JAIPUR INSTITUTE OF TECHNOLOGY GROUP OF INSTITUTIONS LAB MANUAL OF ELECTRICAL MACHINE LAB 2 4th sem

ELECTRICAL MACHINES LAB - II

LIST OF EXPERIMENTS

1. OC & SC TESTS ON SINGLE PHASE TRANSFORMER
2. SUMPNER'S TEST ON A PAIR OF SINGLE PHASE TRANSFORMER
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12. SEPERATION OF CORE LOSSES OF A SINGLE PHASE TRANSFORMER

OPEN CIRCUIT & SHORT CIRCUIT TEST ON A SINGLE PHASE TRANSFORMER

Aim: To perform open circuit and short circuit test on a single phase transformer and to pre-determine the efficiency, regulation and equivalent circuit of the transformer.

Apparatus required:

Sl.

No. equipment Type Range Quantity

1 Voltmeter MI (0-300)V (0-30)V 1 no

1 no

2 Ammeter MI (0-1)A

(0-10)A 1 no

1 no

3 Wattmeter Dynamo type (0-300)V LPF (0-2.5)A 1 no

4 Wattmeter Dynamo type (0-150)V UPF (0-10)A 1 no

5 Connecting Wires ***** ***** Required

Transformer Specifications:

Transformer Rating :(in KVA)

_________________________ Winding Details:

LV (in Volts): ______________________________ LV side current:_________________________

HV (in Volts): ______________________________ HV side Current:________________________

Type (Shell/Core):____________________________

Auto transformer Specifications:

Input Voltage (in Volts):___________________________

Output Voltage (in Volts): ________________________

Frequency (in Hz):________________________ Current rating (in Amp):_____________________

Theory:

OPEN CIRCUIT TEST :

Procedure:

1. Connections are made as per the circuit diagram.
2. Ensure that variac is set to zero output voltage position before starting the experiment.
3. Switch ON the supply. Now apply the rated voltage to the Primary winding by using Variac.
4. The readings of the Voltmeter, ammeter and wattmeter are noted down in Tabular form.
5. Then Variac is set to zero output position and switch OFF the supply.
6. Calculate Ro and Xo from the readings.

Calculations for OC test:

SHORT CIRCUIT TEST:

Procedure:

1. Connections are made as per the circuit diagram.
2. Ensure that variac is set to zero output voltage position before starting the experiment.
3. Switch ON the supply. Now apply the rated Current to the Primary winding by using Variac.
4. The readings of the Voltmeter, ammeter and wattmeter are noted down in Tabular form.
5. Then Variac is set to zero output position and switch OFF the supply.
6. Calculate Ro1 and Xo1 from the readings.

Calculations for SC test:

Let

V_{o2} = Secondary terminal voltage at No- Load

V_2 = Secondary terminal voltage on Full Load

.

Tabular column For OC test

Sl no. Voltmeter reading

(Vo) Ammeter reading

(Io) Wattmeter reading

Wo Ro Xo Cos ϕo

Tabular column For SC test

Sl no. Voltmeter reading

(VSC) Ammeter reading

(ISC) Wattmeter reading

WSC Ro1 Zo1 Xo1

Equivalent Circuit Diagram

Graph:

Load Current Vs Efficiency

Calculate efficiencies at Full load, half load, ¾ load & ¼ loads.

Result:

SCOTT CONNECTION OF TRANSFORMERS

Aim: To perform the Scott connection of transformer from three phase to two phase connection.

Apparatus required:

Sl.

No. equipment Type Range Quantity

1 Voltmeter MI (0-300)V

(0-600)V 3 no

1 no

2 Ammeter MI (0-1)A 1 no

3 Connecting Wires ***** ***** Required

Transformer Specifications:

MAIN Transformer

Transformer Rating :(in KVA) _________________________ Winding Details:

LV (in Volts): _____________________________ LV side current:_________________________

HV (in Volts): _____________________________ HV side Current:________________________

Type(Shell/Core):___________________________

Tappings: ___________________________________

TEASER Transformer

Transformer Rating :(in KVA) _________________________ Winding Details:

LV (in Volts): _____________________________ LV side current:_________________________

HV (in Volts): _____________________________ HV side Current:________________________

Type(Shell/Core):___________________________

Tappings: ___________________________________

3 - ϕ Auto transformer Specifications:

Input Voltage (in Volts):__________________________

Output Voltage (in Volts): ________________________

Frequency (in Hz):________________________ Current rating (in Amp):____________________

Theory:

Procedure:

1. Connections are made as per the circuit diagram
2. Ensure that output voltage of the variac is set in zero position before starting the experiment.
3. Switch ON the supply.

4. The output voltage of the variac is gradually increased in steps upto rated voltage of single phase MAIN transformer and readings are correspondingly taken in steps.

5. Enter the readings in tabular column.

6. After observations, the variac is brought to zero position and switch OFF the supply.

Calculation:

Prove

Tabular Column:

Sl no. Voltmeter reading

V1 Ammeter reading

I1 Voltmeter reading

V2T Voltmeter reading

V2M Voltmeter reading

V2TM Theoretical calculation

V2TM =√ (V22T + V22M)

Result:

SUMPNERS TEST

Aim: to determine the efficiency and losses of a given transformer accurately under full load condition.

Apparatus required:

Sl.

No. equipment Type Range Quantity

1 Voltmeter MI (0-300)V (0-60)V

(0-600)V 1 no

1 no

1 no

2 Ammeter MI (0-2)A

(0-10)A 1 no

1 no

3 Wattmeter Dynamo type (0-300)V LPF (0-2.5)A
1 no

4 Wattmeter Dynamo type (0-150)V UPF (0-10)A
1 no

5 Connecting Wires ***** ***** Required

Transformer Specifications:

Two identical 1- ϕ Transformers

Transformer Rating :(in KVA) ___________________________
Winding Details:

LV (in Volts): _______________________________ LV side
current:___________________________

HV (in Volts): ____________________________ HV side Current:_______________________
Type(Shell/Core):__________________________

1 - ϕ Auto transformer Specifications:

Input Voltage (in Volts):_________________________

Output Voltage (in Volts): _______________________

Frequency(in Hz):_______________________ Current rating (in Amp):____________________

Theory:

Procedure:

1. Make the connections as per the circuit diagram.

2. The secondary winding terminals of the two transformers are connected in series with polarities in phase opposition which can checked by means of a voltmeter.

3. Before starting the experiment, check the variacs are in minimum output voltage position.

4. Close the first DPST-1 switch and switch ON the supply.

5. Increase the variac slowly, and apply rated voltage to the primary windings of 1- ϕ transformers and check the voltmeter reading connected across the secondary terminals.

6. If the voltmeter reading is Zero, continue with step 8.

7. If the voltmeter reading is not zero, interchange the secondary terminals.

8. Now close the DPST-2 switch and vary the variac-2 slowly till rated current flows in the two series-connected secondaries.

9. Note down the readings of V1,V2, I1, I2, W1, and W2 and enter them in a tabular column.

10. W1 = 2Pc, W2= 2Psc. Losses of each transformer = (W1+W2)/2

11. Now the Variacs are brought to zero voltage position and open DPST switches.

Precautions:

1. Initially Autotransformers are kept in minimum position

2. DPST-1, DPST-2, and SPST are kept in open position.

3. Check the polarities of transformer.

Tabular column:

Sl no. Voltmeter reading

V1 Voltmeter reading

V2 Ammeter reading

I1 Ammeter reading

I1 Wattmeter

Reading

W1 Wattmeter

Reading

W2 Transformer

losses

= (W1+W2)/2 η

= op/(op+loss)

Result:

EQUIVALENT CIRCUIT OF A SIGLE PHASE INDUCTION MOTOR

Aim: to determine the equivalent circuit parameters of a single phase induction motor by performing the no- load and blocked rotor tests.

Appparatus required:

Sl. No.	equipment	Type	Range	Quantity
1	Voltmeter	MI	(0-300)V	1 no
2	Ammeter	MI	(0-10)A	1 no
3	Wattmeter	Dynamotype	(0-300)V LPF (0-10)A	1 no

4 Wattmeter Dynamotype (0-150)V UPF (0-10)A 1 no

5 Connecting Wires ***** ***** Required

1 - ϕ induction motor specifications:

Name plate details

Sl. no.	quantity	
1	rated power	
2	Rated voltage	
3	Current	
4	Speed(RPM)	
5	Cos ϕ (pf)	
6	Frequency	
7	rotor	Squirrel cage

Theory:

Procedure:

NO LOAD TEST:

1. The circuit connections are made as per the circuit diagram.
2. Be sure that variac (auto transformer) is set to zero output voltage position before starting the experiment.
3. Now switch ON the supply and close the DPST switch.
4. The variac is varied slowly, until rated voltage is applied to motor and rated speed is obtained.
5. Take the readings of Ammeter, Voltmeter and wattmeter in a tabular column.
6. The variac is brought to zero output voltage position after the experiment is done, and switch OFF the supply.

BLOCKED ROTOR TEST

1. To conduct blocked rotor test, necessary meters are connected to suit the full load conditions of the motor.

2. Connections are made as per the circuit diagram.

3. Before starting the experiment variac (auto transformer) is set to zero output voltage position.

4. The rotor (shaft) of the motor is held tight with the rope around the brake drum.

5. Switch ON the supply, and variac is gradually varied till the rated current flows in the induction motor.

6. Readings of Voltmeter, Ammeter, and wattmeter are noted in a tabular column.

7. The variac is brought to zero output voltage position after the experiment is done, and switch OFF the supply.

8. Loosen the rope after the experiment is done.

CALCULATION FOR NO-LOAD TEST:

CALCULATION FOR BLOCKED ROTOR TEST

Tabular column for NO-Load Test

Sl no. Voltmeter reading

Vo Ammeter reading

Io Wattmeter reading

Wo

Tabular column for Blocked Rotor Test

Sl no. Voltmeter reading

Vsc Ammeter reading

Isc Wattmeter reading

Wsc

Procedure:

1. Connections are made as per the circuit diagram.
2. Initially rheostat is set at maximum resistance position.
3. Switch ON the supply, and vary the rheostat gradually and note down the readings of ammeter and voltmeter
4. For the corresponding values, average of r1 is taken.

Circuit diagram for measurement of R1

Tabular Column of stator winding resistance r1

Sl no. Voltmeter reading V Ammeter reading

I Resistance R

Comments:

1. Since IM is not self starting Machine, it is started by placing an auxiliary winding in the circuit.
2. Here no-load test is similar to open circuiting the load terminals and blocking the rotor is similar to conducting short circuit on the IM.

Result:

Thus the equivalent circuit parameters of single phase Induction Motor are determined by performing No-Load and Blocked rotor test on it.

SYNCHRONOUS IMPEDENCE METHOD

Aim: To find the regulation of a 3 - ϕ alternator by using synchronous impedance method.

Apparatus required:

Sl.

No.	equipment	Type	Range	Quantity
1	Voltmeter	MI	(0-300/600)V	1 no
2	Ammeter	MI	(0-5/10)A	1 no
3	Ammeter	MI	(0-2.5/5)A	1 no
3	Rheostat	Wire-wound	400 Ω /1.7A 145Ω /2A	1 no

2 no

4	Tachometer Digital	*****	1 no	
5	Connecting Wires	*****	*****	Required

Name plate details:

DC Motor(prime mover) 3- ϕ Alternator

KW : Power Rating:

Voltage : PF :

Current : Line voltage:

Speed : Speed

Exctn : Shunt Exctn Voltage:

Voltage : Rated Current :

Field current::

Theory:

Procedure:

OPEN CIRCUIT TEST:

1. Make the connections as per the circuit diagram.
2. Before starting the experiment, the potential divider network in the alternator field circuit and field regulator rheostat of motor circuit is set minimum resistance position.
3. Switch ON the supply and close the DPST switch. The DC motor is started by moving starter handle.
4. Adjust the field rheostat of DC motor to attain rated speed (equal to synchronous speed of alternator)
5. By decreasing the field resistance of Alternator, the excitation current of alternator is increased gradually in steps.
6. Note the readings of field current, and its corresponding armature voltage in a tabular column.
7. The voltage readings are taken upto and 10% beyond the rated voltage of the machine.

SHORT CIRCUIT TEST:

1. For Short circuit test, before starting the experiment the potential divider is brought back to zero output position, i.e., resistance should be zero in value.

2. Now close the TPST switch.

3. The excitation of alternator is gradually increased in steps until rated current flows in the machine and note down the readings of excitation current and load current (short circuit current)

4. Switch OFF the supply.

Procedure to find Armature resistance of alternator:

1. Connections are made as per the circuit diagram.

2. Switch ON the supply. By varying the rheostat, take different readings of ammeter and voltmeter in a tabular column.

3. From the above readings, average resistance Ra of a armature is found out.

Procedure to find synchronous impedance from OC and SC tests.

1. Plot open circuit voltage, short circuit current verses field current on a graph sheet.

2. From the graph, the synchronous impedance for the rated value of excitation is calculated.

3. The excitation emf is calculated at full load current which is equal to the terminal voltage at No load.

4. The voltage regulation is calculated at rated terminal voltage.

Result:

The synchronous impedance of the given alternator is calculated by conducting open circuit and SC test and voltage regulation of the given alternator is calculated at different power factors.

Tabular column:

Sl no. OC test Sl no. S.C. test

Field current in

Amp.(I f) OC voltage per phase (Vo) Field current

If(Amp.) SC current Isc Amp.

Ideal graph:

Connection diagram to find Ra

Tabular column:

Sl no. Armature current

I(amp) Armature voltage

Va (volts) Rdc=V / I

Theoretical calculation:

EFFICIENCY OF 3- ϕ ALTERNATOR

Aim: to determine the efficiency of 3- ϕ Alternator.

Apparatus Required:

Sl.

No. Equipment Type Range Quantity

1 Voltmeter MI (0-300)V

(0-600)V 1 no

1 no

2 Ammeter MC (0-20)A

(0-2.5)A 1 no

1 no

3 MI (0-10)A 1 no

3 Rheostat Wire-wound 400 Ω /1.7A 145Ω /2A
1 no

2 no

4 Tachometer Digital ***** 1 no

5 Wattmeter Electro dynamo meter type
10A/600V UPF 2 no

6 Connecting Wires ***** ***** Required

Name plate details:

DC Motor(prime mover) 3- ϕ Alternator

KW : Power Rating:

Voltage : PF :

Current : Line voltage:

Speed : Speed

Exctn : Shunt Exctn Voltage:

Voltage : Rated Current :

Field current::

Theory:

Procedure:

1. Connections are made as per the circuit diagram.
2. Ensure that TPST switch is opened before starting the experiment.
3. The motor is started with the help of 3-point starter.
4. The speed is set to 1500 RPM by varying rheostat.

5. The readings of voltmeter, ammeter are noted down in a tabular column.

6. The field rheostat of alternator is varied till the rated voltage is obtained in the alternator.

7. TPST switch is closed. Now 3- ϕ load is gradually applied and readings of meters are noted down till rated current flows in the ammeter.

Observation table:

Sl no. V1

(volts) I1

(Ampere) Ish

(Amp.) VL

(volts) IL (volts) W1

(watt) W2

(watt) % η

Circuit diagram for determining the armature resistance of DC motor.

Observation table:

Sl no. Armature current

I(amp) Armature voltage

Va (volts) Rdc=V / I

Procedure:

1. Connections are made as per the circuit diagram.
2. Switch ON the supply. By varying the rheostat, take different readings of ammeter and voltmeter in a tabular column.
3. From the above readings, average resistance Ra of a armature is found out.

Calculations:

oooooooooooo oooo aaaaooaaaaaaaaooooaa

Alternator efficiency =

iiaaoooooo oooo aaaaooaaaaaaaaooooaa

Output of alternator = (W1+W2) watt

Input of alternator = Mechanical output of DC motor.

Mechanical output of DC motor = Electrical input to motor – iron loss – I2aRa - I2shRsh – frictional

and windage losses

At No-Load:

The input to the DC motor VoIo = I2aoRa + I2shRsh + Frictional and windage loss of motor +

iron loss of motor +friction and windage loss of alternator.

Neglecting friction and windage losses of alternator,

VoIo = I2aoRa + I2shRsh + Frictional and windage loss of motor + Iron loss of motor

Core losses = VoIo - (I2aoRa + I2shRsh)

Input to alternator = output of the motor = V1I1 – (Core losses + I2aRa + I2shRsh)

Ia is Varying if the load on the alternator is varying.

$Ia = I1 - Ish$

% efficiency =(o/p of alternator / i/p of alternator)*100

Result: The efficiency of the 3- ϕ alternator is determined.

NO LOAD AND BLOCKED ROTOR TEST ON A 3- ϕ INDUCTION MOTOR

Aim: to determine the equivalent circuit of a 3- ϕ induction motor and calculate various parameters of induction motor with the hlp of circle diagram.

Apparatus Required:

Sl. No.	Equipment	Type	Range	Quantity
1	Voltmeter	MI	(0-600)V	1 no

2 Ammeter MI (0-10)A 1 no

3 Wattmeter Electro dynamo meter type
10A/600V UPF 10A/600V LPF 1 no

1 no

4 Tachometer Digital ***** 1 no

5 Connecting Wires ***** ***** Required

Name plate details:

Power rating

Voltage

Current

Speed(RPM)

Frequency

PF

3- ϕ Auto transformer Details:

Input Voltage: ___________________(Volt) Output Voltage: ___________________(Volt)

Current:______________________(Amp.)

Theory:

Procedure:

NO LOAD TEST:

1. Connections are made as per the circuit diagram.
2. Ensure that the 3- ϕ variac is kept at minimum output voltage position and belt is freely suspended.
3. Switch ON the supply. Increase the variac output voltage gradually until rated voltage is observed in voltmeter. Note that the induction motor takes large current initially, so, keep an eye on the ammeter such that the starting current current should not exceed 7 Amp.
4. By the time speed gains rated value, note down the readings of voltmeter, ammeter, and wattmeter.
5. Bring back the variac to zero output voltage position and switch OFF the supply.

BLOCKED ROTOR TEST:

1. Connections are as per the circuit diagram.
2. The rotor is blocked by tightening the belt.
3. A small voltage is applied using 3- ϕ variac to the stator so that a rated current current flows in the induction motor.
4. Note down the readings of Voltmeter, Ammeter and Wattmeter in a tabular column.
5. Bring back the variac to zero output voltage position and switch OFF the supply.

Tabular column:

NO LOAD TEST:

Sl no. Voltmeter reading

V nl Ammeter reading

Inl Wattmeter reading Wnl (Pnl)

W1+W2

W1 W2

BLOCKED ROTOR TEST

Sl no. Voltmeter reading

V br Ammeter reading

Ibr Wattmeter reading Wbr (Pbr)

W1+W2

W1 W2

Measurement of stator winding resistance (r1): Circuit diagram:

Tabular column:

S no. Voltage (v) Ammeter (I) Resistance (R)

Procedure to find r 1

1. Connections are made as per the circuit diagram
2. Switch ON the supply. By varying the rheostat, take different readings of ammeter and voltmeter in a tabular column.
3. From the above readings, average resistance r1 of a stator is found

Calculations:

FOR NO-LOAD TEST:

The rated Vnl Inl and power Pnl are all per phase values for No-Load test.

BLOCKED ROTOR TEST:

The rated Vbr , Ibr and power Pbr are all per phase values for Blocked rotor test.

Since $Xm >> X2$

$Xbr = X1 + X2$

For squirrel cage induction motor, total leakage reactance Xbr(= X1 + X2) can be distributed between stator and rotor as per the following table:

Sl no	Class of motor	Fraction of Xbr	
		X1	X2
1	Class A	0.5	0.5
2	Class B	0.4	0.6
3	Class C	0.3	0.7
4	Class D	0.5	0.5

With the test data obtained, draw the circle diagram and calculate line current, power factor, slip, torque, and efficiency at Full load. Stator and rotor ohmic losses at standstill are assumed equal.

Result:

Thus various parameters of three phase induction motor with the help of circle diagram are determined.

BRAKE TEST ON 3- ϕ SQUIRREL CAGE INDUCTION MOTOR

Aim: To determine the efficiency of 3- ϕ induction motor by performing load test. To obtain the performance curves for the same.

Apparatus Required:

Sl.

No. Equipment Type Range Quantity

1 Voltmeter MI (0-600)V 1 no

2 Ammeter MI (0-10)A 1 no

3 Wattmeter Electro dynamo meter type
10A/600V UPF 10A/600V LPF 1 no

1 no

4	Tachometer	Digital	*****	1 no
5	Connecting Wires	*****	*****	Required

Name plate details:

Power rating

Voltage

Current

Speed(RPM)

Frequency

PF

3- ϕ Auto transformer Details:

Input Voltage: ____________________(Volt)   Output Voltage: ____________________(Volt)
Current:__________________________(Amp.)
Freq.:______________________________(Hz) Theory:

Procedure:

1. Connections are made as per the circuit diagram.
2. Ensure that the 3- ϕ variac is kept at minimum output voltage position and belt is freely suspended.
3. Switch ON the supply. Increase the variac output voltage gradually until rated voltage is observed in voltmeter. Note that the induction motor takes large current initially, so, keep an eye on the ammeter such that the starting current current should not exceed 7 Amp.
4. By the time speed gains rated value, note down the readings of voltmeter, ammeter, and wattmeter at no-load.
5. Now the increase the mechanical load by tightening the belt around the brake drum gradually in steps.
6. Note down the various meters readings at different values of load till the ammeter shows the rated current.
7. Reduce the load on the motor finally, and switch OFF the supply.

Calculations:

Input power = W 1+ W 2

Output power = (2 ∏ N T) / 60

N =Speed of the motor in RPM

T = 9.81 (S1 –S2) R N-m

S = load in Kg.

R = radius of the pulley in meters (________) Mt.

Power factor = Cos [tan-1(3(W1−W2))]

W1+W2

Ideal graphs:

1. Speed or slip Vs output power
2. Torque Vs output power
3. % efficiency Vs output power

Tabular Column:

Sl no Voltage

(VL) Current

IL Load Speed W1 W2 i/p power

W1+W2 Torque

T O/P power %η PF

S1 S2

Result:

The efficiency of three phase induction motor is determined by conducting a brake test on it.

DETERMINATION OF Xd AND Xq OF SALIENT POLE SYNCHRONOUS MOTOR

Aim: To determine the direct axis reactance Xd and quadrature axis reactance Xq by conducting a slip test on a salient pole synchronous machine.

Apparatus required:

Sl. No.	Equipment	Type	Range	Quantity
1	Voltmeter	MI	(0-300)V	1 no
2	Ammeter	MI	(0-5)A	1 no
3	Rheostat	Wire-wound	400 Ω /1.7A	1 no
4	Tachometer	Digital	*****	1 no
5	Connecting Wires	*****	*****	Required

DC Motor (prime mover) 3- ϕ Alternator

KW : Power Rating:

Voltage : PF :

Current : Line voltage:

Speed : Speed

Exctn : Shunt Exctn Voltage:

Voltage : Rated Current :

Field current::

3- ϕ Auto transformer Details:

Input Voltage: ____________________(Volt) Output Voltage: ____________________(Volt)
Current:________________________(Amp.) Freq: ______________________________(Hz) Theory:

Procedure:

1. Connections are made as per the circuit diagram.

2. Initially set field regulator, 3-ϕ variac at minimum position and TPST switch open.

3. The DC motor is started slowly by sliding starter handle and it is run at a speed slightly less than the synchronous speed of the alternator.

4. Close the TPST switch.

5. With field winding left open, a positive sequence balanced voltages of reduced magnitude

(around 25% of rated Value) and of rated frequency are impressed across the armature terminals.

6. The prime mover (DC motor) speed is adjusted till ammeter and voltmeters pointers swing slowly between maximum and minimum positions.

7. Under this condition , readings of maximum and minimum values of both ammeter and voltmeter are recorded

Calculations:

maximum armature terminal voltage per phase

Xd= minimum armature armature current per phase

minimum armature terminal voltage per phase

Xq =

maximum armature current per phase

Note:

1. When performing this test, the slip should be made as small as possible.

2. During Slip test, it is observed that swing of the ammeter pointer is very wide, whereas the voltmeter has only small swing.

Tabular column:

Sl no. Speed Vmax

(VL) Vmin

(VL) Imax

(IL) Imin

(IL) Xd Xq

Result: Hence Xd and Xq are calculated by conducting slip test on Salient pole machine.

‘V’ AND ‘INVERTED V’ CURVES OF SYNCHRONOUS MOTOR

Aim: To plot the ‘v’ and ‘inverted v’ curves of synchronous motor.

Apparatus Required:

Sl.

No. Equipment Type Range Quantity

1 Voltmeter MI (0-600)V 1 no

2 Ammeter MC MI (0-2.5)A (0-10)A 1 no

1 no

3 Rheostat Wire-wound 400 Ω /1.7A 1 no

4 Tachometer Digital ***** 1 no

5 Wattmeter Electrodynamometer 10A, 600V UPF

10A , 600V LPF 1 no

1 no

6 Connecting Wires ***** ***** Required

Name plate details

3- ϕ Synchronous motor

Power Rating:

PF

Line voltage:

Speed

Freq.

Rated Current :

Field current (If)

Field Voltage (Vf)

3- ϕ Auto transformer details

Input voltage: ________________________(Volt) Output Voltage : _____________________(Volt)

Freq. :__________________________________(Hz)
Current: ____________________________(Amp)

Electrical Machines-II laboratory

Theory:

Procedure:

1. Connections are made as per the circuit diagram.
2. Opening the SPST switch connected across the field DC supply is given to the field and field current is adjusted to 0.3A (20% of rated field current)
3. The DC supply to the field is removed and SPST switch is connected across the field by closing the switch
4. As 3- ϕ , 440V, 50Hz AC supply is applied to 3- ϕ dimmer stator keeping it in minimum output position, keeping it prior to that motor is kept in no load state.
5. Gradually supply voltage to synchronous motor is increased and then motor starts running as squirrel cage induction motor. The direction of rotation is observed. if it is not proper then supply phase sequence is altered.
6. Observing Ia, the voltage is gradually increased. It will reach a high value and suddenly falls to a low value.
7. At that instant, open SPST switch connected across the field. The DC supply is then given to the field. Then the motor is pulled into synchronism and motor now works as a synchronous motor.
8. Gradually the supply voltage to stator is increased by observing the armature current. If Ia, increases above the rated value then increase If such that Ia will be within

limits and thus full rated supply voltage is gradually given to the motor. Now motor will work as synchronous motor with full rated voltage.

9. By varying If in steps, armature currents are recorded at no-load.

10. By applying half of full load on motor, If and Ia are recorded again. The same experiment is repeated at 3/4th load, full load and corresponding readings are recorded.

11. Completely removing the load on motor, the 3- ϕ supply to stator and then the DC supply to the field are switched OFF

Observation table:

Sl no.	Supply voltage	Wattmeter W1	Wattmeter W2	Field current If(Amp)	Armature current Ia(Amp)	Cos ϕ

Calculations:

Power factor = Cos [tan-1(3(W1−W2))]

W1+W2

Ideal graphs:

Result:

SEPARATION OF NO LOAD LOSSES IN 1-Φ TRANSFORMER

Aim: To separation the Eddy current loss and Hysteresis loss from the iron loss of 1-Φ transformer.

Apparatus Required:

Sl. No.	Equipment	Type	Range	Quantity

1 Voltmeter MI (0-300)V 1 no

2 Ammeter MC (0-2.5)A 1 no

3 Rheostat Wire-wound 400 Ω /1.7A 145Ω /2A
1 no

2 no

4 Tachometer Digital ***** 1 no

5 Wattmeter Electro dynamo meter type
10A/600V LPF 1 no

6 Connecting Wires ***** ***** Required

Name plate details:

DC Motor(prime mover) 3- ϕ Alternator

KW : Power Rating:

Voltage : PF :

Current : Line voltage:

Speed : Speed

Exctn : Shunt Exctn Voltage:

Voltage : Rated Current :

Field current::

Transformer Specifications:

Transformer Rating :(in KVA) _________________________ Winding Details:

LV (in Volts): _____________________________ LV side current:_________________________

HV (in Volts): _____________________________ HV side Current:________________________ Type (Shell/Core):___________________________

Theory

Procedure:

1. Make the circuit connections as per the circuit diagram.

2. The prime mover is started with the help of 3-point starter and it is made to run at rated speed.

3. By varying alternators field rheostat gradually, the rated primary voltage is applied to transformer.

4. By adjusting the speed of prime mover the required frequency, is obtained and corresponding reading are noted.

5. The experiment is repeated for different frequency and corresponding readings are tabulated.

6. The prime mover is switched off using the DPIC switch after bringing all the rheostats to initial position

7. From the tabulated readings the iron loss is separated from eddy current loss and hysteresis loss by using respective formulae.

Tabular form:

Separation of No load losses in single phase Transformer:

Multiplication factor=

S.No

Speed of the prime mover

N(rpm) Supply frequency

(f)Hz Primary voltage

(V)volts Wattmeter readings(w) Iron or core loss

(Wi)watts

Wi/f

Observed

(watts)   Actual (watts)

Calculation:

1. Frequency(f)=PNs/120

Where P-number of poles; Ns-Synchronous speed in rpm

2. Hysteresis loss(Wh)=Af
3. Eddy current loss(We)=Bf2
4. Iron loss or core loss(Wi)= We +Wh

Model Graph:

The graph drawn as frequency Vs(Wi/f)

Precautions:

1. The motor field rheostat should be kept at minimum resistance position.
2. The alternator field rheostat should be kept maximum resistance position.

3. The motor should be run in anticlockwise direction.
4. Avoid loose connections.
5. Take the readings with any parallax error.

Result:

TITLE: BRAKE TEST ON 3-Φ INDUCTION MOTOR

CIRCUIT DIAGRAM

TITLE: OC TEST ON 1-Φ TRANSFORMER

CIRCUIT DIAGRAM

TITLE: SC TEST ON 1-Φ TRANSFORMER

CIRCUIT DIAGRAM

TITLE: NO-LOAD & BLOCKED ROTOR TEST ON 3-Φ INDUCTION MOTOR

CIRCUIT DIAGRAM

TITLE: EFFICIENCY OF 3-Φ ALTERNATOR

CIRCUIT DIAGRAM

TITLE: DETERMINATION OF Xd & Xq ON 3-Φ SALIENT POLE MACHINE CIRCUIT DIAGRAM

TITLE: DETERMINATION OF REGULATION ON 3-Φ ALTERNATOR (SYNC. IMP. & MMF) CIRCUIT DIAGRAM

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TITLE: DETERMINATION OF REGULATION ON 3-Φ ALTERNATOR (ZPF & ASA METHODS) CIRCUIT DIAGRAM

TITLE: SCOTT CONNECTION

CIRCUIT DIAGRAM

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TITLE: SUMPERNER’S TEST

CIRCUIT DIAGRAM

TITLE: EQUIVALENT CIRCUIT OF 1-ϕ INDUCTION MOTOR

CIRCUIT DIAGRAM

TITLE: V & INV V CURVES OF 3-ϕ SYNCHRONOUS MOTOR

CIRCUIT DIAGRAM