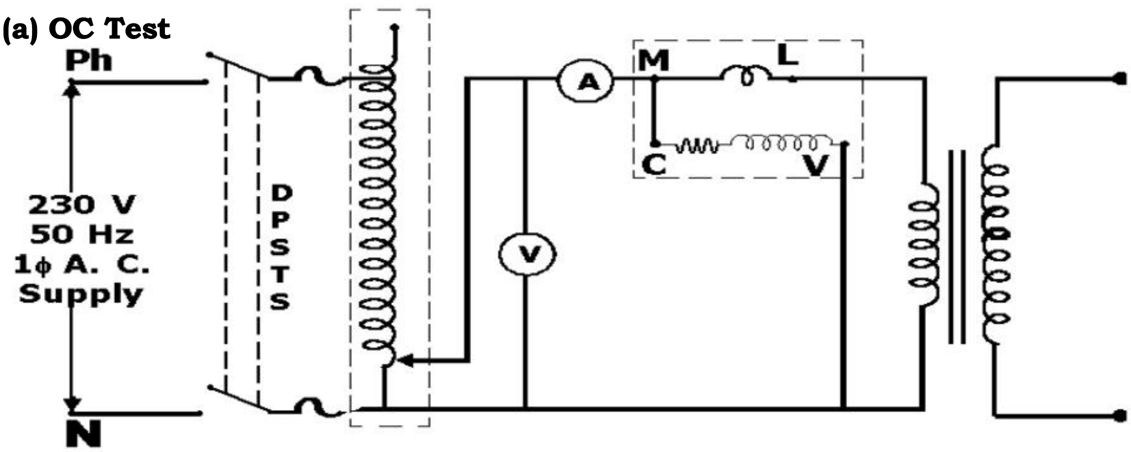
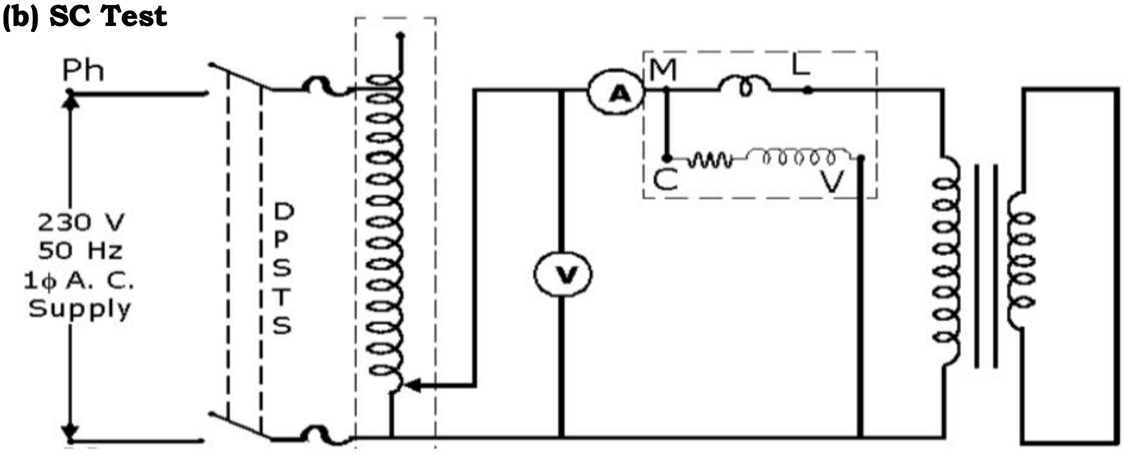
OC & SC TESTS ON SINGLE PHASE TRANSFORMER

Circuit Diagram:

(a) OC Test



(b) SC Test



Name Plate Details 1Φ T/F:

KVA =

LV Voltage =

HV Voltage =

Frequency =

OC& SC TESTS ON SINGLE PHASE TRANSFORMER

Exp. No. **Date:**

AIM:

To predetermine the efficiency, regulation at different operating conditions by conducting open circuit and short circuit tests on a single-phase transformer

APPARATUS:

S. No.	Name	Range	Type	Quantity
1.	Voltmeter			
2.	Voltmeter			
3.	Ammeter			
4.	Ammeter			
5.	Wattmeter			
6.	Wattmeter			
7.	Single-phase variac			
8.	Connecting wires			

PROCEDURE:

Open Circuit Test:

It is usually done on the L.V. side, keeping the H.V. side open.

1) Make the connections as shown in the circuit diagram.
2) Apply the rated V_0 voltage to L.V using variac
3) Note down the no load current I_0 and power W_0 for rated voltage V0.

Short Circuit Test:

Short circuit test, is usually done on the H.V. side keeping the L.V. side short circuited.

i. Make connections as shown in the circuit diagram.
ii. Apply rated current (ISC) by varying variac.
iii. Note the corresponding power input (WSC) and (ISC) for VSC.

OBSERVATIONS:

O.C. Test:

Voltage V_0 (Volts)	Current I_0 (amps)	Power W_0 (Watts)

S.C. Test:

Voltage applied V_{SC} (Volts)	Current Drawn I_{sc} (amps)	Power Input W_{sc} (Watts)

FORMULAE:

From O.C. Test:

No Load Power factor = $\cos\phi_0 = \frac{W_0}{V_0 I_0} =$

$\phi_0 =$

$\sin\phi_0 =$

$I_w = I_0 \cos\phi_0 =$ $\qquad$ $R_0 = V_0 / I_w =$

$I_\mu = I_0 \sin\phi_0 =$ $\qquad$ $X_0 = V_0 / I_\mu =$

From S.C. Test:

Total impedance referred to the H.V. side

$Z_{02} = \frac{V_{SC}}{I_{SC}} =$

Total resistance referred to the H.V. side

$R_{02} = \frac{W_{SC}}{I_{SC}^2} =$ $\qquad$ $X_{02} = \sqrt{Z_{02}^2 - R_{02}^2}$

Therefore, total resistance and reactance referred to L.V. side (Primary side)

$R_{01} = \frac{R_{02}}{K^2}$ $\qquad$ $X_{01} = \frac{X_{02}}{K^2}$

Where 'k' is transformation ratio

% Efficiency at any load and given p.f :

Let the load p.f. is Cos ϕ and
X = actual load / full load

Then, output power at actual load = X * full load = (X) (KVA) (p.f.) = _______ Watts

Iron losses W_i = WOC =

Copper losses Wcu = (X^2) (WSC) =

Total losses $(W_t) = W_i + W_{cu}$

% Efficiency = (output power)/(output + losses) =

% Voltage regulation at full load of given p.f. :

% Regulation at full load = $(I_2 R_{02} \cos\phi \pm I_2 X_{02} \sin\phi)/V2$

% Regulation at any load = $(xI_2 R_{02} \cos\phi \pm xI_2 X_{02} \sin\phi)/V2$

'+' for lagging power factor '-' for leading power factor

CALCULATIONS:

Table - 1: Efficiency calculations:

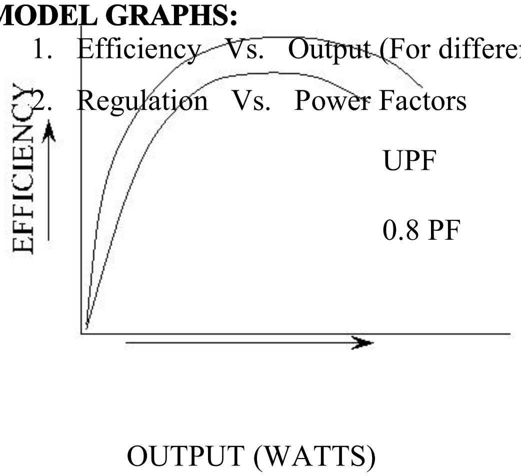
Fraction of load (x)	**PF = Cosϕ**	
	1.0	**0.8**
1/4		
1/2		
3/4		
1		

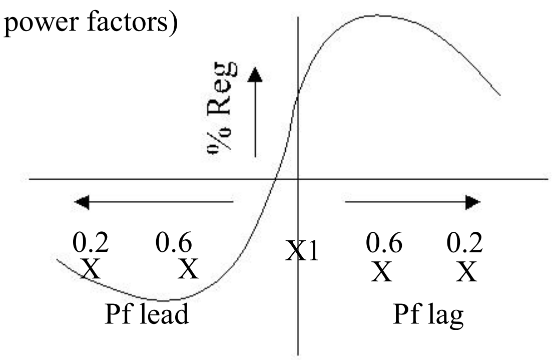
Table - 2: % regulation:

Fraction of load (x)	p.f. = Cos ϕ									
	1.0		0.8		0.6		0.4		0.2	
	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag
1/4										
1/2										
3/4										
1										

MODEL GRAPHS:

1. Efficiency Vs. Output (For different power factors)
2. Regulation Vs. Power Factors





EFFICIENCY CURVE

REGULATION VS PF CURVE

PRECAUTIONS:

1. Loose connections are to be avoided.
2. Circuit connections should not be made while power is ON.
3. Ensure variac position is zero before starting the experiment.
3. Readings of meters must be taken without parallax error.
4. While doing the open circuit test, ensure that the H.V. side is open.
5. While doing the short circuit test ensure that the L.V. side is short circuited.
6. High voltage & low voltage sides of T/F should be properly connected.
8. Check the corresponding meters are connected as per the circuit diagram of the corresponding test

RESULT:

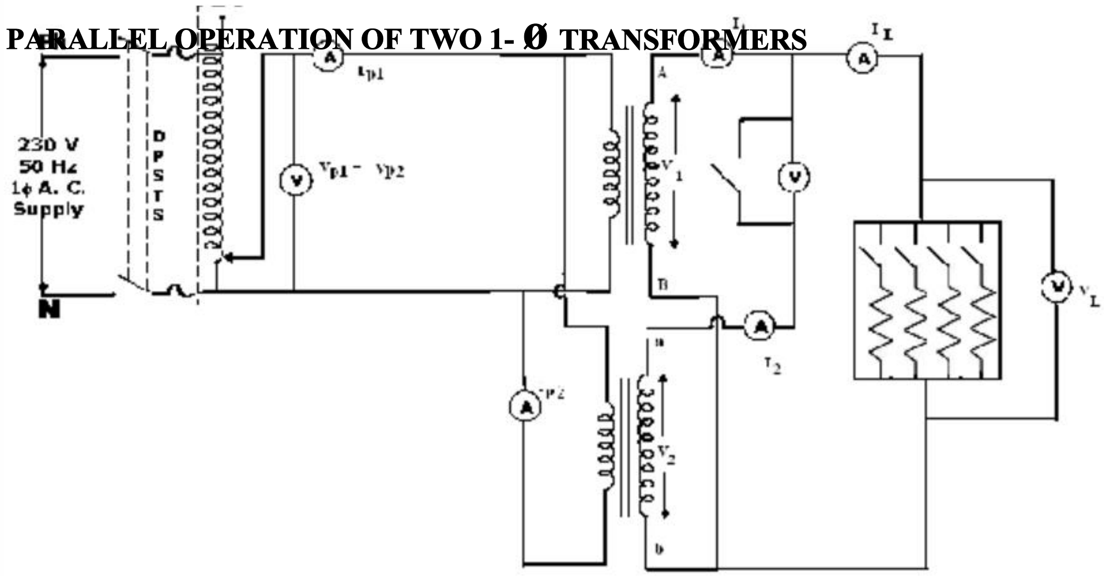
Efficiency & Regulation of transformer are determined and equivalent circuit is drawn

Signature of the Faculty

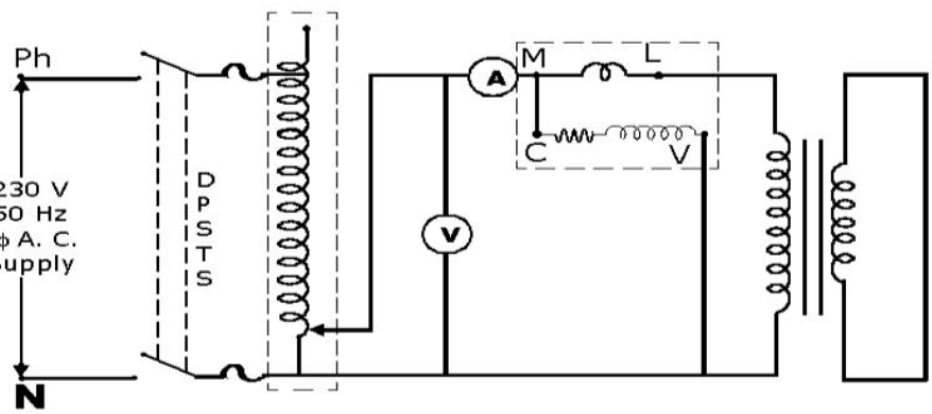
VIVA-VOCE QUESTIONS:

1. Why iron losses are negligible in short circuit test?
2. The leakage flux in a transformer depends upon?
3. Why is it preferred to determine the efficiency of transformer indirectly rather than by loading it.
4. What will happen if DC supply is given to the transformer?
5. Why is the core of transformer laminated.
6. What is the role of power transformers in 'power systems'?
7. What are the assumptions made in drawing the equivalent circuit?
9. What is the condition for maximum efficiency of a 1-φ transformer?
10. Why copper losses are negligible in OC test.
11. Why low power factor wattmeter are used in OC test.
12. Why unity power factor wattmeter is used in SC test.
13. Why no load current and no load power factor is low.
14. Why transformer oil is used in the transformer.
15. Why half of LV & half of HV are placed on the same limb in Core type Practical Transformer.
16. Why HV Winding is placed over the LV winding.

PARALLEL OPERATION OF TWO 1- Ø TRANSFORMERS



SC TEST



Name Plate Details 1Φ T/F:

KVA =

LV Voltage =

HV Voltage =

Frequency =

PARALLEL OPERATION OF TWO
1-Ø TRANSFORMERS

Exp. No. **Date:**

AIM:

To conduct parallel operation on given single phase transformers.

APPRATUS:

S. No.	Item	Type	Range	Quantity
1	Transformers of same voltage ratio			
2	Ammeters			
3	Voltmeters			
4	Watt meters			
5	Variac			
6	Single pole Knife switch			

PROCEDURE:

Polarity Test:

1. Connections are made as per the circuit diagram.
2. Apply voltage of say 100 V.
3. Measure voltage across terminals A-a
4. If VA-a is equal to V_1+V_2 then it is Additive polarity.
5. If VA-a is equal to V_1-V_2 then it is Subtractive polarity.
6. Mark the terminals (Dot convention) after the polarity test.

Parallel operation:

1. Connections are made as per the circuit diagram.
2. Switch on the power supply.
3. Slowly increase the voltage upto its rated value of transformer primaries.
4. Verify the voltage across the switch is one of the secondary of transformer, if it is zero, then close the switch, otherwise switch off the supply and change for correct polarity and repeat the steps 3 and 4.
5. After closing the switch, gradually increase the load in steps and note the values of all meters at each step till full load is reached.
6. Decrease the load and switch off the mains supply.
7. Tabulate the readings as shown.

OBSERVATIONS:

S. NO.	V_{PI}	V_{P2}	I_{P1}	I_{P2}	I_{S1}	I_{S2}	V_L	I_L

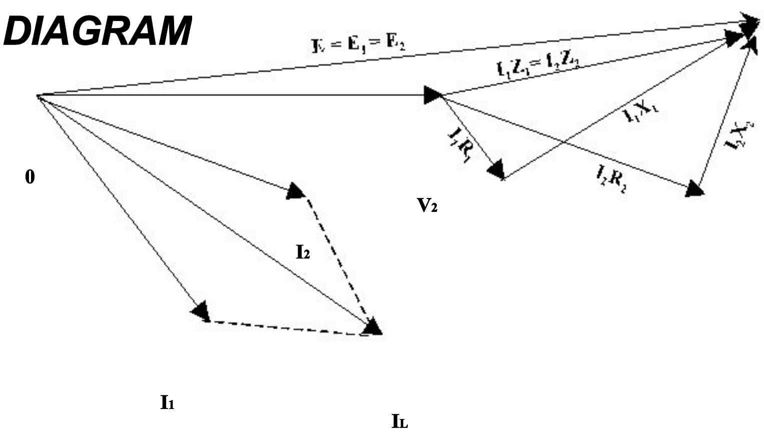
FORMULAE:

Draw the vector diagram for full load value a~~nd verify~~ $I_{S1}+I_{S2} = I_L$.
For all values verify

$$I_{S1} = \frac{Z_1}{Z_1 + Z_2} I_L$$

$$I_{S2} = \frac{Z_2}{Z_1 + Z_2} I_L$$

VECTOR DIAGRAM



PRECAUTIONS:

1. Ensure the correct connections of the transformers.
2. Check the KVA ratings of the transformers.
3. Avoid loose connections are to be made.

CALCULATIONS:

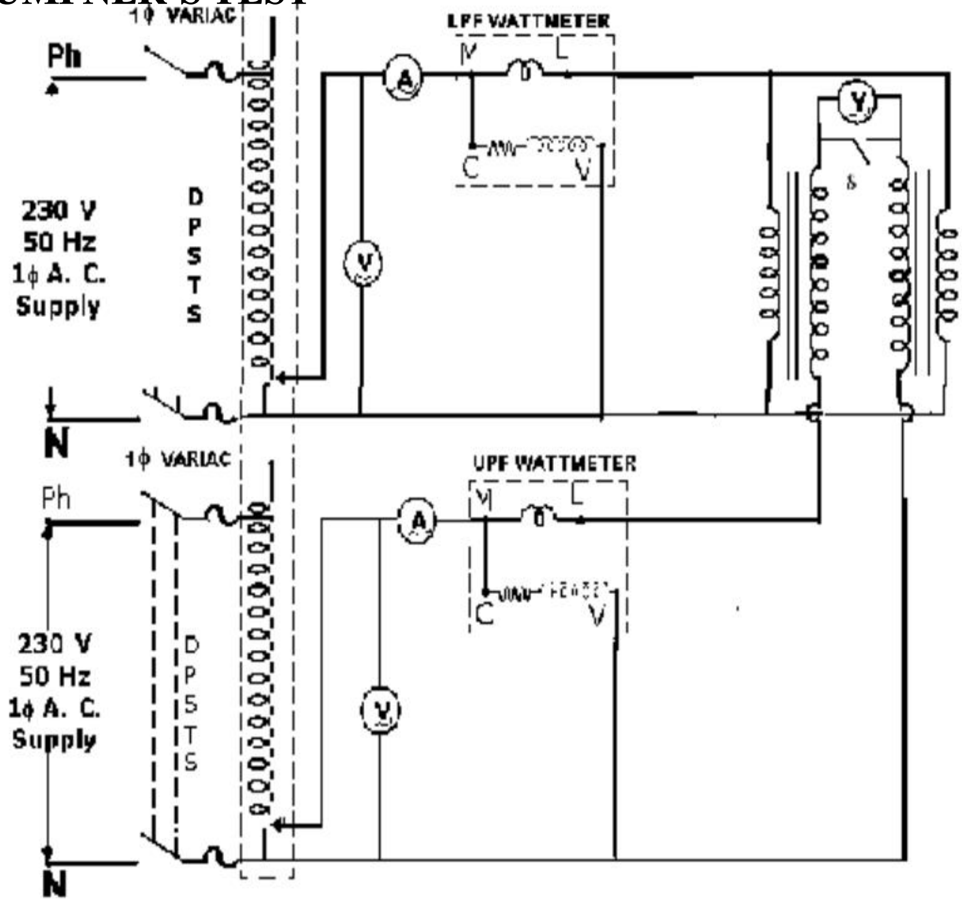
RESULTS:
The two transformers have been operated in parallel and checked for the equal load sharing.

Signature of the Faculty

VIVA-VOCE QUESTIONS:

1. Define voltage regulation of a transformer?
2. What are the conditions for parallel operation?
3. Why do the transformer operated in parallel?
4. Why transformer is operated at constant frequency?
5. How to calculate power transform conductivley and inductively in auto transformer?
6. What is auto transformer?
7. How eddy current losses are reduced?
8. What is the importance of Buchloz relay?
9. Draw the phasor diagram of transformer at inductive load conditions?
10. Why transformer in KVA?
11. Define all-day efficiency of transformer.
12. Draw the phasor diagram of an auto transformer?
13. Explain the losses of transformer.
14. Why, we are calculate the all-day efficiency of a distribution transformer
15. Why, the efficiency of transformer is high a half load compared to full-load?

SUMPNER' S TEST



Name Plate Details 1st T/F:

KVA =

LV Voltage =

HV Voltage =

Frequency =

Name Plate Details 2nd T/F:

KVA =

LV Voltage =

HV Voltage =

Frequency =

SUMPNER′S TEST

Exp. No. **Date:**

AIM:

To conduct Sumpner's test on two similar 1-ϕ transformers and to find the efficiency and regulation of each transformer at different load conditions.

APPARATUS:

S. No.	Name	Range	Type	Quantity
1.	Voltmeter			
2.	Voltmeter			
3.	Voltmeter			
4.	Ammeter			
5.	Ammeter			
6.	Wattmeter			
7.	Wattmeter			
8.	Variac (230/270V),15A			
9.	Variac (230/270V),15A			
10.	DPST Switch			
11.	Connecting wires			

PROCEDURE:

1. Give connections as per circuit diagram.
2. Apply a small voltage to the L.V. windings of the transformers. The voltmeter connected across SPST must give zero reading. Otherwise interchange the HV terminals of the transformer.
3. Now rated voltage is applied to the L.V. windings of the transformers.
4. Close the S.P.S.T. switch in secondary circuit and give supply to the secondary. Slowly increase the voltage till the rated current flows through secondaries.
5. Note down the readings of all the meters.

OBSERVATIONS:

L.V. SIDE			H.V. SIDE		
V_1 (volts)	I_1 (amps)	W_1 (watts)	V_2 (volts)	I_2 (amps)	W_2 (watts)

FORMULAE:

I_o = No load current of each transformer $= I_1 / 2$

V_o = No load voltage of each transformer $= V_1$

W_o = Iron losses of each transformer $= W_1 /2$

No load P.F. $\cos \phi_0 = W_1 / V_1 I_1$

$I_w = I_o \cos \phi_o$

$I_\mu = I_o \sin \phi_o$

$R_o = V_o / I_w$

$X_o = V_o / I_\mu$ referred to L.V side

$I_{s.c}$ = short circuit current of each transformer $= I_2$

$V_{s.c}$ = short circuit voltage of each transformer $= V_2 /2$

$W_{s.c}$ = Full load copper losses of each transformer $= W_2/2$

$W_{s.c} = I_{s.c}^2 R_{HV}$

$Z_{o1} = V_{s.c} / I_{s.c.}$

$R_{o1} = W_{s.c} / I_{s.c}^2$

$X_{o1} = \sqrt{Z_{01}^2 - R_{01}^2}$

% Reg $= I_1 \times R_{o1} \times \cos \phi \pm I_1 \times X_{o1} \times \sin\phi / V_{H.V.}$

CALCULATIONS:

At Cos ϕ =

S.No	% load (X)	Load current $=X(I_{F.L})$ (amp)	(Wcu) copper losses= $(X)^2$ Wsc (watt)	Output= KVA.Cosϕ (o/p) (watt)	Input= o/p+Wi+Wcu (watt)	η = output/input
	25%					
	50%					
	75%					
	100%					

At full load

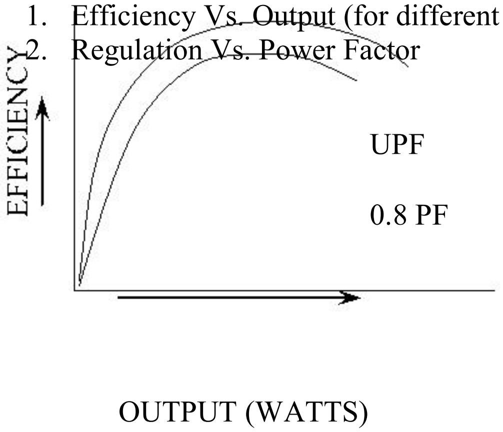
S No.	**Cos ϕ**	**% Reg (lag p.fs)**	**% Reg.(Lead p.fs)**
1	0.0		
2	0.2		
3	0.4		
4	0.6		
5	0.8		
6	1		

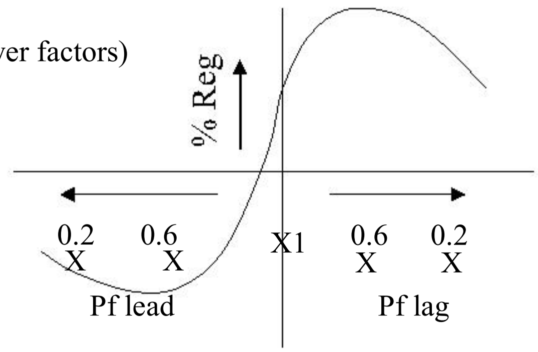
REGULATION CURVE

PF CURVE

MODEL GRAPHS:

1. Efficiency Vs. Output (for different power factors)
2. Regulation Vs. Power Factor





PRECAUTIONS:

1. There should not be loose connections in the circuit.
2. Don't aply the secondary current greater than full load current of a transfomrer.
3. Ensure that the variac should be at zero position while switching ON.
4. LV range voltmeter must be connected in secondary side after checking the phase opposition.

RESULT

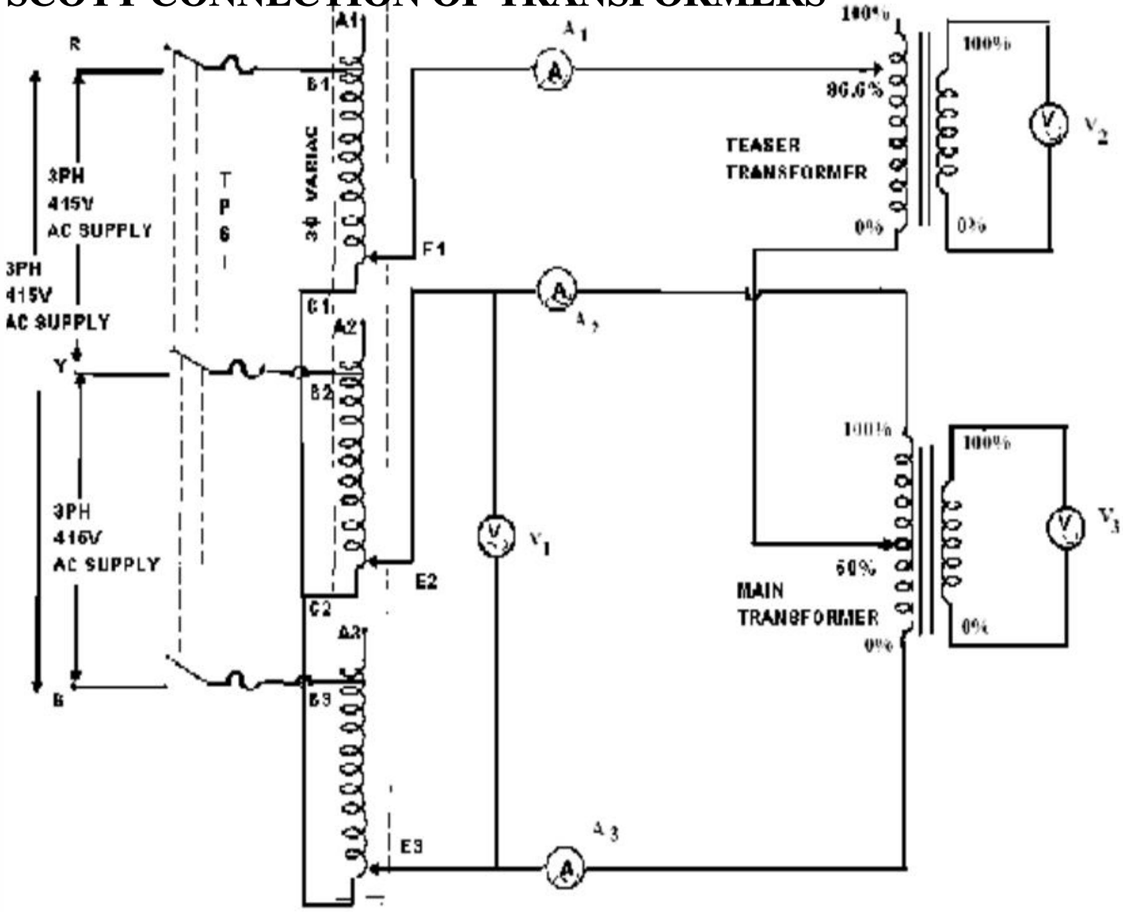
Efficiency and regulation of each transformer at different load conditions are calculated.

Signature of the Faculty

VIVA-VOCE QUESTIONS:

1. What is necessary condition required to conduct this test?
2. What is the condition for maximum efficiency?
3. What is all day efficiency?
4. What are the conditions for parallel operation of transformers?
5. Why transformer rating in KVA?
6. How to reduce the magnetic losses in a transformer?
7. What is the relationship between thickness of laminations, supply frequency and core losses of the transformer?
8. What is the condition for maximum voltage regulation?
9. What is the condition for zero voltage regulation?
10. What is the load KVA corresponds to maximum efficiency?
11. How are the primaries connected in this test?
12. What are the factors affecting regulation of a transformer?
13. Comment upon the reading of wattmeter connected in the primary circuit of transformer?
14. The full-load copper losses of a transformer are 1200W, then the copper loss at one-fourth load is?
15. Draw the equivalent circuit of a transformer?

SCOTT CONNECTION OF TRANSFORMERS



SCOTT CONNECTION- VOLTAGE VERIFICATION

Name Plate Details 1st T/F:

KVA =

LV Voltage =

HV Voltage =

Frequency =

Name Plate Details 1st T/F:

KVA =

LV Voltage =

HV Voltage =

Frequency =

SCOTT CONNECTION OF TRANSFORMERS

Exp. No. **Date:**

AIM:

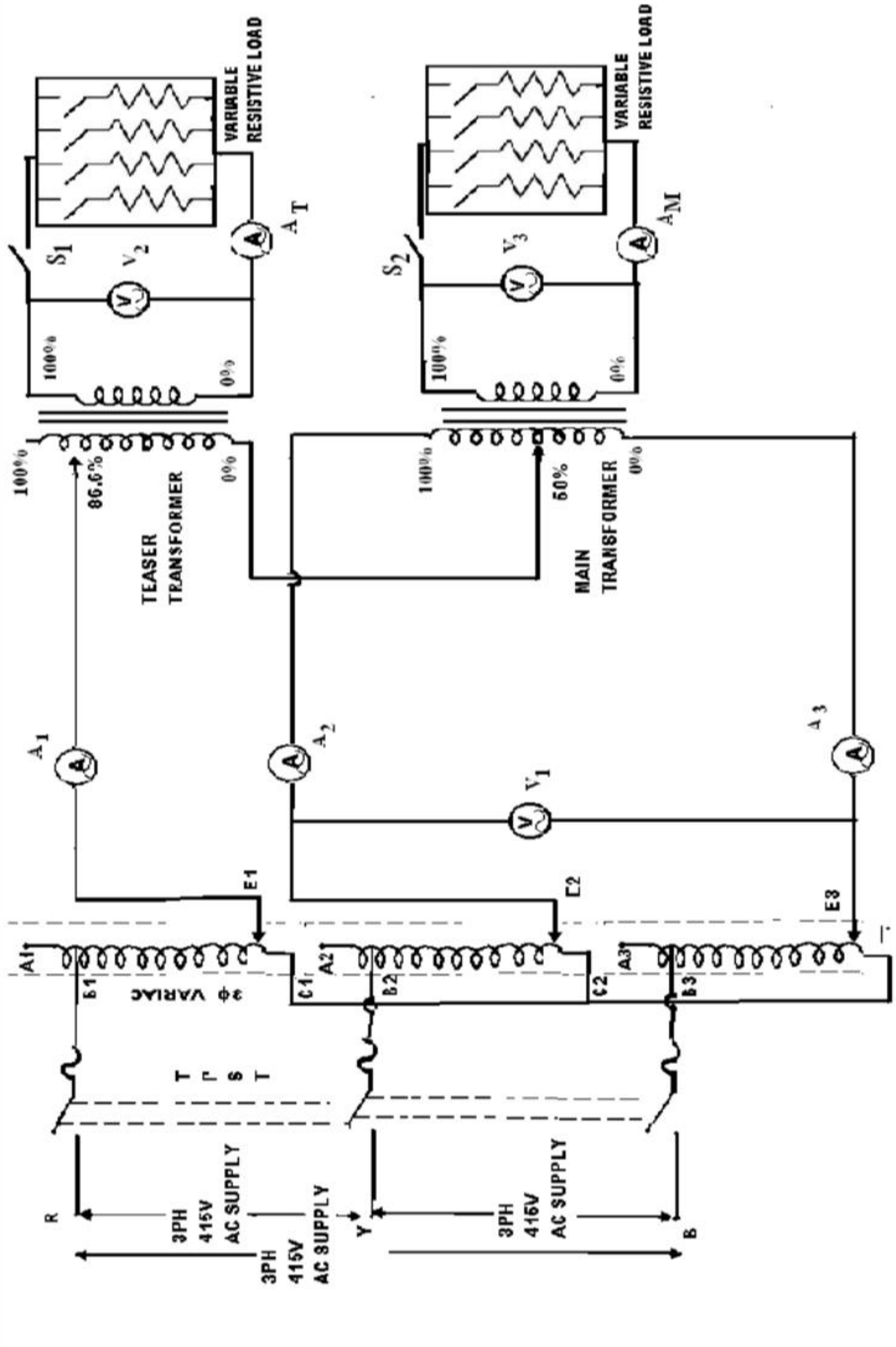
To obtain a balanced two-phase supply from 3-ϕ system by using Scott connection.

APPARATUS:

S. No.	Name	Range	Type	Quantity
1.	Voltmeter			
2.	Ammeter			
3.	Variac			
4.	Load			
5.	Connecting wires			

PROCEDURE:

1. Connect as per the circuit diagram.
2. Ensure that the switches S1 and S2 are open.
3. Adjust the 3-ϕ variac for min voltage at its output.
4. Switch on the AC supplies and apply the rated voltage across the primaries of the transformers.
5. Record the voltages V1, V2 and V3 and verify that the output is a balanced two-phase supply.
6. Switch on the Ac supply again. Adjust the output voltage of the variac as per the rated voltage of the primaries of the transformer.
7. Close the switches S1 and S2 to load both the secondaries. Adjust equal loading conditions also.
8. Switch off the load from both secondaries and adjust the variac, so that its output voltage is minimum and then switch off the supply.



SCOTT CONNECTION- LOADING

OBSERVATIONS:

For balanced two-phase supply:

S. No.	V_1 (V)	V_2 (V)	V_3 (V)

Under loaded conditions:

S. No.	A_M	A_T	A_1	A_2	A_3	V_1 (V)	V_2 (V)

FORMULAE:

Verify that the vector sum of V_1 and V_2 should be equal to √2 times V_1 or V_2.

$$V = \sqrt{(V_1^2 + V_2^2)}$$

Where V is the resultant 2Φ (line to line) voltage.

PRECAUTIONS:

1. Loose connections must be avoided.
2. Properly rated and required ranged meters are used
3. The tapping ratios must be properly observed.

RESULT:

Three-phase to two-phase conversion is obtained by using Scott connection.

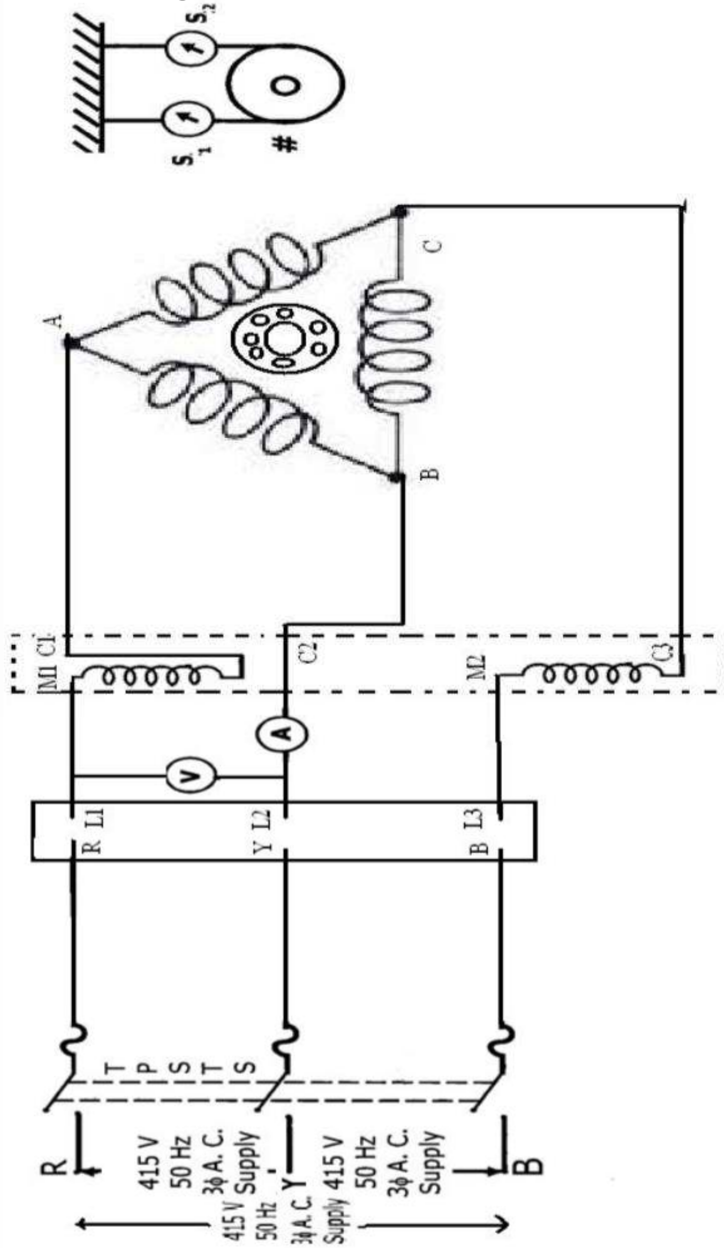
Signature of the Faculty

VIVA-VOCE QUESTIONS:

1. How many transformers are needed for scott connection?
2. Is it possible to obtain 3-phase balanced system from two-phase system?
3. Why is it essential that 86.6% tapping must be there in teaser transformer?
4. What tapping should be available on the main transformer and why?
5. Comment about the iron losses occurring in main & teaser transformers, especially from the consideration of their inequality?
6. What is the major field of application of a 2-phase ac system which is obtained from scott connection?
7. What is the phasor difference between the output voltage of scott connection?
8. If the load on the two secondaries of scott connected transformers are different, what will be the position of current in primary windings.
9. Where is the position of neutral point of 3-phase balanced ac system in this connection?
10. Explain why the load of closed delta is to be reduced by 43.3% when it is operated as open delta?
11. What is utilisation factor of open delta connection?
12. Can a Δ-Y transformer be operated as open delta transformer?
13. What are the advantages of open delta connection?
14. Draw the phasar diagram of open delta connected transformer?
15. What will happen if the transformer is connected to DC supply?
16. What is difference between a distribution & power transformer?

BRAKE TEST ON THREE PHASE INDUCTION MOTOR

Circuit Diagram:



Name plate details:

1. HP/KW :
2. Current :
3. Speed :
4. Voltage :
5. Frequency :

:

BRAKE TEST ON THREE PHASE INDUCTION MOTOR

Exp. No. **Date:**

AIM:

To determine the performance characteristics of a 3-phase induction motor by performing a brake test on it

APPARATUS:

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

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Switch on the 3–phase AC mains, apply the rated voltage by using 3-φ variac
3. Take down the readings of all the meters, spring balance readings and the speed under no load condition.
4. Increase the load on the motor gradually by tightening the belt.
5. Record the readings of all the meters, spring balance readings and the speed at every setting of the load.
6. Observations may be continued up to the full load current rating of the motor.
7. Reduce the load gradually and finally unload it completely and decrease the voltage to zero.
8. Switch off the supply.
9. Note down the effective diameter of the brake drum.

OBSERVATIONS:

S. No.	V (volts)	I (amps)	W (watts)		Spring Balance		N (rpm)	Cosϕ	Torque= $r(S_1-S_2)9.81$ Nm	Input(W) – W_1+W_2	O/P = $2\pi NT/60$	Efficiency = O/P / I/P
			W_1	W_2	S_1	S_2						
1												
2												
3												
4												
5												
6												
7												
8												
9												

FORMULAE:

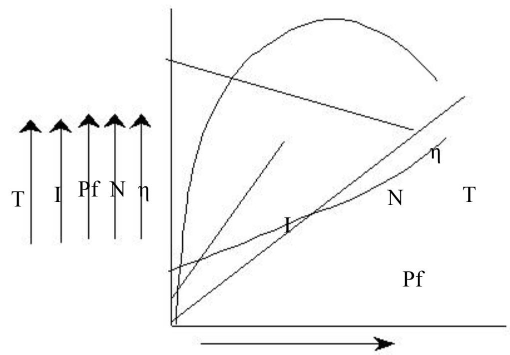
Torque (T) = $r(S_1-S_2) \times 9.81$ *where r = radius of the drum*

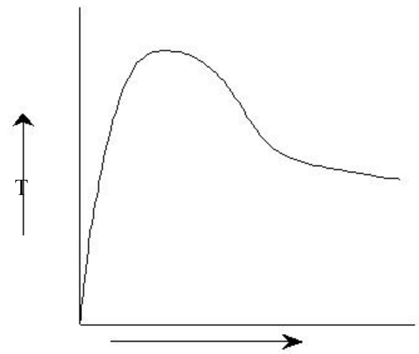
Output = $2\pi NT/60$

Efficiency = Output / Input

MODEL GRAPHS:

1. Speed Vs. Output
2. Power Factor Vs. Output
3. Efficiency Vs. Output





OUTPUT

% SLIP

PERFORMANCE CURVES

PRECAUTIONS:

1. There should not be loose connections in the circuit.
2. Don't run the machine beyond the full-load current.
3. Make sure that Auto Transformer is in zero position before starting.

RESULT:

Load test on 3-ϕ induction motor is conducted and the various performance characteristic curves are drawn.

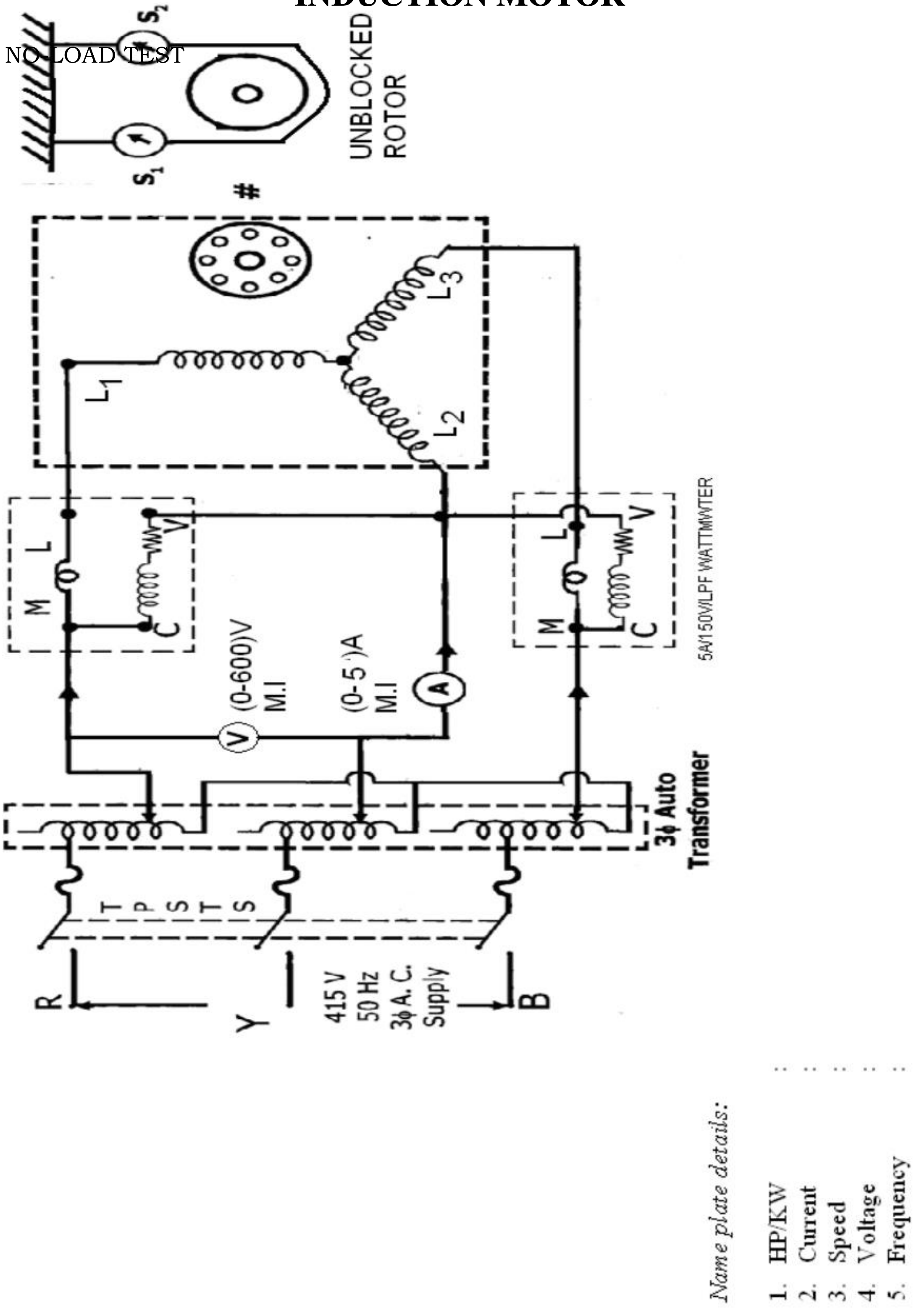
Signature of the Faculty

VIVA-VOCE QUESTIONS:

1. What factors determine the direction of the motor?
2. How can the direction of rotation of the motor be reversed?
3. What modifications would necessary if a motor is required to operate on voltage different from that for which it was originally designed?
4. What is cogging?
5. What are the indications of winding faults in an induction motor?
6. Why the number of poles of the stator and rotor of an electrical motor be equal?
7. Why skewing of rotor is done in a 3-ϕ induction motor?
8. What is crawling
9. What is the condition for maximum efficiency of an induction motor
10. Name the different methods of speed control of an induction motor
11. What is difference between conduction and induction motor
12. Why the speed of an induction motor is always less than the synchronous speed
13. Explain the different power stages of an induction motor
14. Explain the effect of frequency changes on losses
15. What are the advantages of double-cage induction motor compared to the induction motor

NO-LOAD & BLOCKED ROTOR TEST ON THREE PHASE INDUCTION MOTOR

NO-LOAD TEST



NO-LOAD & BLOCKED ROTOR TEST ON THREE PHASE INDUCTION MOTOR

Exp. No. **Date:**

AIM:

To conduct No-load test and Blocked Rotor Tests on a Three-phase Induction Motor and pre-determine its performance by drawing the circle diagram.

APPARATUS:

S. No.	Name	Range	Type	Quantity
1.	Voltmeter			
2.	Ammeter			
3.	Wattmeter			
4.	Tachometer			
5.	3-phase variac			
6.	Starter			

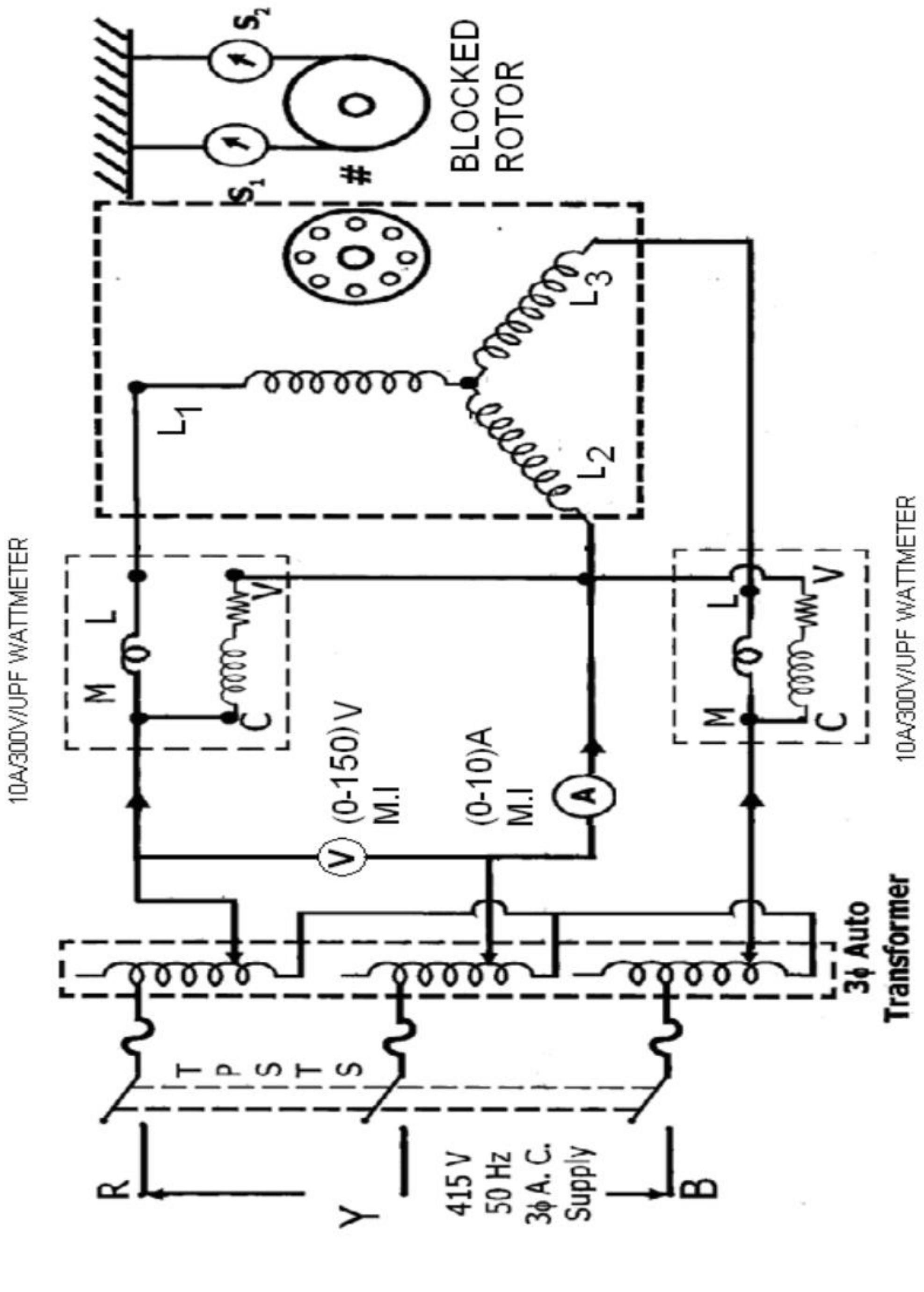
PROCEDURE :-

NO LOAD TEST -

(1) Connections are given as per the circuit diagram.
(2) Precautions are observed and motor is started on the no load.
(3) Autotransformer is varied to have rated voltage applied.
(4) The meter readings are then tabulated.

BLOCKED ROTOR TEST :-

(1) Connections are given as per circuit diagram.
(2) Precautions are observed and motor is started on full load or blocked rotor position.
(3) Autotransformer is varied to have rated current flowing in motor.
(4) The meter readings are then tabulated.



10A/300V/UPF WATTMETER
M
L
C
V
(0-150) V
M.I
(0-10)A
M.I
BLOCKED
ROTOR
S1
S2
L1
L2
L3
10A/300V/UPF WATTMETER
3ϕ Auto
Transformer
TPSTS
R
Y
B
415 V
50 Hz
3ϕ A. C.
Supply

TABULAR COLUMNS

NO LOAD TEST:

S.No	Voltage Voc Volts	Current Ioc Amps	Wattmeter readings (W1) Observed	W1 x mf1 Actual Watts	Wattmeter readings (W2) Observed	W2 x mf2 Actual Watts
1						

Voc= open circuit voltage
Ioc = open circuit current

BLOCKED ROTOR TEST:

S.No.	Voltage Vsc Volts	Current Isc Amps	Wattmeter readings(W1) Observed	W1 x mf1 Actual Watts	Wattmeter readings(W2) observed	W2 x mf2 Actual Watts
1.						

Vsc = short circuit voltage
Isc = short circuit current

CALCULATIONS:

From O.C. Test :

No Load Power factor = $\cos\phi_0 = \dfrac{W_{OC}}{\sqrt{3}V_0 I_{0\,Ph.}} =$

$\phi_0 =$, $Sin\phi_0 =$

$I_w = I_0 \cos\phi_0 =$, $I_\mu = I_0 \sin\phi_0 =$

Then,

$R_0 = V_{0Ph} / I_w =$

$X_0 = V_{0Ph} / I_\mu =$

From Blocked Rotor Test:

$\cos\phi_{SC} = \dfrac{W_{SC}}{\sqrt{3}V_{SC} I_{SC\,Ph.}} =$

WSC/ph = $\dfrac{W_{SC3-\phi}}{3} =$

$R_{SC} = \dfrac{W_{SC}/Ph.}{I_{SC}^2} = R_1 + R_2$

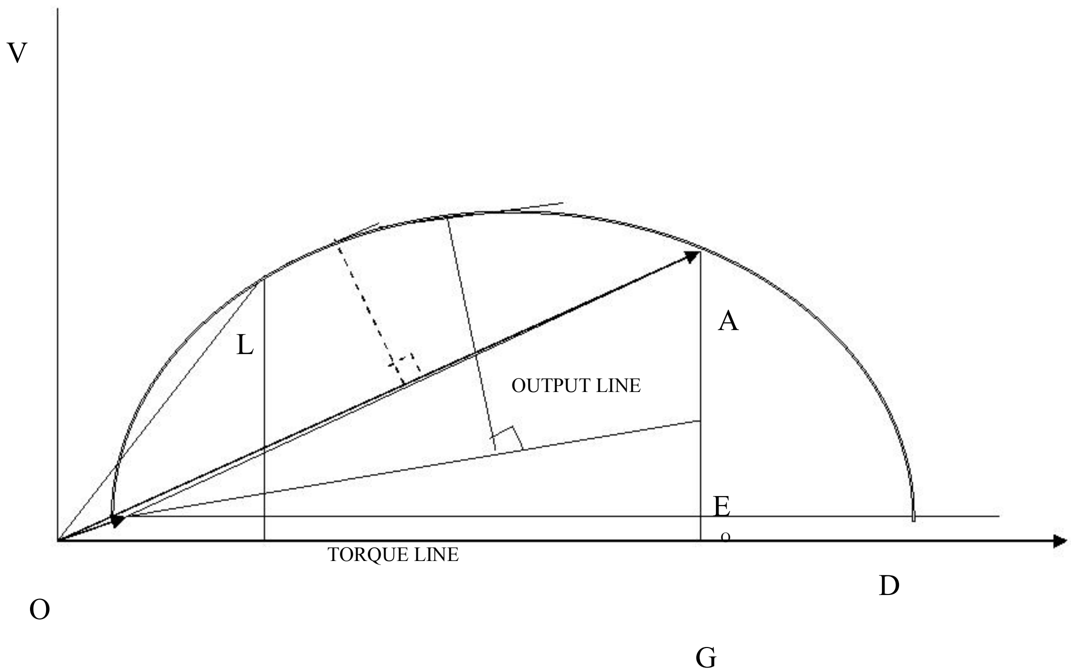
$Z_{02} = \dfrac{V_{SC}}{I_{SC}} =$

$R_{SC} = Z_{SC} \cos \phi_{SC}$

$X_{SC} = Z_{SC} \sin \phi_{SC} = X_1 + X_{21}$

MODEL GRAPHS:

Circle Diagram



Circle Diagram

PRECAUTIONS:

Blocked Rotor test:

1. Blocking of the rotor should be done properly.
2. Make sure to apply only a small voltage corresponding to rated current.
3. Keep the Auto Transformer in the initial position at the time of starting.

O.C. Test:

1. Remove the load on the rotor shaft properly.
2. Keep the 3-phase auto Transformer in the initial position only at the time of starting

RESULT:

Thus we obtained the equivalent circuit parameters of a 3-phase slip ring induction motor by performing, no load, blocked rotor test on it.

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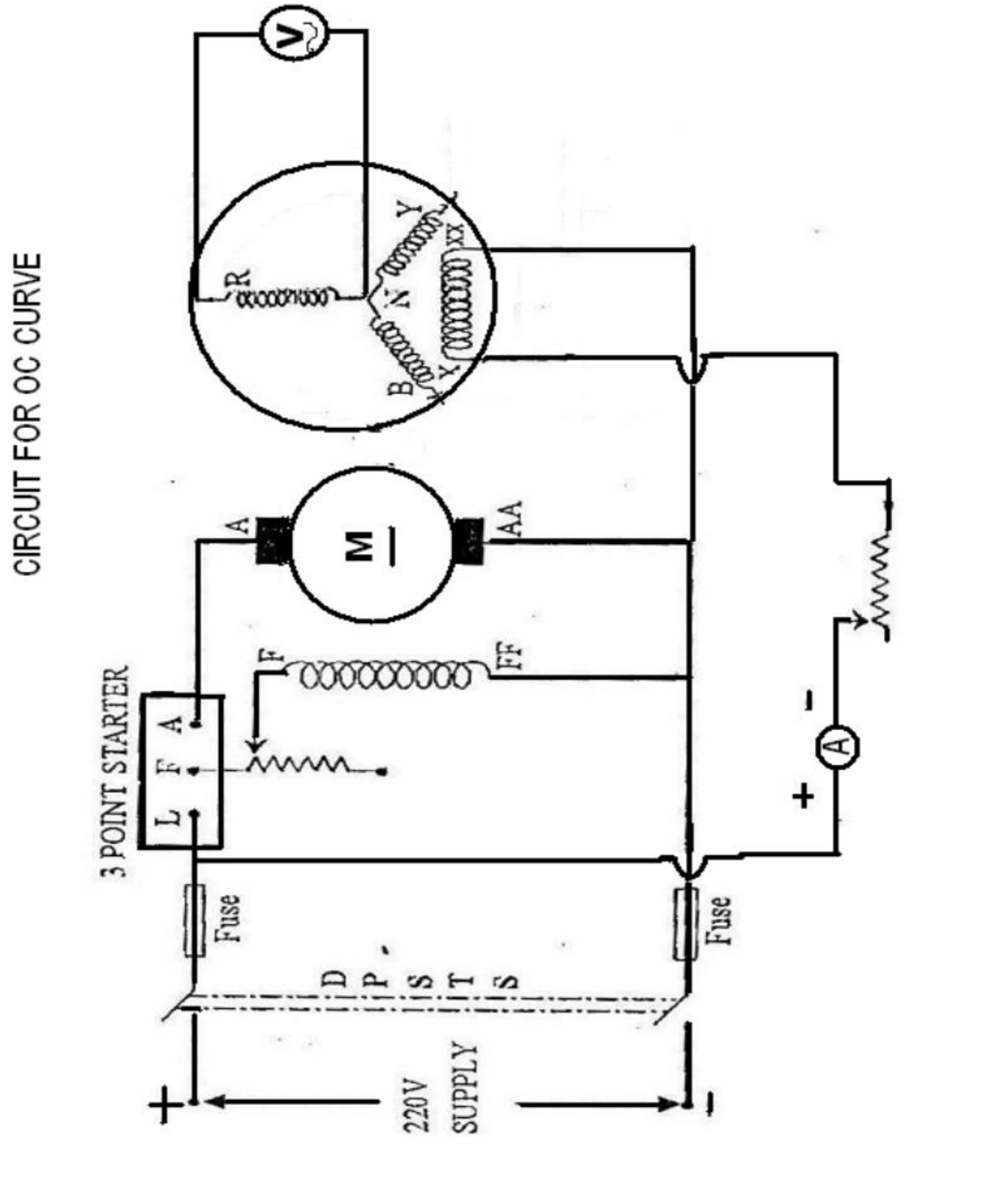
VIVA-VOCE QUESTIONS:

1. Explain why the power input to stator with rotor blocked is nearly equal to copper losses in the winding.
2. How can you calculate the η of Induction Motor from result of no load test & blocked rotor test.
3. What is the difference between the rotor power input and the rotor power developed?
4. What are the losses that take place in an induction motor? State the factors on which such losses depend.
5. What tests are to be performed on an induction motor to be able to draw its circle diagram? What information one can get about the performance of the motor from circle diagram? What assumptions and approximations are made in drawing the circle diagram?
6. Explain why an Induction Motor draws heavy current as compared to its full load current at starting.
7. Explain why the no load current of Induction Motor is much higher than that of an equivalent T/F.
8. Explain why the power of an Induction Motor is very low at starting.
9. Explain why an Induction Motor can not runs at synchronous speed.
10. Show that the locus of Rotor of an Induction Motor is semi circle.

REGULATION OF ALTERNATOR BY EMF & MMF METHODS



Name plate details:

1. HP/KW :
2. Current :
3. Speed :
4. Voltage :
5. Frequency :

REGULATION OF ALTERNATOR
BY EMF & MMF METHODS

Exp. No. **Date:**

AIM:

To obtain the % regulation of an alternator at full load by using

i. Snychronous Impedence method &

ii. MMF method at

a. UPF
b. 0.8 lag
c. 0.8 lead

APPARATUS:

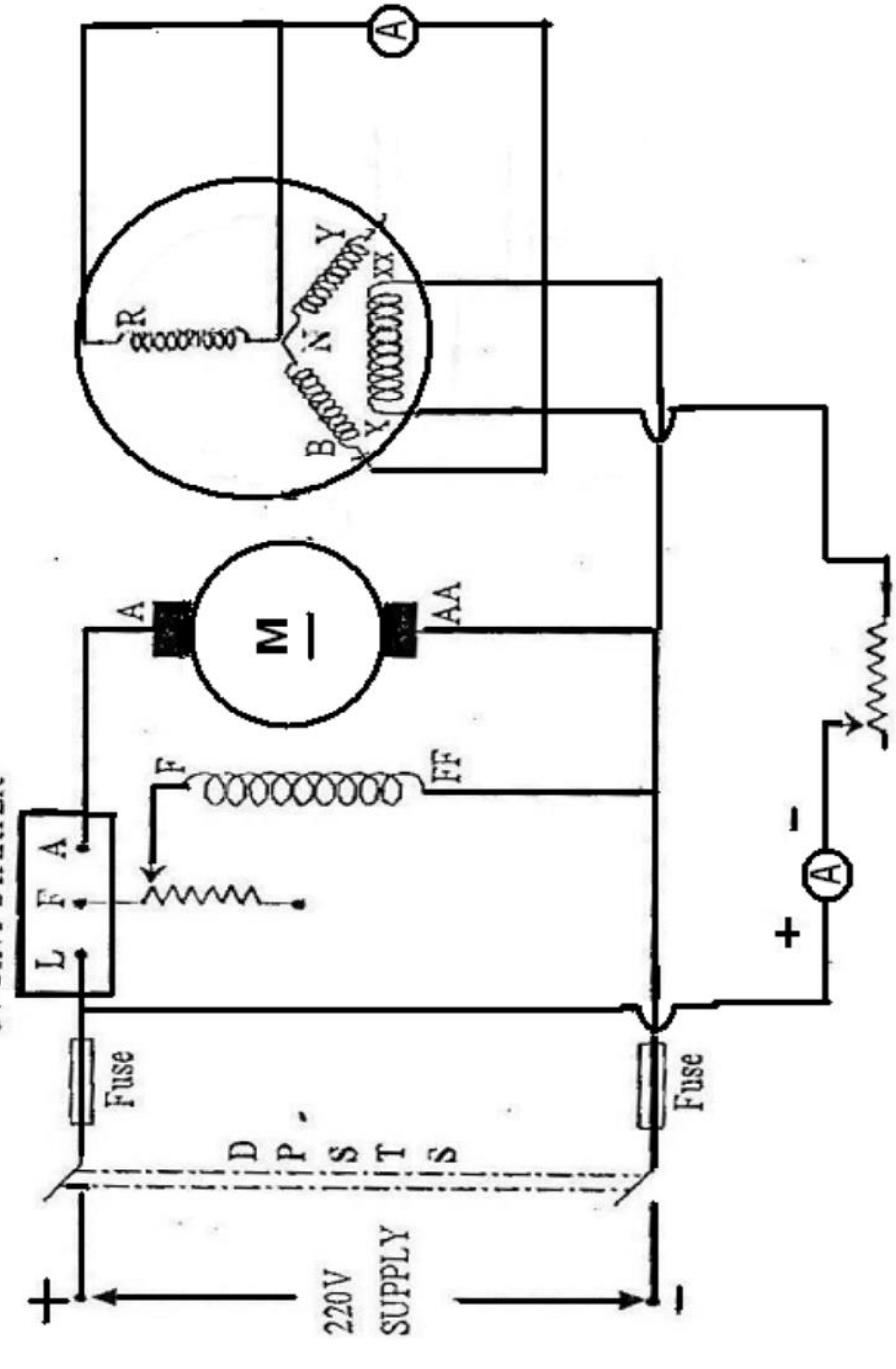
S. No.	Name	Range	Type	Quantity
1.	Voltmeter			
2.	Ammeter			
3.	Rheostats			
4.	Tachometer			

PROCEDURE:

O.C. Test:

1. Give connections as per the circuit diagram.
2. Keep the resistance in the motor field circuit in its minimum position. Keep the resistance in generator field circuit in its maximum resistance position.
3. Switch on the supply, bring the starter to its maximum position, cut off the resistance in the motor armature circuit gradually and adjust the speed of the motor to the rated speed of generator.
4. Keeping the speed as constant note down the open circuit voltage by varying the field current of generator in steps till rated voltage is obtained.
5. Bring the resistance in generator field circuit to its maximum position, bring the field resistance of motor to its minimum position and switch off the supply.

CIRCUIT FOR SC CURVE



S.C.Test:

1. Give connections as per the circuit diagram.
2. Start the motor with help of starter and adjust its speed to rated value.
3. Adjust the generator field rheostat such that rated current flows in shunt circuit armature.

Calculation of armature resistance.

1. Make the connections as per the circuit diagram. (Fig.3)
2. Switch ON the supply and by varying the resistance, note down the voltage and current at different steps Hence calculate the armature resistance.
3. Plot O.C.C. and S.C.C. curves and calculate the synchronous impedance corresponding to rated current.
4. Predict the regulation at various power factors.

OBSERVATIONS:

At Rated speed

O.C. Test

S. No	$V_{o.c}$/ Ph volts	I_f Amp

S.C. Test

S. No	I_f Amp	$I_{s.c}$/ Ph volts

Armature Resistance

S. No	Voltage (V)	Current (I)	R_a = V/I

FORMULAE:

i. Synchronous Impedance Method:

IFL = Full load short circuit current = ISC =

IF1 = Field current corresponding to full load short circuit current =

E1/Phase = O.C. voltage corresponding to field current IF1 =

$$Zg \text{ (per phase)} = \frac{E_1 (per\ phase)(O.C.)}{I_{SC}(S.C.\ full\ load\ Current)} \ Ohms$$

$$X_S = \sqrt{Z_S^2 - R_a^2} \ Ohms$$

$$E_0 = \sqrt{(V\,Cos\phi + IR_a)^2 + (V\,Sin\phi + IX_s)^2}$$

ii. For leading p.f's

$$E_0 = \sqrt{(V\,Cos\phi + IR_a)^2 + (V\,Sin\phi + IX_s)^2}$$

iii.For U.P.F.

$$E_0 = \sqrt{(V + IR_a)^2 + (IX_s)^2} =$$

% Reg 'up' = $\frac{E_0 - V}{V} x100$

ii. MMF Method:

IF1 = field current corresponding to F.L., S.C. current from S.C. test =

IF2 = field current corresponding to rated no load voltage from O.C.C. =

for Cos ϕ lagging p.f.

IF3 = Result vector sun of IF1 & IF2 =

at Cos ϕ lagging

$$I_{F3} = \sqrt{(IF_1)^2 + (IF_2)^2 + 2(IF_1)(IF_2)Cos\,(90-\phi)}$$

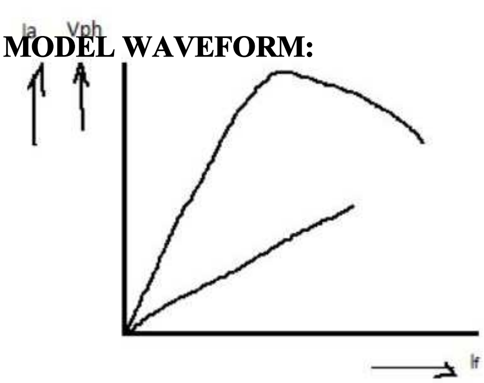
E0 = No load emf corresponding to field current IF3 from O.C.C. =

iii. For Cos-ϕ lagging p.f. :

Replace '+ϕ' with '-ϕ' in the above equations and find IF3 and Corresponding E0.

% Reg 'up' = $\frac{E_0 - V}{V} x100$ *(find for lagg p.f. & leading p.f.)*

MODEL WAVEFORM:



PRECAUTIONS:

1. The motor field rheostat should kept minimum & armature rheostat in maximum position before starting.
2. The alternator exciter field Rheostat is kept maximum position before starting the experiment.
3. Keep all the switches in open and stator is at initial (OFF) position.
4. Check the field winding is properly connected.
5. The motor field rheostat should be kept in the minimum resistance position.
6. The alternator field potential divider should be in the maximum voltage position.
7. Initially all switches are in open position.
8. Keep the speed is constant of an induction motor while conducting o.c test.

RESULT:

The % Regulation of Alternator at different p.f's is calculated by using mmf & synchronous impedance methods and the result are compared.

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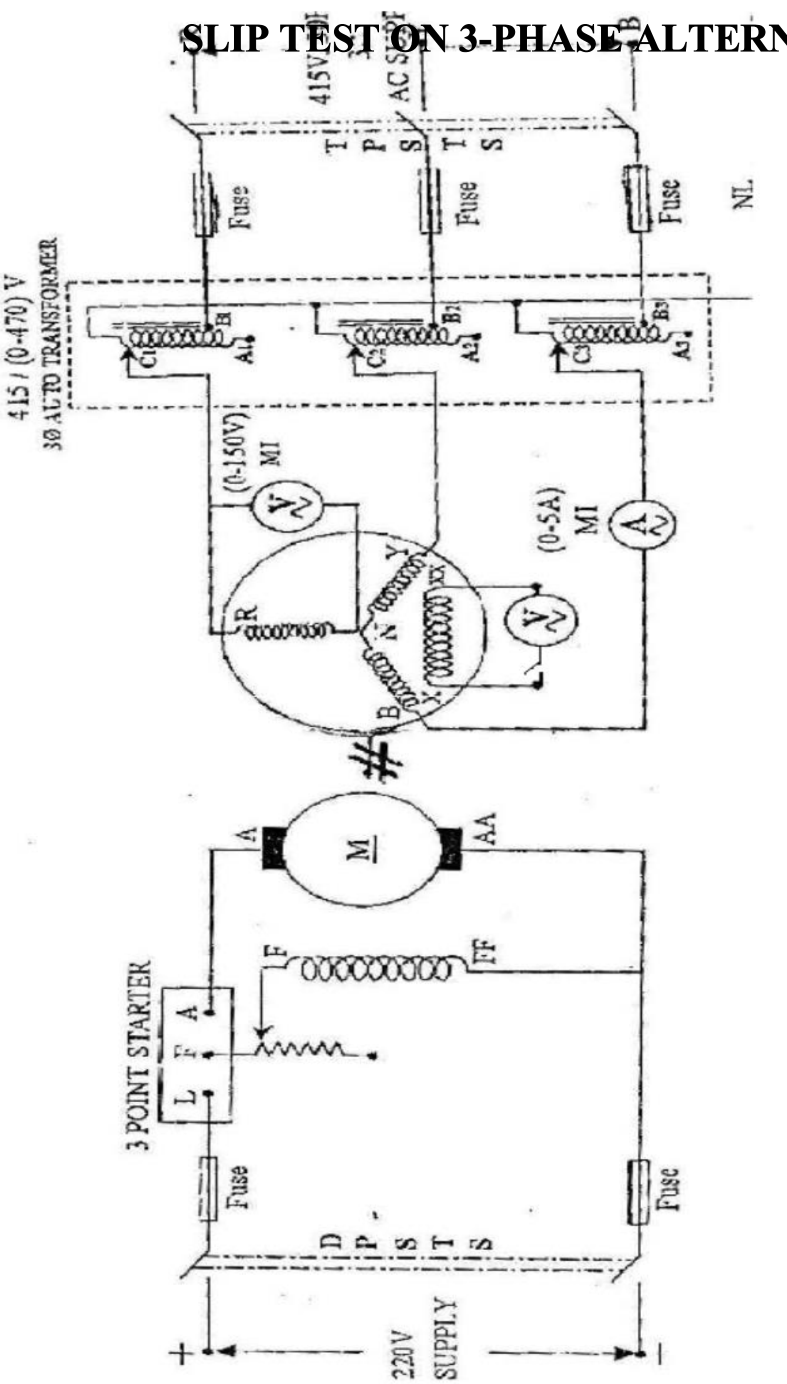
VIVA-VOCE QUESTIONS:

1. What are the advantages and disadvantages of each method.
2. Why the O.C. characteristic is not linear.
3. At what value of field current should the synchronous impedance be calculated & why.
4. What are the precautions needed to conduct this experiment.
5. What are the various types of alternators.
6. What is synchronizing power & synchronizing torque.

5. Define the term synchronous Reactance.
6. Why the armature is stationary & field rotates in synchronous speed.
7. Define magnetizing, demagnetizing & cross magnetizing effect.
8. Explain armature reaction effect in synchronous motor.
9. Under what conditions regulation is of –ve.
10. What is zero power factor operation.
11. Is it possible to operate two alternations in parallel having different regulation? Why?

SLIP TEST ON 3-PHASE ALTERNATOR



Name plate details:

1. HP/KW :
2. Current :
3. Speed :
4. Voltage :
5. Frequency :

SLIP TEST ON 3-PHASE ALTERNATOR

Exp. No. **Date:**

AIM:

To conduct a slip test on 3-Φ alternator and pre-determine the regulation through vector diagram.

APPARATUS REQUIRED:

S.no	Name of Apparatus	Range	Type	Quantity
1	Ammeter	(0-5)A	MI	1
		(0-1)A	MC	1
2	Voltmeter	(0-150)V	MI	1
		(0-5)V	MC	1
3	Rheostat	250 Ω /1.5A		1
4	Tachometer		Digital	1
5	TPST Switch			1
6	Connecting Wires			As reqd.

PROCEDURE:

1. Note down the name plate details of motor and alternator.
2. Connections are made as per the circuit diagram.
3. Give the supply by closing the DPST switch.
4. Using the three point starter, start the motor to run at the synchronous speed by varying the motor field rheostat at the same time check whether the alternator field has been opened or not.
5. Apply 20% to 30% of the rated voltage to the armature of the alternator by adjusting the autotransformer.
6. To obtain the slip and the maximum oscillation of pointers the speed is reduced slightly lesser than the synchronous speed.
7. Maximum current, minimum current, maximum voltage and minimum voltage are noted.
8. Find out the direct and quadrature axis impedances.

PRECAUTIONS:

1. The motor field rheostat should be kept in minimum.
2. The direction of the rotation due to prime mover and the alternator on the motor should be the same.
3. Initially all the switches are kept open.

FORMULAE USED:

1. $X_d = V_{max}/I_{min}$ Ω
2. $X_q = V_{min}/I_{max}$ Ω

TABULAR COLUMNS

(i) To find the Direct Axis and Quadrature axis impedances:

S.NO	Vmax	Vmin	Imax	Imin
1				
2				

ESULT:

Xd & Xd values are determined.

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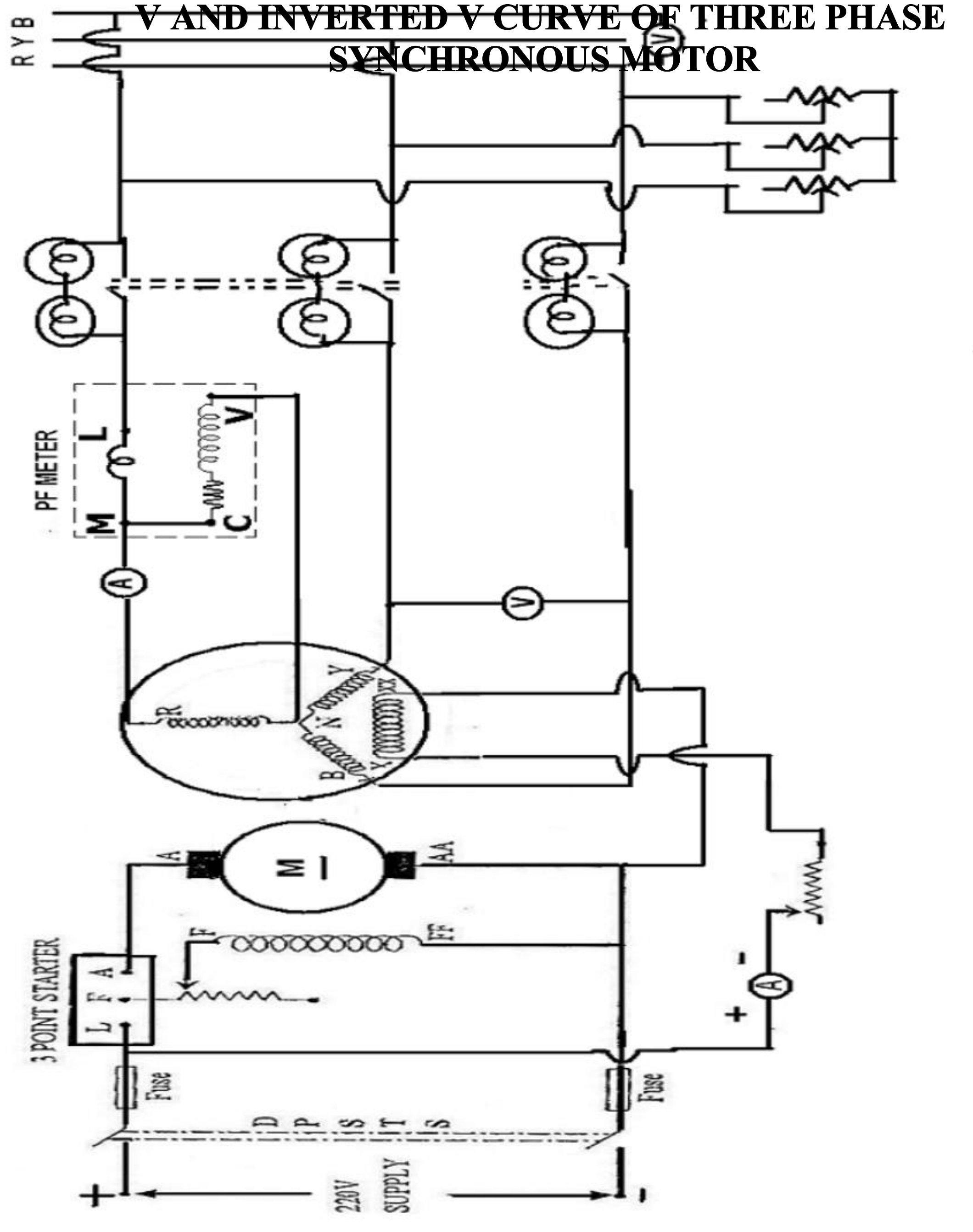
VIVA-VOCE QUESTIONS

1. What is meant by salient pole type rotor?
2. What is the necessity of damper winding?
3. What is meant by Two Reaction theory?
4. State Two Reaction theory.
5. What is d axis and q axis?
6. What is meant by magnetizing and cross magnetizing component?
7. What is called slip test?
8. What is meant by power angle?
9. Compare salient pole and Non salient pole rotor.

V AND INVERTED V CURVE OF THREE PHASE SYNCHRONOUS MOTOR



Name plate details:

1. HP/KW :
2. Current :
3. Speed :
4. Voltage :
5. Frequeney :

V AND INVERTED V CURVE OF THREE PHASE SYNCHRONOUS MOTOR

Exp. No. **Date:**

AIM

To draw the V and inverted V curves of a 3 phase Synchronous Motor.

APPARATUS REQUIRED:

S.No	Name of the apparatus	Type	Range	Quantity
1	Ammeter	MI		
2.	Voltmeter	MI		
3.	Ammeter	MC		
4.	Rheostat			
5.	Wattmeter	UPF		

PROCEDURE:

(1) Connections are made as per the circuit diagram..
(2) Close the TPST switch.
(3) By adjusting the autotransformer from the minimum position to the maximum position the rated voltage is given to motor. The motor starts as an induction motor.
(4) In order to give the excitation to the field for making it to run as the synchronous motor, close the DPST switch.
(5) By varying the field rheostat note down the excitation current, armature current and the power factor for various values of excitation.
(6) The same process has to be repeated for loaded condition.
(7) Later the motor is switched off and the graph is drawn.

TABULATION FOR V- CURVE AND INVERTED V - CURVE OF THREE PHASE SYNCHRONOUS MOTOR

Armature voltage :

S No.	Without Load			With Load		
	Excitation Current (I_f)	Armature Current (I_a)	Power Factor ($Cos\phi$)	Excitation Current (I_f)	Armature Current (I_L)	Power Factor ($Cos\phi$)
	Amps	Amps		Amps	Amps	

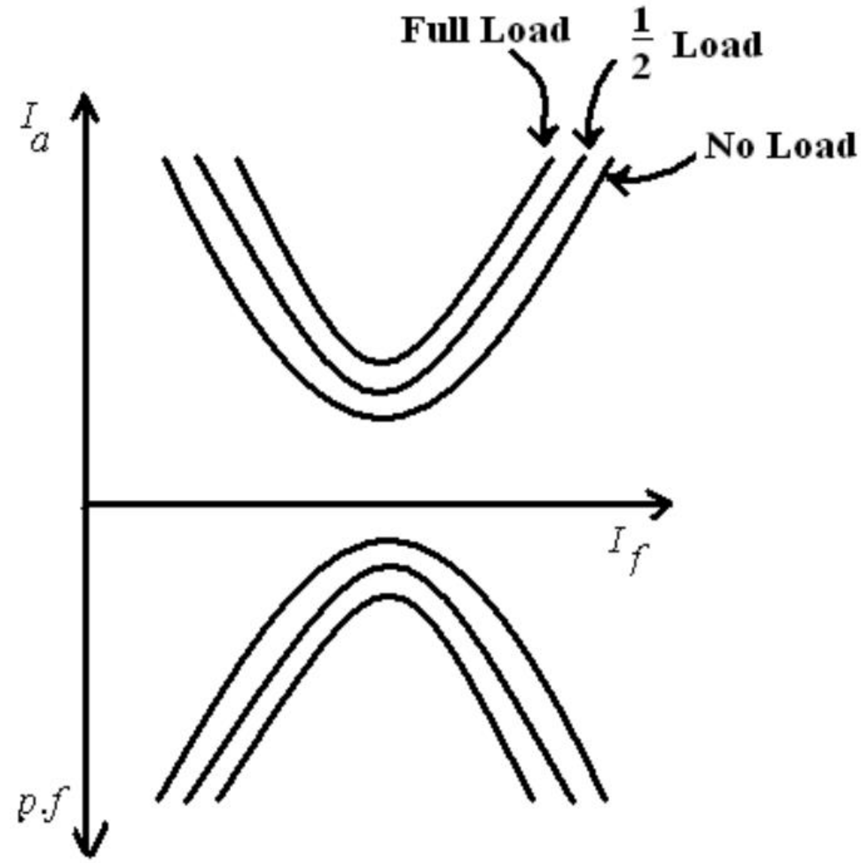
PRECAUTION:

(1) The Potential barrier should be in maximum position.
(2) The motor should be started without load .
(3) Initially TPST switch is in open position.

GRAPH:

The graph is drawn for-

(1) Armature current Vs Excitation current.
(2) Power factor Vs Excitation current.



V & Inverted V Curves

RESULT:

The V-curves and inverted V-curves of the 3-phase synchronous motor have been drawn.

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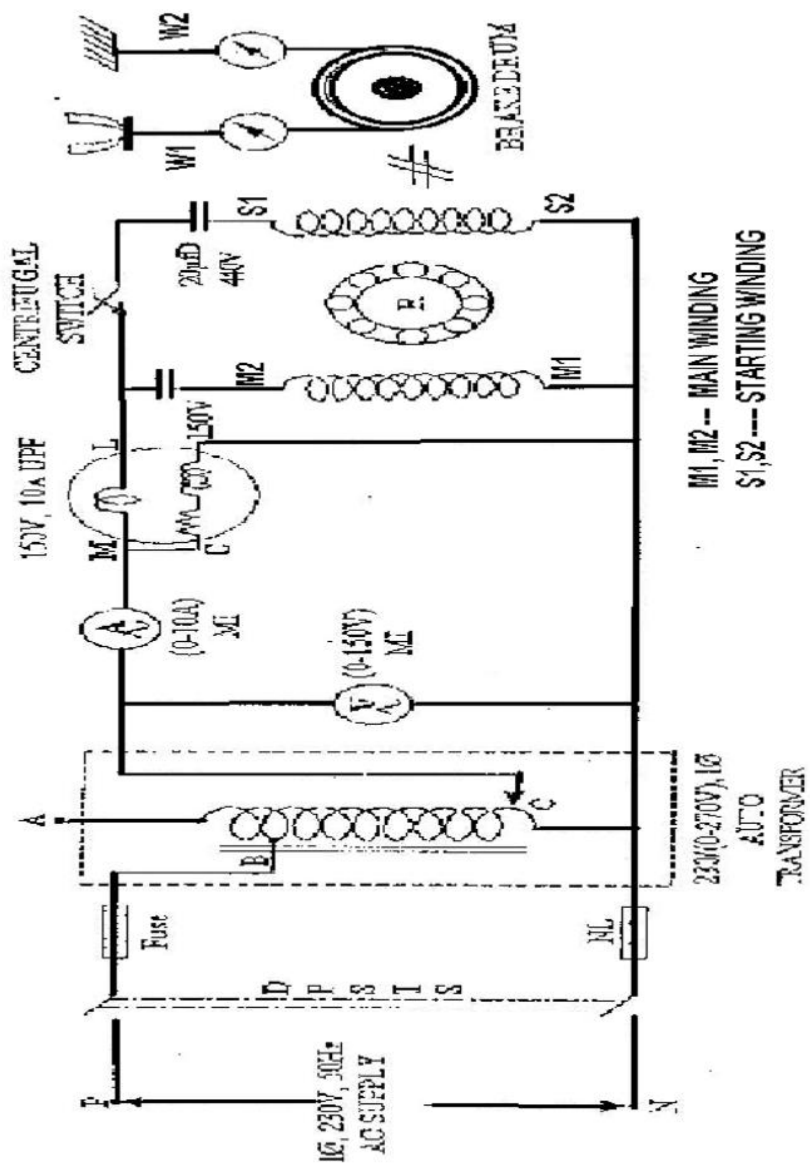
VIVA QUESTIONS:

1. Define V and Inverted V curves.
2. When Synchronous motor is is said to receive 100% excitation?
3. Define critical excitation.
4. What do you mean by under excitation and over excitation?
5. What is synchronous capacitor?
6. What is hunting?
7. Mention some application of synchronous motor.
8. What could be the reasons if a synchronous motor fails to start?
9. A synchronous motor starts as usual but fails to develop its full torque. What could be due to?
10. What are the various methods of starting synchronous motor?
11. What significant characteristic of a synchronous motor is revealed by its V-curves?

EQUIVALENT CIRCUIT OF 1Φ INDUCTION MOTOR



Name plate details:

1. HP/KW :
2. Current :
3. Speed :
4. Voltage :
5. Frequency :

EQUIVALENT CIRCUIT OF 1-Φ INDUCTION MOTOR

Exp. No. **Date:**

AIM:

To draw the equivalent circuit of a single phase induction motor by conducting the no-load and blocked rotor test.

APPARATUS REQUIRED:

S.No	Name of Apparatus	Range	Type	Qty.
1	Voltmeter			
2	Ammeter			
3	Wattmeter			
4	Connecting wires			

PROCEDURE:

NO LOAD TEST:

1. Connections are given as per the circuit diagram.
2. Precautions are observed and the motor is started at no load.
3. Autotransformer is varied to have a rated voltage applied.

BLOCKED ROTOR TEST:

1. Connections are given as per the circuit diagram.
2. Precautions are observed and motor is started at blocked rotor position.
3. Autotransformer is varied to have rated current flowing in motor.
4. Meter readings are noted.

PRECAUTIONS:

NO LOAD TEST:

- Initially DPST Switch is kept open.
- Autotransformer is kept at minimum potential position.
- The machines must be started on no load.

BLOCKED ROTOR TEST:

- Initially the DPST Switch is kept open.
- Autotransformer is kept at minimum potential position.
- The machine must be started at full load(blocked rotor).

$R_{eff} = 1.5 \times R_{dc}$

FORMULAE-

NO LOAD TEST-

$\cos \Phi = W_o/V_oI_o$
$I_w = I_o \cos\Phi$
$I_m = I_o \sin \Phi$
$R_o = V_o/I_w$
$X_o = V_o/I_m$

BLOCKED ROTOR TEST-

$Z_{sc} = V_{sc}/I_{sc}\ \Omega$
$R_{sc} = W_{sc}/I_{sc}2\ \Omega$
$X_{sc} = \sqrt{(Z_{sc}^2 - R_{sc}^2)}\ \Omega$

TABULATION

NO LOAD TEST-

S.No.	**Vo(volts)**	**Io(amps)**	**Wo(watts)**	
			M.F	Observed

BLOCKED ROTOR TEST-

S.No.	**Vsc(volts)**	**Isc(amps)**	**Wsc(watts)**	
			M.F	Observed Actual

CALCULATIONS:

RESULT:

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VIVA QUESTIONS:

1. What is the function of capacitor in a single phase induction motor?
2. Define double field revolving theory.
3. What are the classifications of single phase induction motor based on the method of starting?
4. What design features are incorporated in a split phase motor to make it starting?
5. What is the advantage of a capacitor start motor over a resistance split phase motor?
6. In which direction does a shaded pole motor runs?
7. Give the function performed by induction motor starter.
8. What do you mean by synchronous condenser?
9. What type of motor is used in computer drives and wet grinders?
10. What is the difference between the dc motors and single phase induction motor?