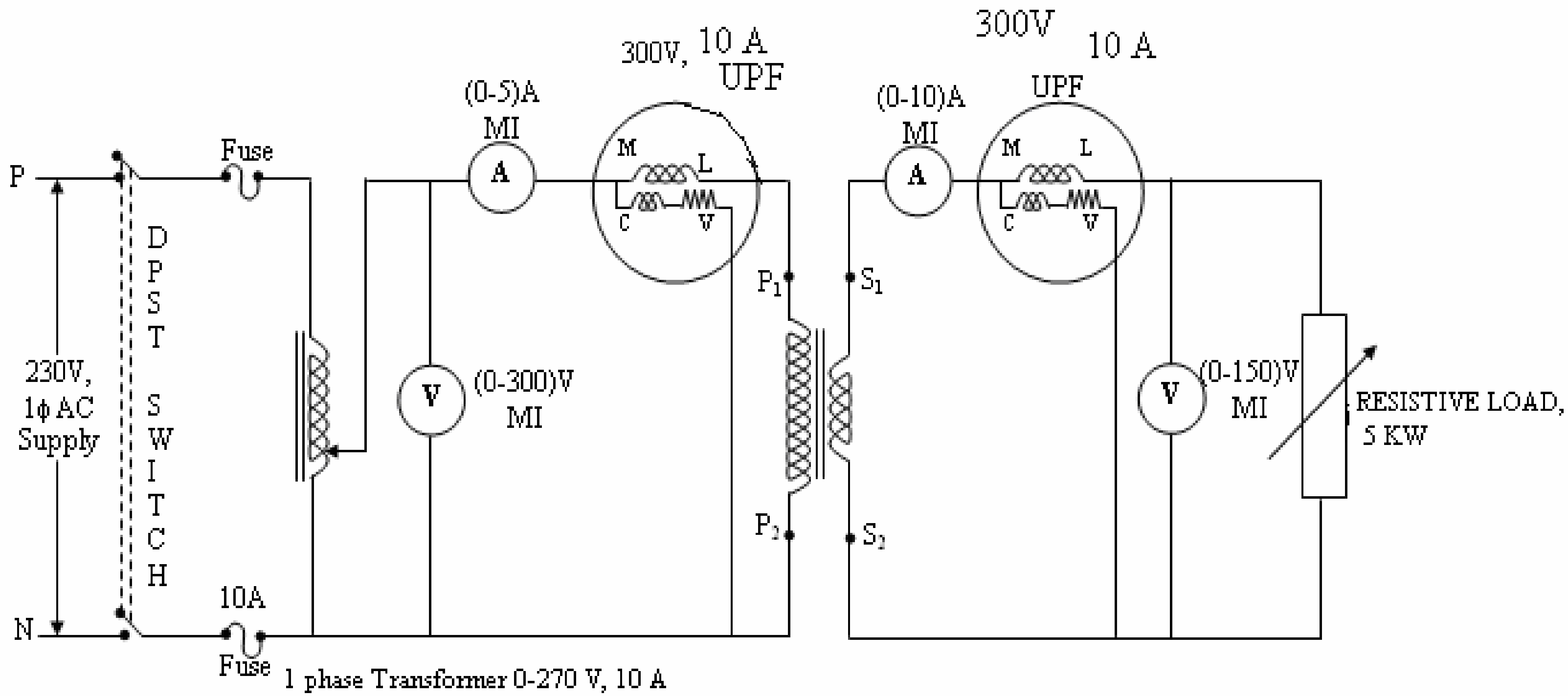




RESULT:

Thus the speed control of DC Shunt Motor is obtained using Armature and Field control methods.

CIRCUIT DIAGRAM:



FUSE RATING:

125% of rated current

$$\frac{125 \times}{100} =$$

NAME PLATE DETAILS:

	Primary	Secondary
Rated Voltage :	230V	115V
Rated Current :		
Rated Power :	1KVA	1KVA

Ex.No. 4 **Date:…………**

LOAD TEST ON A SINGLE PHASE TRANSFORMER

AIM:

To conduct load test on single phase transformer and to find efficiency and percentage regulation.

APPARATUS REQUIRED:

S.No.	Apparatus	Range	Type	Quantity
1	Ammeter	(0-10)A (0-5) A	MI MI	1 1
2	Voltmeter	(0-150)V (0-300) V	MI MI	1 1
3	Wattmeter	(300V, 10A)	Upf	2
4	Auto Transformer	1ϕ, (0-270)V	10 A	1
5	Resistive Load	5KW, 230V	-	1
6	Connecting Wires	2.5sq.mm	Copper	Few

FORMULAE:

Output Power = W_2 x Multiplication factor

Input Power = W_1 x Multiplication factor

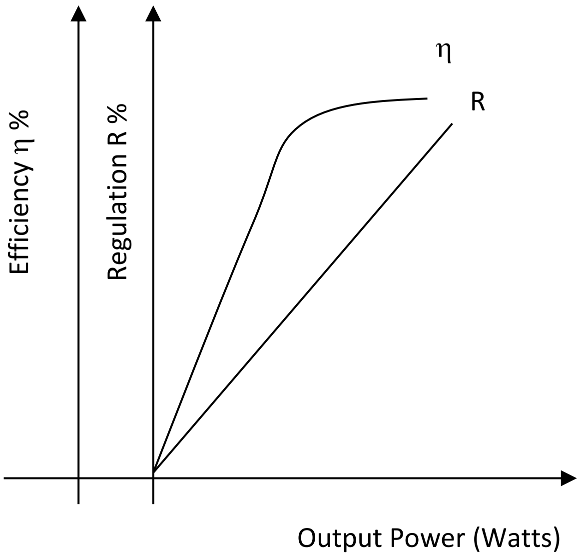
$$\text{Efficiency } \eta \% = \frac{\text{Output Power}}{\text{Input Power}} \times 100\%$$

$$\text{Regulation R } \% = \frac{V_{NL} - V_{FL} \text{ (Secondary)}}{V_{NL}} \times 100\%$$

TABULAR COLUMN:

S.No.	Load	Primary			Secondary			Input Power W_1 x MF	Output Power W_2 x MF	Efficiency %η	% Regulation
		V_1 (Volts)	I_1 (Amps)	W_1 (Watts)	V_2 (Volts)	I_2 (Amps)	W_2 (Watts)				

MODEL GRAPHS:



PRECAUTIONS:

1. Auto Transformer should be in minimum position.
2. The AC supply is given and removed from the transformer under no load condition.

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. After checking the no load condition, minimum position of auto transformer and DPST switch is closed.
3. Ammeter, Voltmeter and Wattmeter readings on both primary side and secondary side are noted.
4. The load is increased and for each load, Voltmeter, Ammeter and Wattmeter readings on both primary and secondary sides are noted.
5. Again no load condition is obtained and DPST switch is opened.

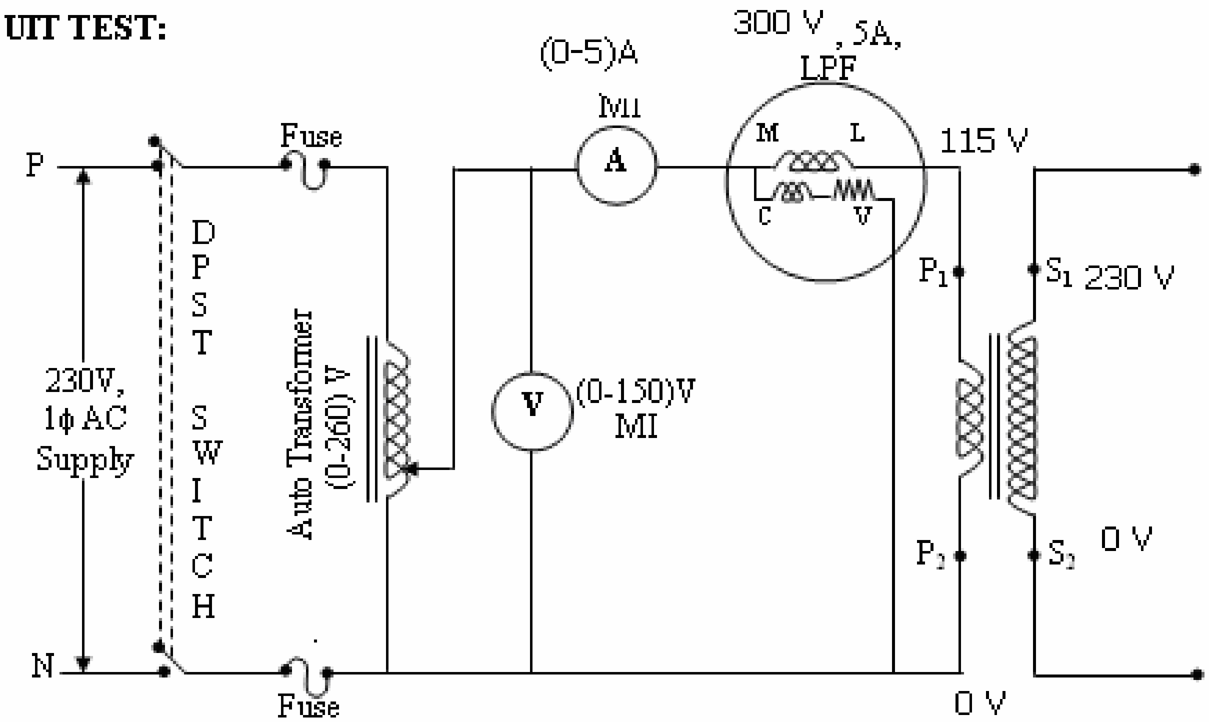
$$\text{Multiplication Factor Of wattmeter (MF)} = \frac{\text{Current Coil Rating} \times \text{Presser Coil Rating}}{\text{Full Scale Deflection}} \times \text{PF}$$

RESULT:

Thus the load test on single phase transformer is conducted.

CIRCUIT DIAGRAM:

OPEN CIRCUIT TEST:



FUSE RATING:

10% of rated current

$$\frac{10 \times \quad}{100} =$$

NAME PLATE DETAILS:

	Primary	Secondary
Rated Voltage :	115V	230V
Rated Current :		
Rated Power :	1KVA	1KVA

Ex. No. 5 **Date:…………….**

OPEN CIRCUIT & SHORT CIRCUIT TEST ON A SINGLE PHASE TRANSFORMER

AIM:

To predetermine the efficiency and regulation of a transformer by conducting open circuit test and short circuit test and to draw equivalent circuit.

APPARATUS REQUIRED:

S.No.	Apparatus	Range	Type	Quantity
1	Ammeter	(0-5) A	MI	1
2	Voltmeter	(0-150)V	MI	1
3	Voltmeter	(0-75)V	MI	1
4	Wattmeter	(300V, 5A) (300V, 5A)	LPF UPF	1 1
5	Auto Transformer	(0-270) V	10 A	1
6	Connecting Wires	2.5sq.mm	Copper	Few

FORMULAE:

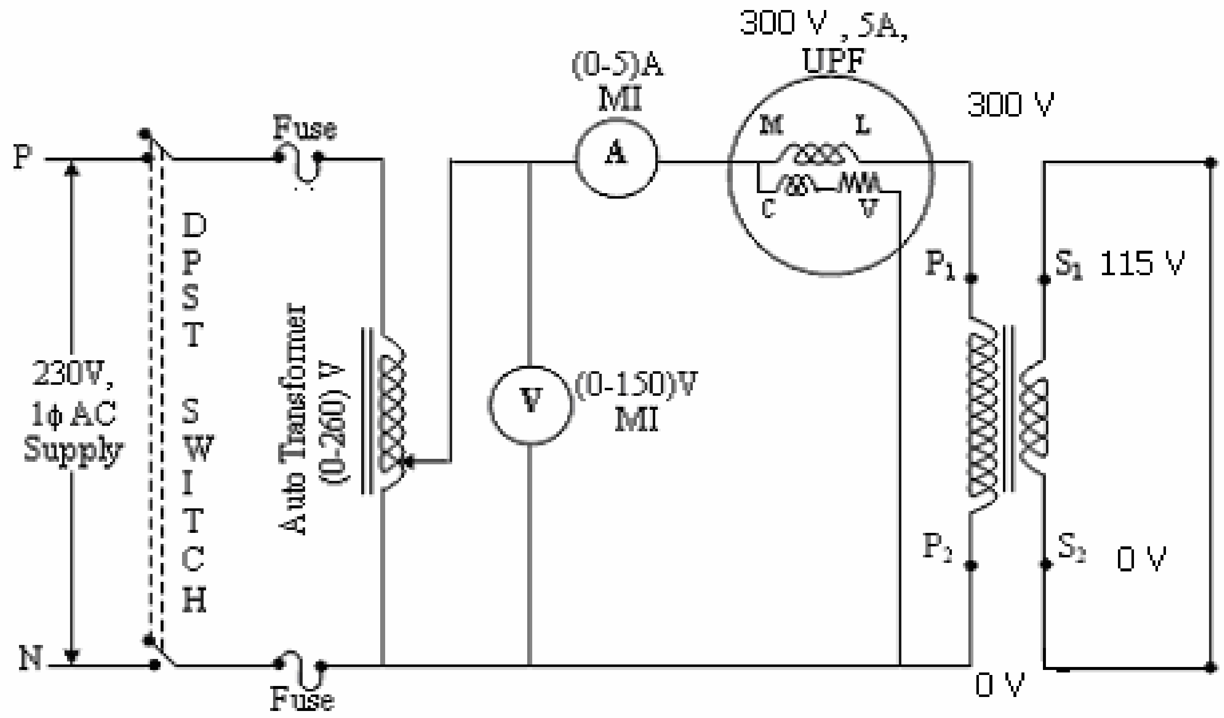
Core loss: $W_o = V_o I_o \cos\phi_o$

$$\cos\phi_o = \frac{W_o}{V_o I_o} \qquad \phi_o = \cos^{-1}\frac{W_o}{V_o I_o}$$

$I_\omega = I_o \cos\phi_o$ (Amps) $I_\mu = I_o \sin\phi_o$ (Amps)

CIRCUIT DIAGRAM:

SHORT CIRCUIT TEST:



FUSE RATING:

125% of rated current

$$\frac{125 \times}{100} =$$

NAME PLATE DETAILS:

	Primary	Secondary
Rated Voltage :	230V	115V
Rated Current :	4.3 A	8.6 A
Rated Power :	1KVA	1KVA

Percentage Efficiency: **for all loads and p.f.**

$$\text{Efficiency } \eta\% = \frac{\text{Output Power}}{\text{Input Power}} = \frac{(X) \times \text{KVA rating} \times 1000 \times \cos\phi}{\text{Output power + losses}}$$

$$= \frac{(X) \times \text{KVA rating} \times 1000 \times \cos\phi}{(X) \times \text{KVA rating} \times 1000 \times \cos\phi + W_o + X^2 W_{sc}}$$

Percentage Regulation:

$$R\% = \frac{(X) \times I_{sc} (R_{o2} \cos\phi \pm X_{o2} \sin\phi) \times 100}{V_2}$$

+ = lagging

- = leading

Where X is the load and it is 1 for full load, ½ for half load, ¾ load, ¼ load etc.. and the power factor is, upf, o.8 p.f lag and 0.8 p.f lead

PRECAUTIONS:

1. Auto Transformer should be in minimum voltage position at the time of closing & opening DPST Switch.

PROCEDURE:

OPEN CIRCUIT TEST:

1. Connections are made as per the circuit diagram.
2. After checking the minimum position of Autotransformer, DPST switch is closed.
3. Auto transformer is adjusted to get the rated primary voltage (150 V).
4. Voltmeter, Ammeter and Wattmeter readings on primary side are noted.
5. Auto transformer is again brought to minimum position and DPST switch is opened.

SHORT CIRCUIT TEST:

1. Connections are made as per the circuit diagram.
2. After checking the minimum position of Autotransformer, DPST switch is closed.
3. Auto transformer is adjusted to get the rated primary current.
4. Voltmeter, Ammeter and Wattmeter readings on primary side are noted.

Auto transformer is again brought to minimum position and DPST switch is opened

TABULAR COLUMN:

OPEN CIRCUIT TEST:

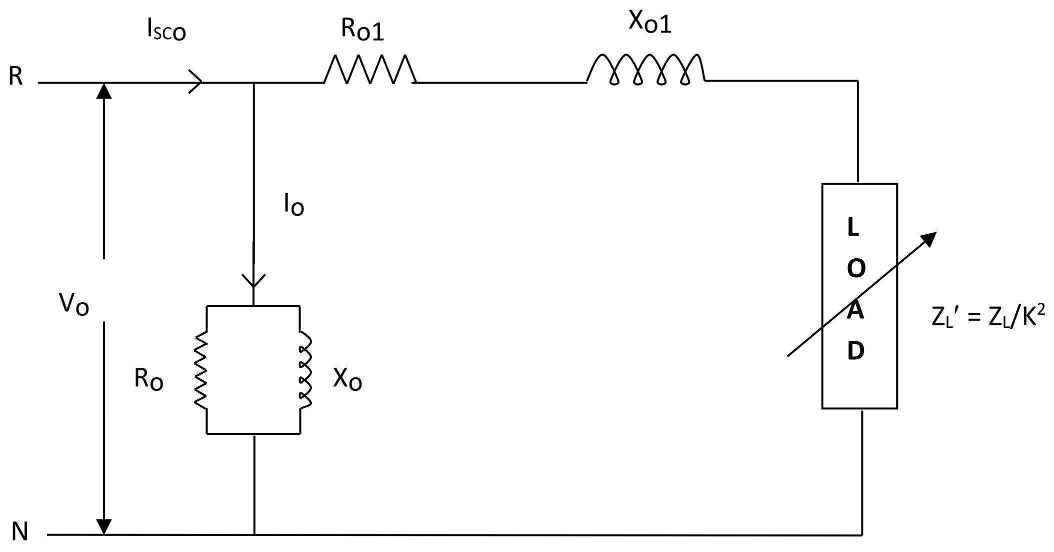
V_o (Volts)	I_o (Amps)	W_o (Watts)

SHORT CIRCUIT TEST:

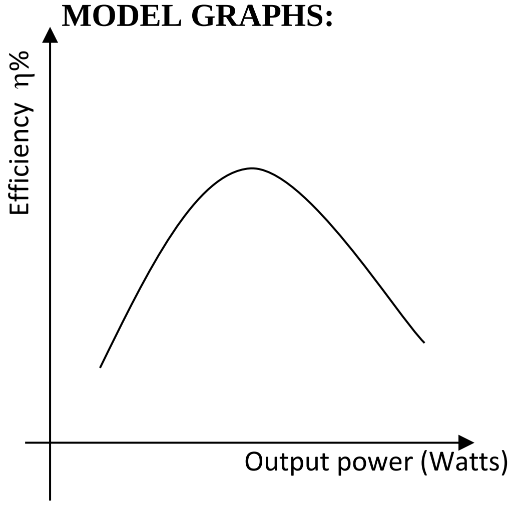
V_{sc} (Volts)	I_{sc} (Amps)	W_{sc} (Watts)

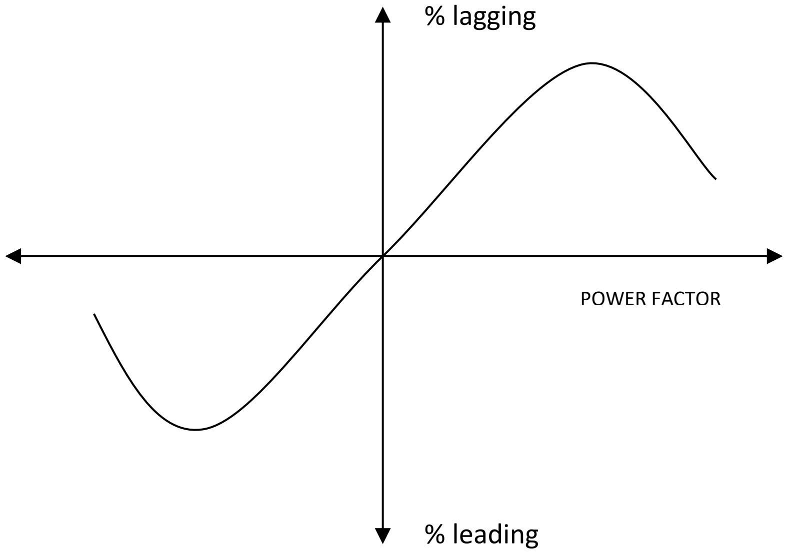
Current Coil Rating X Presser Coil Rating
Multiplication Factor = -- X PF
Of wattmeter (MF) Full Scale Deflection

EQUIVALENT CIRCUIT:



MODEL GRAPHS:

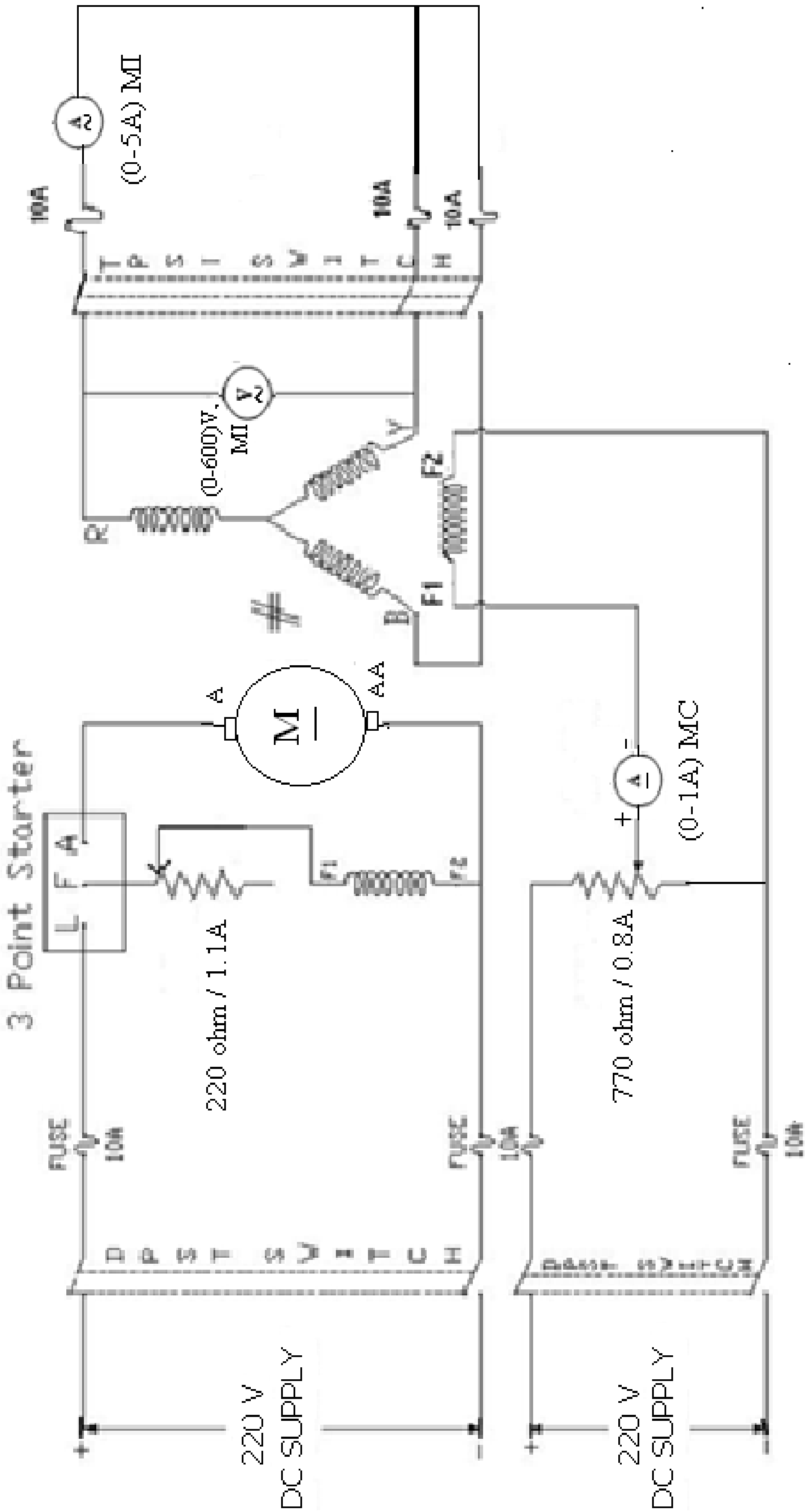




RESULT:

Thus the efficiency and regulation of a transformer is predetermined by conducting open circuit test and short circuit test and the equivalent circuit is drawn.

Ex.No. 6


(0-5A) MI
10A
TPST SWITCH
(0-600)V,
MI
R
Y
B
F1
F2
A
AA
M
3 Point Starter
L F A
220 ohm / 1.1A
770 ohm / 0.8A
(0-1A) MC
FUSE
10A
DPST SWITCH
220 V
DC SUPPLY
220 V
DC SUPPLY

Date:…………

REGULATION OF ALTERNATOR BY EMF & MMF METHOD

AIM:

To pre-determine the regulation of alternator by EMF & MMF method.

APPARATUS REQUIRED:

Sl.No.	Name of apparatus	Range	Type	Quantity
1	Voltmeter	0-600V	MI	1
2	Ammeter	0-5A	MI	1
3	Ammeter	0-1A,0-10A	MC	Each one
4	Rheostat	220 ohms / 1.1A, 770 ohms / 0.8 A	Wire wound	Each one
5	Connecting wires	-	-	12

Formula:

$$Z_s = \frac{\text{Open circuit voltage}}{\text{Short circuit current}} \quad \text{at constant field current}$$

$R_{dc} = 1.6 \times R_a$

$X_S = \sqrt{(Z_S^2 - R_{ac}^2)}$

Z_S → Synchronous impedance (Ω)

X_S → Synchronous Reactance (Ω)

R_{ac} → Effective Resistance (Ω)

$$E_O = \sqrt{(V\cos\varphi + I_aR_{ac})^2 + (V\sin\varphi \pm I_aX_S)^2}$$

(+ → lagging p.f and - →leading p.f)

V → rated voltage (volts) I_a → rated armature current (volts)
R_{ac} → effective resistance (Ω) Cosφ→ power factor

$$\% \text{ Regulation} = \frac{E_0 - V}{V} \times 100\ \%$$

Tabulation:

Open circuit test:

Sl.No	I_f (Amperes)	Open circuit line voltage E_0(Volts)	Open circuit phase voltage E PH=$E_{0\ /\ /3}$ (Volts)
1.			
2.			
3.			
4.			
5.			
6.			
7.			

Short circuit test:

I_{f2} (Amperes)	I_{sc} (Amperes)

Precautions:

- TPST switch must be kept open.
- Motor side rheostat must be kept in minimum position and alternator side rheostat in maximum position.

Procedure:

Open circuit test:

- Make the connections as per the circuit diagram.
- Switch on the supply.
- Start the motor –alternator set by using starter.
- Adjust the field rheostat of the motor to get the rated speed.
- Increase the alternator field current in convenient steps and note down all the meter readings upto 125% of the rated voltage.
- Bring back the rheostat to the original position.

Short circuit test:

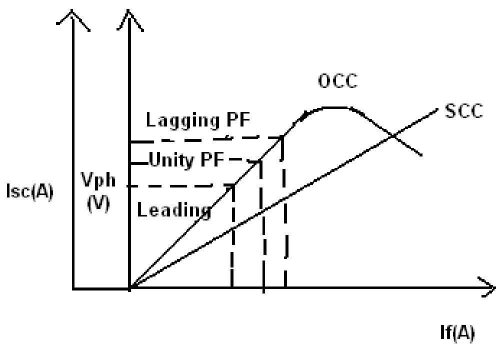
- Close the TPST switch and adjust the potential divider such that the maximum full load current flows through the armature winding.
- Note down all the meter readings.
- Bring back the rheostats to original position and switch off the supply.

Calculation of Regulation by EMF & MMF :

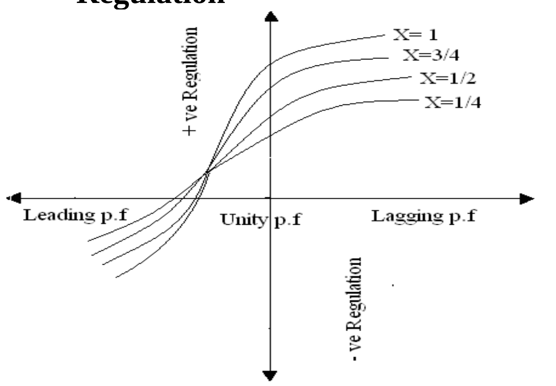
Cosφ	Sin φ	E_{ph} (volts)		% Regulation	
		Leading EMF	leading MMF	lagging EMF	lagging MMF

MODEL GRAPH:

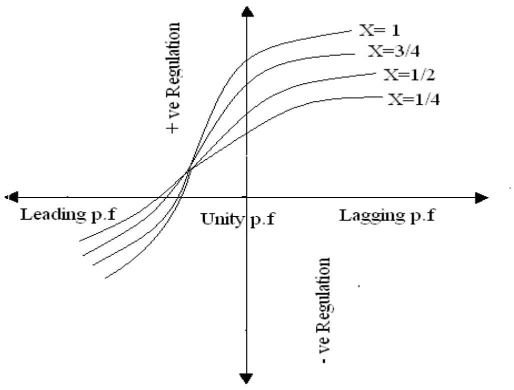
OCC & SCC



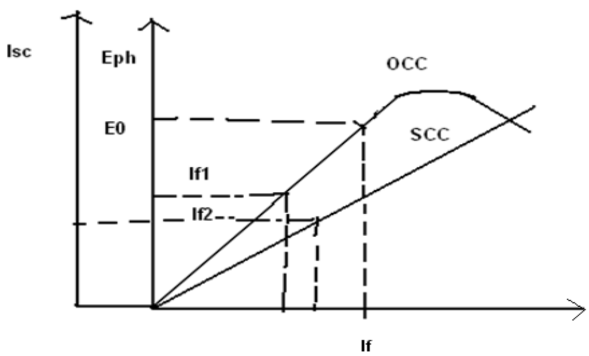
EMF Method
Regulation



MMF Method
Regulation

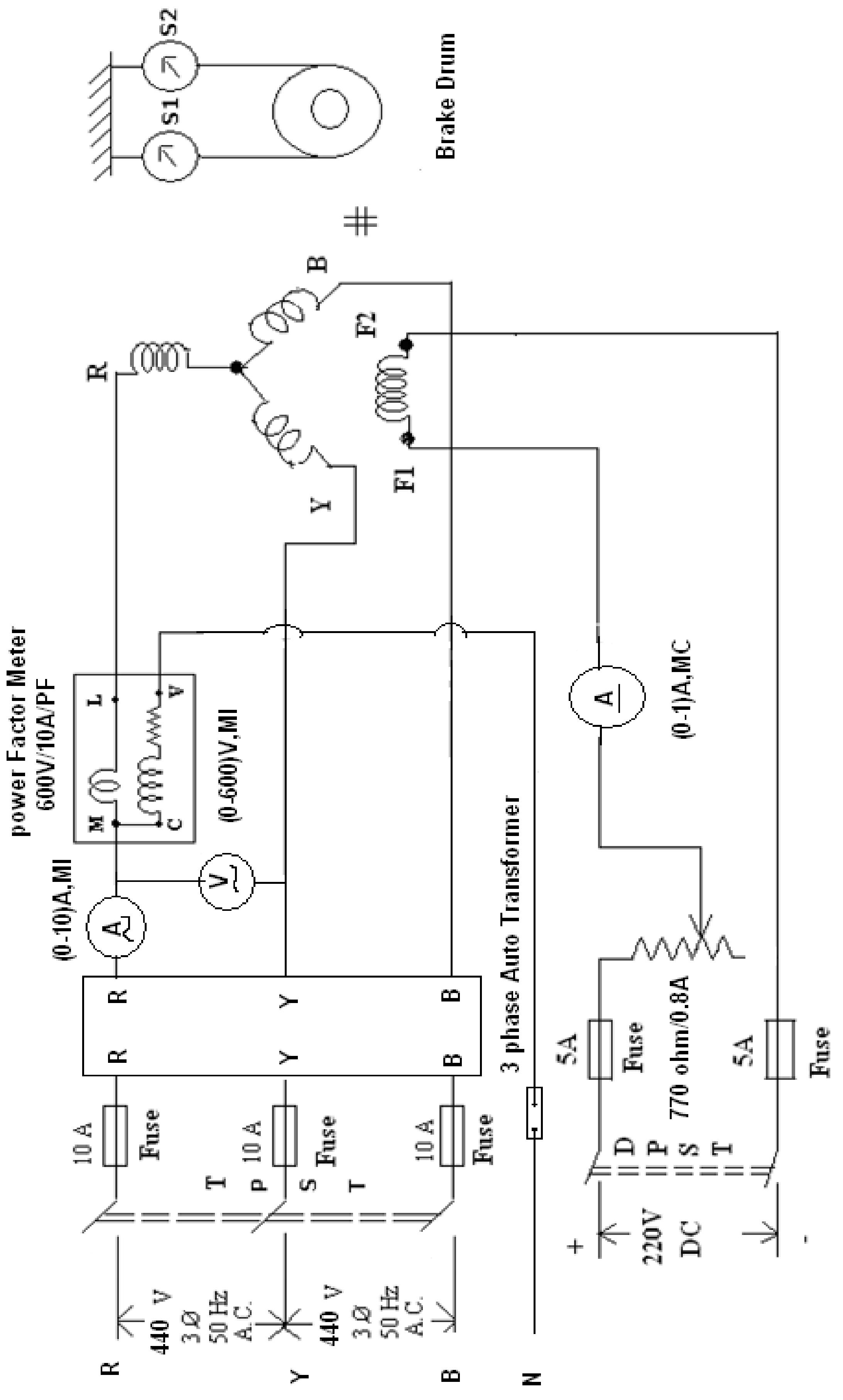


OCC&SCC



RESULT:

Thus the regulation of alternator by EMF and MMF method was determined and the characteristic curve was drawn.



S1
S2
Brake Drum
R
B
Y
F1
F2
power Factor Meter
600V/10A/PF
M
L
C
V
(0-600)V,MI
(0-10)A,MI
(0-1)A,MC
R
Y
B
3 phase Auto Transformer
10 A
Fuse
TPST
5A
Fuse
770 ohm/0.8A
DPST
440 V
3 Ø
50 Hz
A.C.
220V
DC
+
-
N

Ex.No. 7 **Date:……..**

V and Inverted V curves of Three Phase Synchronous Motor

AIM:

To draw the V and inverted V curves of the three phase synchronous motor.

APPARATUS REQUIRED:

S.NO	APPARATUS	TYPE	RANGE	QUANTITY
1.	Ammeter	MC, MI	(0-5)A, (0-10)A	1, 1
2	Voltmeter	MI	(0-600)V	1
3.	Power factor Meter	-------	600V,10A,	1
4	Connecting Wires	-		Req.

PROCEDURE:

- Connections are made as per the circuit diagram.
- In order to give the excitation to the field for making it to run as the synchronous motor close the TPST switch.
- By varying the field rheostat note down the excitation current, armature current and the power factor for various values of excitation.
- The same process has to be repeated for loaded conditions. Later the motor is switched off and the graph is drawn.

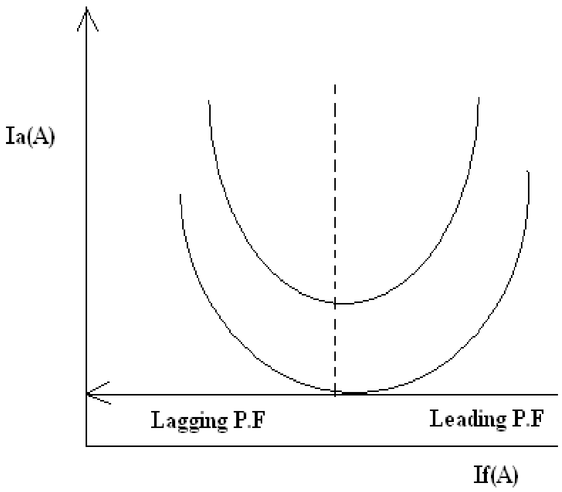
TABULATION:

WITHOUT LOAD CONDITION

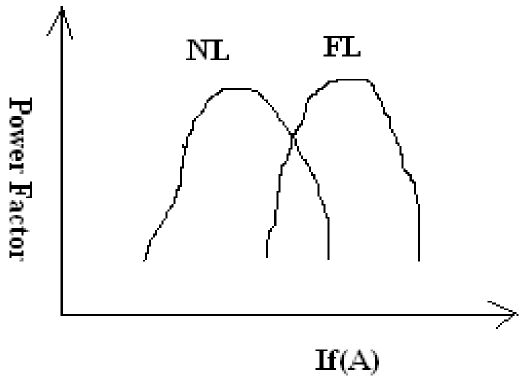
Sl. No.	Excitation Current If(amps)	Armature Current Ia(amps)	Power Factor cosΦ
1.			
2.			
3.			
4.			
5.			
6.			

MODEL GRAPH:

i) EXCITATION CURRENT Vs ARMATURE CURRENT



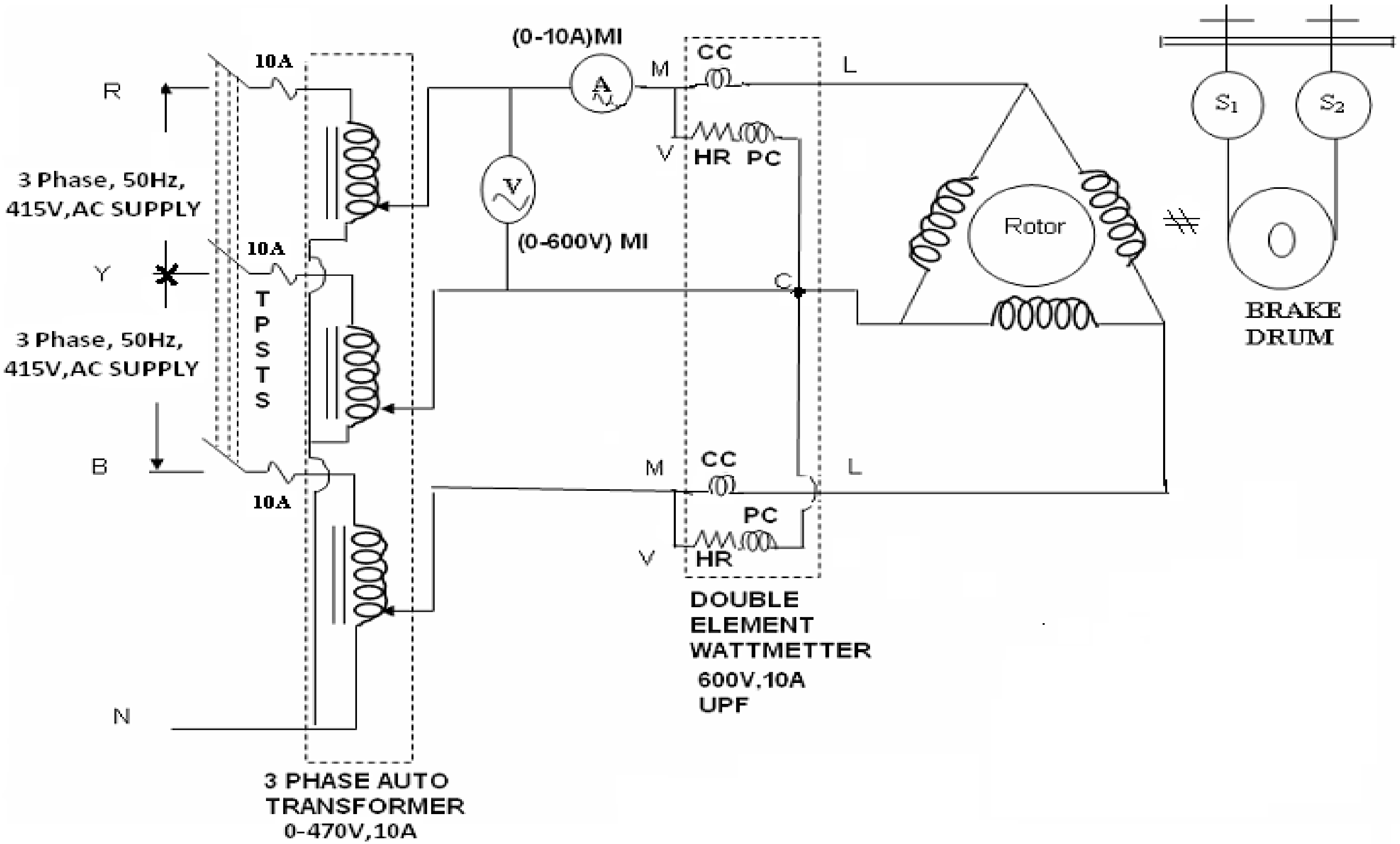
ii) EXCITATION CURRENT Vs POWER FACTOR



RESULT:

Thus the V and inverted V curves of the three phase synchronous motor were drawn.

CIRCUIT DIAGRAM FOR SQUIRREL CAGE INDUCTION MOTOR



Ex.No. 8 **Date:……….**

LOAD TEST ON 3PHASE SQUIRREL CAGE INDUCTION MOTOR

AIM:

To determine the performance characteristics of the given 3φ squirrel cage induction motor by conducting load test.

APPARATUS REQUIRED:

Sl.No.	Name	Range	Type	Quantity
1	Voltmeter	0-600V	MI	1
2	Ammeter	0-10A	MI	1
3	Double element Wattmeter	600V,10A	Dynamometer	1
4	Connecting wires	-	-	As required
5	Tachometer	-	Digital	1

Formula:

Input power = W x MF (watts)

Torque (T) = (S1 ~ S2) x 9.81 x r (N-m)

Output power = 2ΠNT / 60 watts

Efficiency = output power / input power x 100%

Slip $= \frac{N_S - N}{N_S} \times 100\ \%$

S_1, S_2= spring balance readings in Kg.

R = radius of the brake drum in m (circumference / 2Π)

N = Actual speed of the rotor in rpm

T = Torque (N-m)

N_S = Synchronous speed rpm

$$PF = \frac{\text{Input power}}{\sqrt{3} V_L\, I_L}$$

TABULAR COLUMNS FOR 3-PHASE SQUIRREL CAGE INDUCTION MOTOR

S. No	Load Current (I_L) Amps	Load Voltage (V_L) Volts	Input Power (W)	Speed (N) rpm	Spring Balance Reading Kg			Torque (T) N-m	Output power (W)	% η	Slip (S) %	Power Factor (cosΦ)
					S_1	S_2	S_1-S_2					

Thickness of Belt=--------- m

Radius of brake drum= ------ m

Precautions:

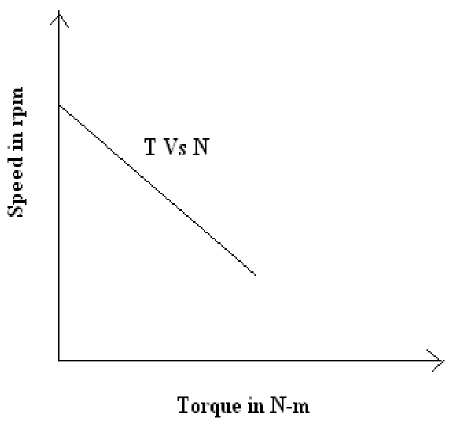
- There should be no load at the time of starting.
- Auto transformer must be kept at minimum position

Procedure:

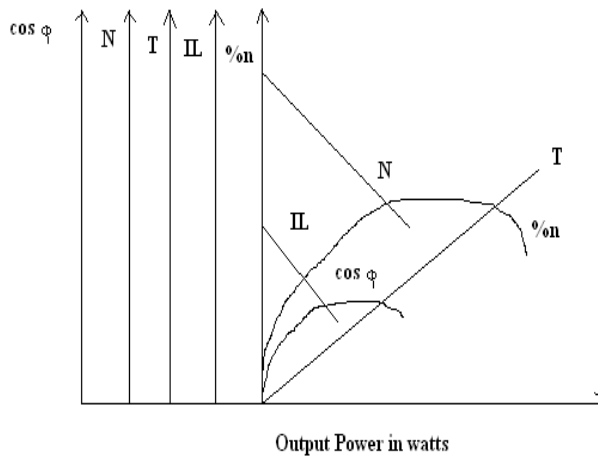
- Make the connections as per the circuit diagram.
- Switch on the supply and adjust the auto transformer to get the rated voltage and note down the no load readings.
- Adjust the loads and for various loads note down the corresponding meters reading till the rated current is reached.
- Unload the motor, bring back the auto transformer to minimum position and switch off the supply.

MODEL GRAPH

MECHANICAL CHARACTERISTICS

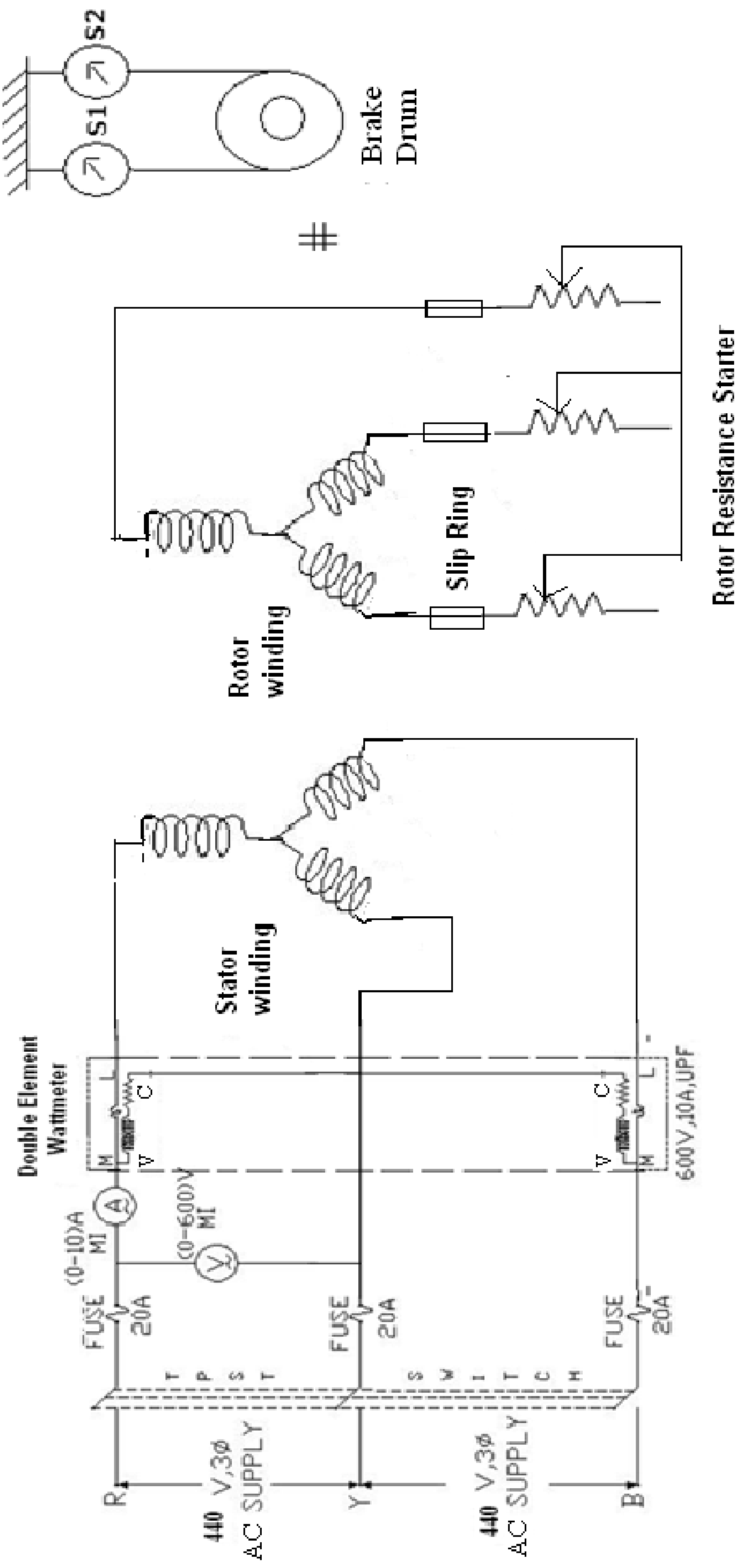


ELECTRICAL CHARACTERISTICS



RESULT:

Thus the load test on 3 phase induction motor was done and the characteristic curve was drawn.


S1
S2
Brake Drum
Rotor winding
Slip Ring
Rotor Resistance Starter
Stator winding
Double Element Wattmeter
M
L
C
V
600V,10A,UPF
(0-10)A MI
(0-600)V MI
FUSE 20A
FUSE 20A
FUSE 20A
TPST SWITCH
R
Y
B
440 V,3Ø AC SUPPLY
440 V,3Ø AC SUPPLY

Ex.No. 9 **Date:…………**

Speed control of three-phase Slip Ring Induction motor

AIM:

To conduct load test on three phase slip ring Induction motor and to draw the performance characteristics curve.

APPARATUS REQUIRED:

S.NO	APPARATUS	TYPE	RANGE	QUANTITY
1	Voltmeter	(0-600) V	MI	1
2	Tachometer	Digital	(0-10000)RPM	1
3	Connecting Wires	-		As Required

FUSE RATING CALCULATION:

125% of rated current.

PRECAUTION:

1. TPST switch should be at open position.
2. 3-phase autotransformer should be at minimum voltage position.
3. There should be no-load at the time of starting (Loosen the belt on the brake drum)

PROCEDURE:

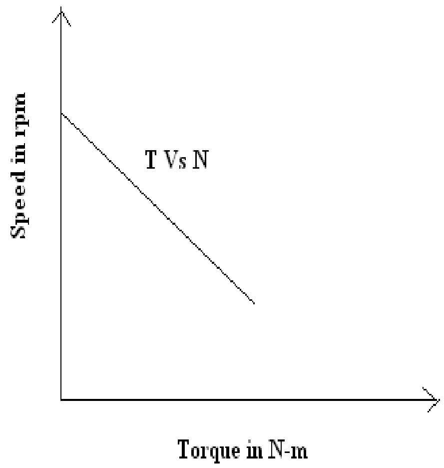
1. Note down the name plate details of motor.
2. The connections are made as per the circuit diagram.
3. The TPST switch is closed and the motor is started to run at rated speed.
4. Rated voltage of 3-phase induction motor, is applied by adjusting autotransformer
5. The initial readings of ammeter, voltmeter and wattmeter are noted.
6. By increasing the load step by step, the reading of ammeter, voltmeter and wattmeter
7. Decrease the load; bring auto-transformer to its minimum voltage position.
8. Switch off the supply and the graph is drawn.

TABULATION FOR SPEED CONTROL ON 3-PHASE SLIP RING INDUCTION MOTOR:

S. No	Load Voltage (V_L) Volts	Rotor Resistance Position	Speed (N) rpm
1.			
2.			
3.			
4.			
5.			
6.			
7.			

MODEL GRAPH:

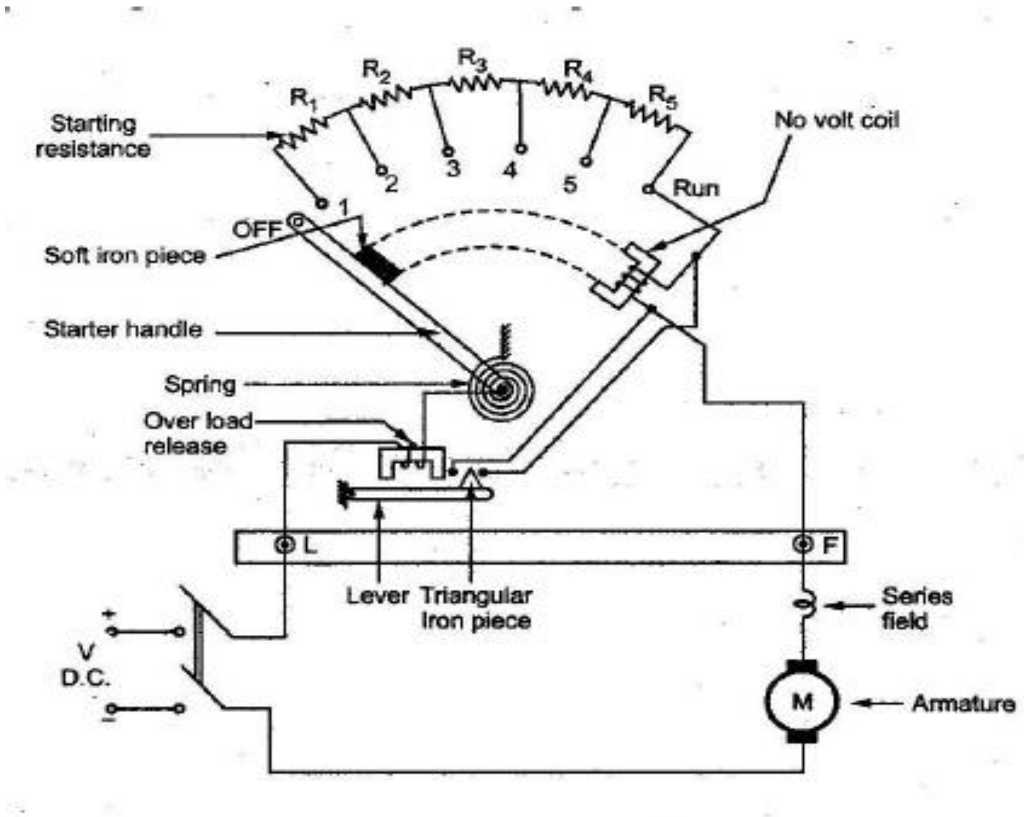
MECHANICAL CHARACTERISTICS



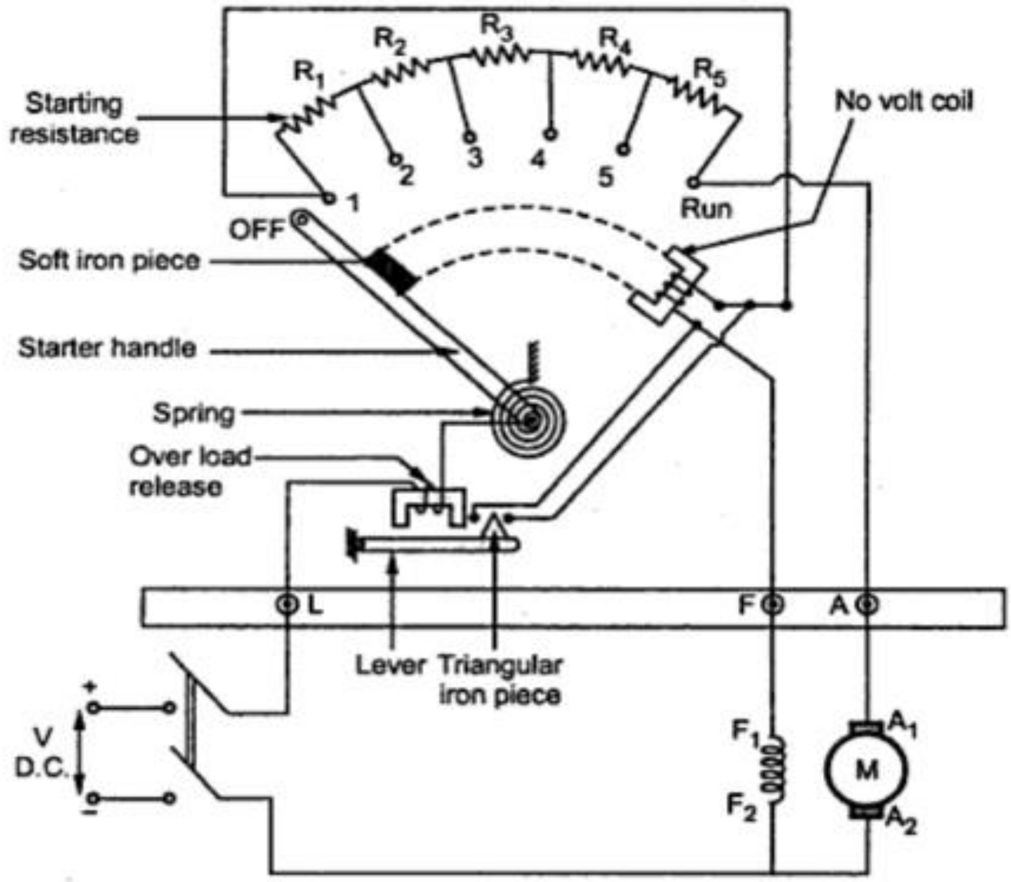
RESULT:

Thus the load test on three phase slip ring induction motor is conducted and its performance characteristics curves are drawn.

TWO POINT STARTER



THREE POINT STARTER



Ex.No. 10 **Date:……….**

Study of DC & AC Starters

AIM:

To study about the DC motor starter.

TWO POINT STARTER:

A two point starter is used for switching a series motor which has the problem of over spreading due to loss at the load from the shaft. Here for starting the motor, the control on in moved clockwise from its position against the spring tension. The control arm is held in the 'ON' position by an electromagnet. This held on electromagnet connected in series with the armature circuit. If the motor losses it load current and hence the strength of the electromagnet also decreases. The control arm return to the DFF position due to a spring tension, thus the preventing motor from over spreading the starter which are connected with the supply and motor terminals

THREE POINT STARTER:

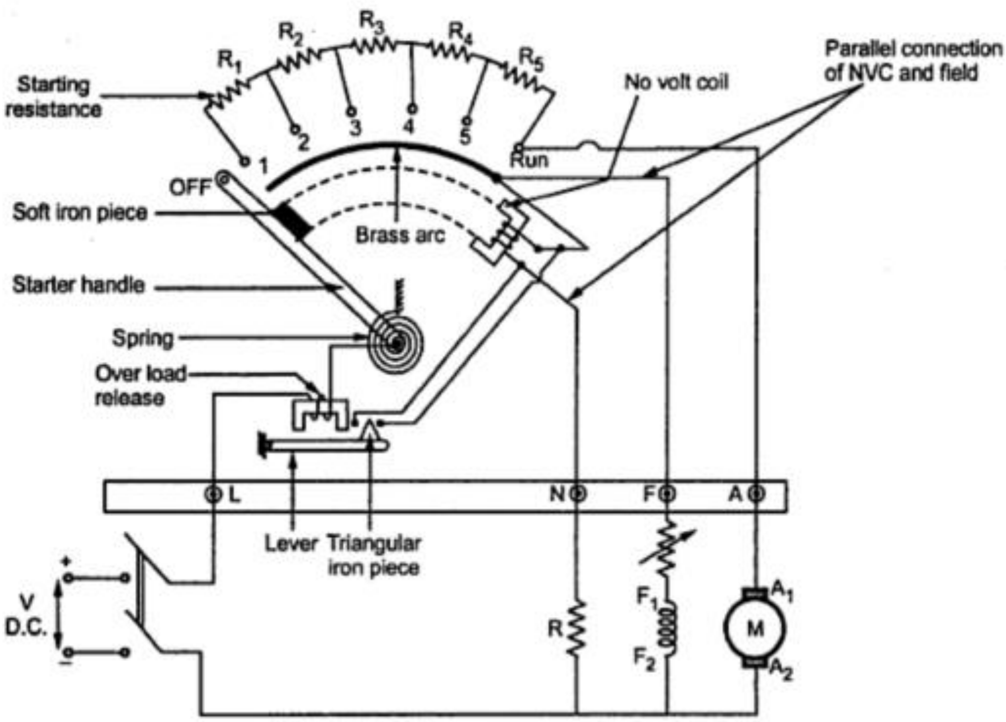
If is used for starting a shunt on compound motor will at the load held on electromagnet is connected in series with the shunt field coil. In case at disconnection in the field circuit due to the internal feature (or) field rheostat failure. The control arm will retain to its OFF position due to spring tension. It is necessary because the shunt motor will over speed is it losses the field excitation.

The starter also retains to the OFF position in case of low supply using no volt release over load protection for the motor can be interrupted by connecting another electromagnetic coils. This coil falls on iron piece upwards within short circuit the coil ab hold down electromagnet.

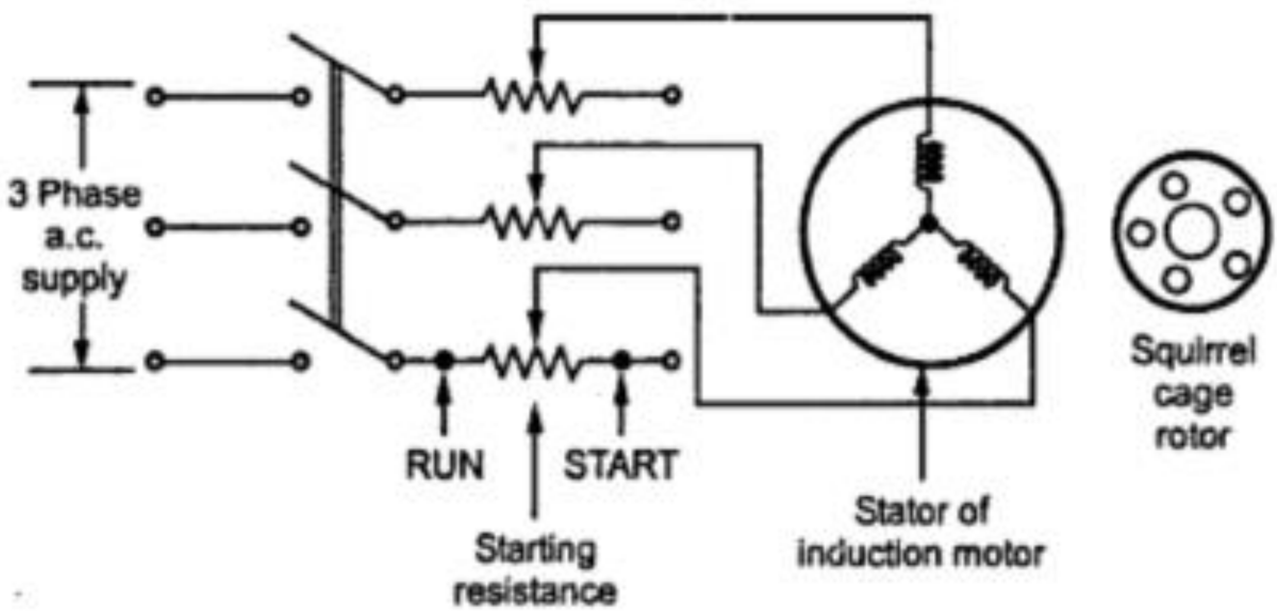
The electromagnet gets de-energized and three force the starter arm return to 'OFF' position. Thus protecting the motor against overload.

If should be noted that (L, F, A) are three terminals of a three point starter use at a grass strip as shown in fig enables can't of the field circuit directly with the supply is stead of via the starter resistance.

FOUR POINT STARTER:



STATOR RESISTANCE STARTER



FOUR POINT STARTER:

When compared to three point starter it will be noticed that one important change has been taken at the shunt field circuit and has been connected directly access the time through a protecting resistance. When the arm touches stud no.1 the line current divides into three parts.

1. One part posses through the starting resistance Rs series field and motor armature.
2. The second part posses through the shunt field and its field.

It should be particularly noted that this arrangement any change at current is the shunt field doesn't offer the current passing through the motion coil. It means the electromagnet full excited by the hold on coil.

THREE PHASE INDUCTION MOTOR STARTERS:

1. AUTO TRANSFORMER STARTER:

It is also known as autotransformers or compensator. It consists of an autotransformers with necessary switches or three phase transformers reduced voltage is applied to the motor when the motor pick up 80%. So, that the transformer is out- out and full voltage is given to the motor most of the autotransformer are provided with 3 sets of tops so as to reduce the voltage to 85, 60 up to 50% of the line voltage.

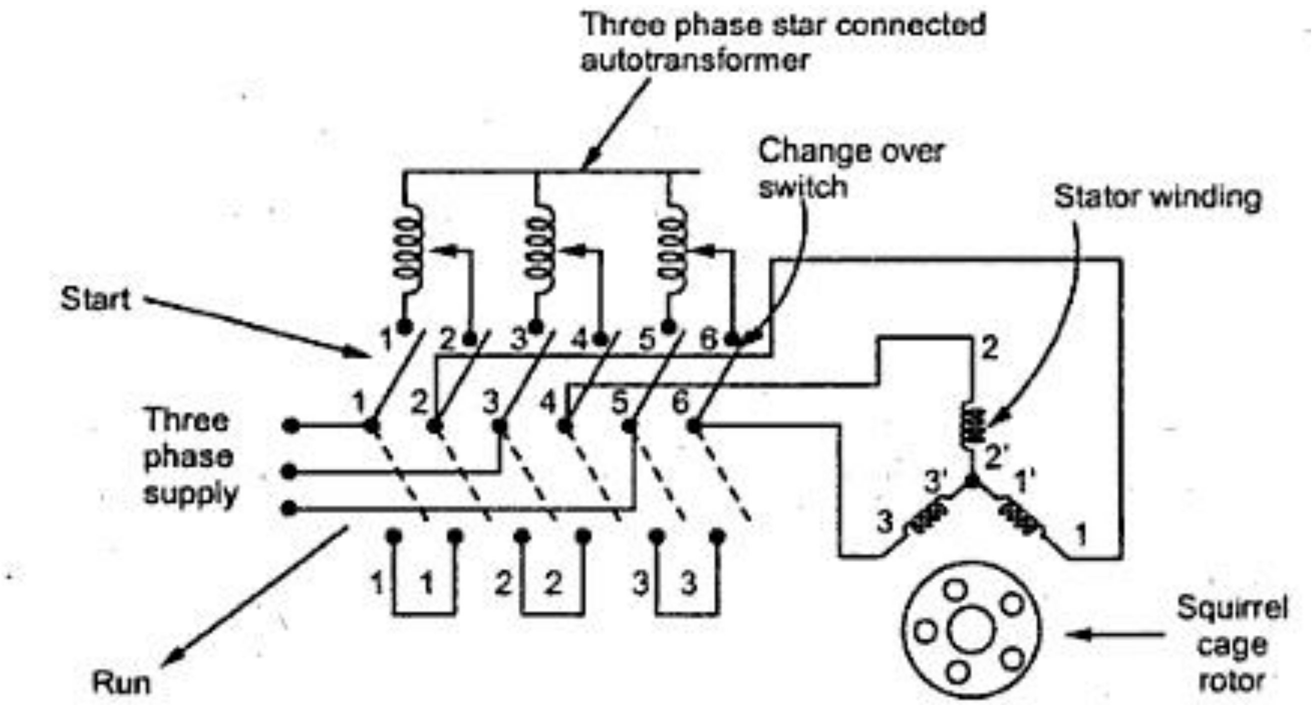
2. STAR – DELTA STARTER:

This method is used in the case of the motor which one built t run normally with a delta connected starter winding. It consists of two way switch connect the motor in star for starting and then delta for normal running. The star connected applied voltage by a factor of 1/□3 and hence the torque developed because 1/□3 of that of which would have been developed if the motor war directly connected in the delta.

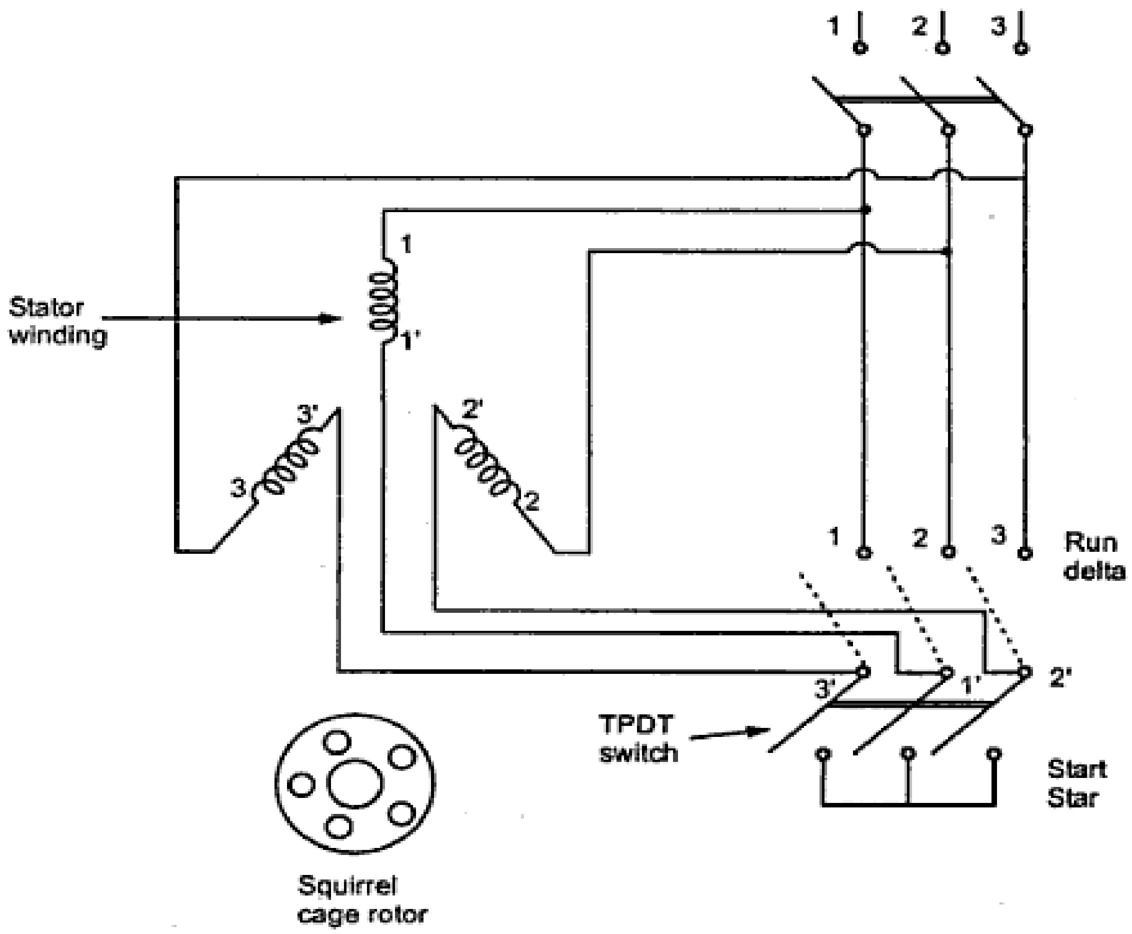
The Three types of star delta starters are;

1. Hand Operated
2. Semi Automatic
3. Fully Automatic

AUTO TRANSFORMER STARTER



STAR DELTA STARTER



3. DIRECT ON LINE STARTER (or) D.O.L. STARTER:

When fully voltage is supplied across the starters of induction motor, lot of current in drawn by the winding. This is because at the time of starting the induction motor are started using direct on line starter on heavy starting current will flow through the winding such as heavy starting current of short duration may not cause to the motor. Since the construction of induction motor are rugged.

More over it takes time for temperature rise to endanger the utilization of motor windings. But this heavy impression current will cause large voltage drop with the linear during the period of motor

A direct alternate method at starting of induction motor is application up to starting of induction motor. The ON push button is pressed coil A becomes energized and if open contacts are closed when OFF button push button is pressed in a will get energized and main contacts of the conductor open when the motor starts, in case of overload on the motor the contact of over load may be opened and sub sequent the motor will stop.

Result:

Thus the AC & DC motor starters were studied.

	EX.No	EX.No	EX.No	EX.No	EX.No	EX.No	EX.No	EX.No	EX.No	EX.No	EX.No
BATCH 1	1A	1B	2A	2B	3	4	5	6	7	8	9
DATE											
BATCH 2	1B	2A	2B	1A	4	5	3	9	8	7	6
DATE											
BATCH 3	2A	2B	1A	1B	5	3	4	8	7	6	9
DATE											
BATCH 4	2B	1A	1B	2A	3	4	5	7	6	9	8
DATE											