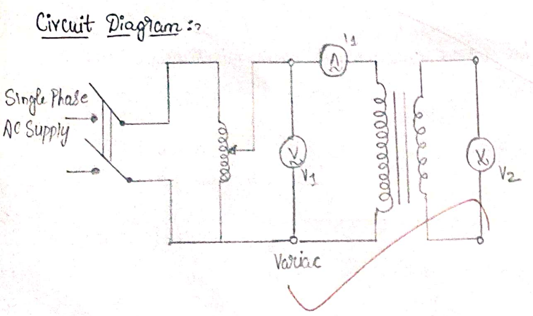
Circuit Diagram :-



Tabular Column :-

S.No	Primary Voltage (V_1) in Volts	Secondary Voltage (V_2) in Volts	Primary current (I_1) in amps	Turn ratio $K = V_2/V_1$	Secondary current $I_2 = I_1/K$
1.	230V	230 V	0.21 A	1	0.21
2.	230V	228 V	0.4 A	0.99	0.40
3.	230V	226 V	0.6 A	0.98	0.61
4.	230V	224 V	0.8 A	0.97	0.82

Calculations

① $K = 230/230 = 1$

② $K = 228/230 = 0.99$

③ $K = 226/230 = 0.98$

④ $K = 224/230 = 0.97$

① $I_2 = 0.21/1 = 0.21$

② $I_2 = 0.4/0.99 = 0.40$

③ $I_3 = 0.6/0.98 = 0.61$

④ $I_4 = 0.8/0.97 = 0.82$

2/2/25

Expt :- 08 Calculation of Secondary turns and Current in a transformer

Aim:- To calculate the Secondary turns and current in a single phase transformer

Apparatus Required :-

Sl.No	APPARATUS	RANGE	QUANTITY
1	Single Phase transformer	230/115V	1
2	Auto transformer	0-300VAC	1
3	Voltmeter	0-300V AC	1
4	Ammeter	0-10 AC	1
5	Connecting wires	-	As required
6	Single Phase AC Power Supply	-	-

Theory:-

It is Essential to know the relative polarity at any instant of primary and Secondary terminals for making correct connections. When The two transformers are to be connected in parallel to share the load on the system. The marking is correct if Voltage V_3 is less than V_1, Such as polarity is termed as Subtractive polarity. The Standard practice is to have Subtractive polarity. The standard ~~PR~~ because it reduces The voltage stress between adjacent leads. In case $V_3 > V_1$, The EMF induced in primary and Secondary have additive relation and transformer is said to have additive polarity.

Name plate details:-

KVA Rating	
Rated H.V Side Voltage	230 V
Rated H.V side current	4.5A
Rated L.V Side Voltage	230 V
Rated L.V Side current	4.5A

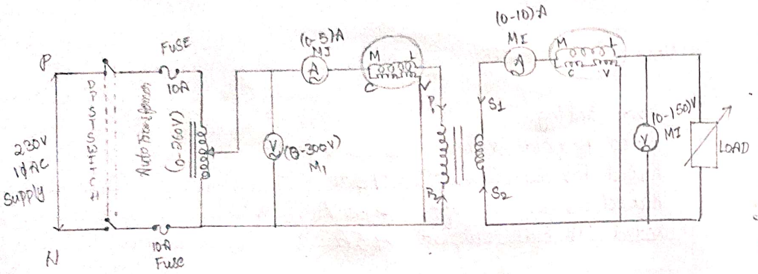
Procedure:

1. Connect the Circuit as shown in the diagram.
2. switch on the ac supply
3. Reduce Voltage V_1 across primary and V_2 across
4. If $V_1 > V_2$ Then transformer is step down.
5. If $V_2 > V_1$ then transformer is step up.
6. switch off ac supply.

Marks obtained:

Theoretical calculations		20	20
Observation		20	20
Exceution of practice Examples		30	30
Viva		10	8
Record		20	20
Total Score		100	98
Date of Experiment	20/2/25	Faculty Signature	
Date of record Submission			

Result:- Thus the secondary turns and current in a single phase the transformer is calculated.



S.NO	LOAD	Primary			Secondary			INPUT POWER MF=4	OUTPUT POWER MF=2	Efficiency η (%)	% Regulation
		V_1	I_1	W_1	V_2	I_2	W_2				
1	No LOAD	230	0	0	215	0	0	0	0	0	–
2	200	228	1	220	210	1	240	880	480	55	0.9
3	400	226	1.5	270	205	1.5	480	1080	960	89	1.7
4	600	225	2.6	600	205	2.5	770	2400	1540	64	2.2
5	800	224	3.5	800	200	3.1	980	3200	1960	61	2.6

20/2/25

Expt 09. Load Test on a Single Phase transfromer

Aim:- To Conduct load test on Single phase transfromer and to find Efficiency and percentage regulation.

Apparatus Required:

S.No	APPARATUS	RANGE	TYPE	QTY
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, 5A)(150V, 5A)	UPF, UPF	1,1
4	Auto Transformer	1ϕ, (0-260)V	–	1
5	Resistive load	5kW, 230V	-	1
6	Connecting Wires	2.5 Sq.mm	Copper	Few

Precautions:

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

Name plate details:

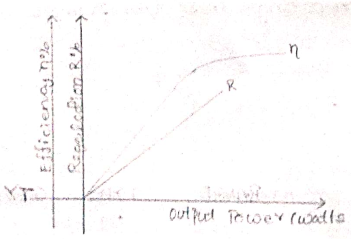
- KVA Rating:
- Rated HV Side Voltage: 230V
- Rated HV Side Current: ~~10A~~ 5A
- Rated LV Side Voltage: 115V
- Rated LV Side Current: 10A

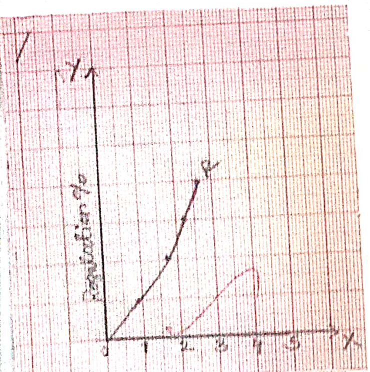
Fuse Rating calculations:

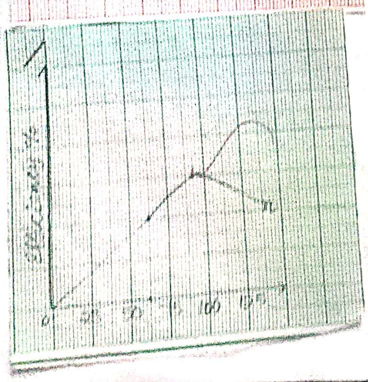
The required fuse ratings for O.C. are 20% of rated current on L.V Side = (20/100) x Rated current on L.V Side.

The required fuse ratings for S.C are 120% of rated current on H.V Side.

$$\frac{125 \times 5}{100} = 6.25\ A$$







Procedure:

1. Connections are made as per the circuit diagram
2. After checking the no load conditions, 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 reading on both Primary and Secondary sides are noted.
5. Again no load condition is obtained and DPST switch is opened.

Formulae:

Output Power = W_2 x Multiplication factor

Input Power = W_1 x Multiplication factor

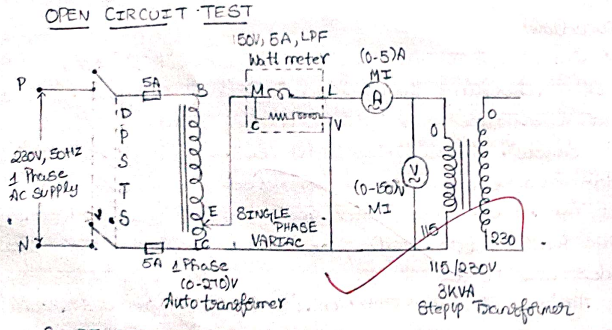
$$\text{Efficiency } \eta\% = \frac{\text{Output Power}}{\text{Input Power}} \times 100\%$$

Marks obtained:

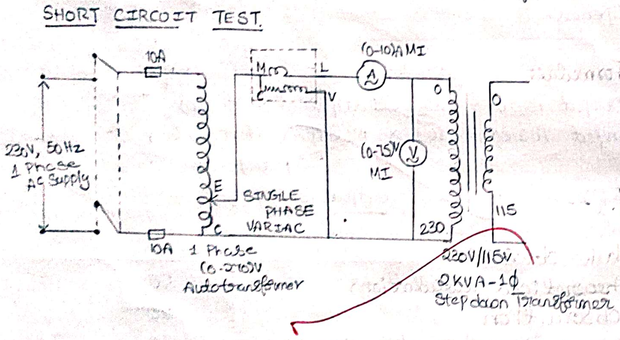
Theoretical calculations	20	20
Observation	20	20
Execution of practice Examples	30	30
Viva	10	9
Record	20	20
Total Score	100	99
Date of Experiment	20/2/2025	
Date of Record submission		Faculty sign

Result: Thus the conduct load test on single phase transformer and Efficiency and Percentage regulation are calculated.

OPEN CIRCUIT TEST



SHORT CIRCUIT TEST



Test	Voltage (V)	Current (A)	Power (W)
O.C Test (On LV Side)	$V_0 = 115$	$I_0 = 0.4$	$W_0 = 4$
S.C Test (on HV Side)	$V_{sc} = 12$	$I_{sc} = 4.2$	$W_{sc} = 9$

20/2/25 Expt 10: OC and SC test on single phase transformer

Aim: To conduct ~~load~~ OC and SC test on single phase transformer

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	Watt meter	(300V, 5A) (150V, 5A)	UPF, UPF	1, 1
4.	Auto transformer	1ϕ (0-260)V	–	1
5.	Resistive load	5KW, 230V	–	1
6.	Connecting Wires	2.5 sq.mm	Copper	Few

Precautions:

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

Name plate Details:

- KVA Rating
- Rated H.V Side Voltage - 230
- Rated H.V Side Current - 5A
- Rated L.V Side Voltage - 115V
- Rated L.V Side Current - 10A

Fuse rating calculations:

The required fuse ratings for O.C are 20% of rated current on L.V Side = (20/100) × Rated Current on L.V Side

The required fuse ratings for S.C are 120% of rated current on H.V Side = (120/100) × Rated current on H.V Side

Procedure:

(I) O.C. TEST

1. The Circuit connections are made as per the circuit diagram
2. Keeping the H.V. winding open and the auto transformer in its minimum position the main supply is switched ON.
3. By slowly and carefully adjusting the auto transformer, the rated voltage (115V) is applied to L.V. winding of the transformer.
4. Under this condition the ammeter (I_0), Voltmeter (V_0) and Wattmeter (W_0) readings a noted down.
5. After the Experiment is completed, the auto transformer is slowly brought back to minimum position and then the main supply is switched off.

(II) S.C. TEST

1. The Circuit connections are made as per the circuit diagram.
2. Short circuiting the LV winding and keeping the auto transformer in its minimum position, the main supply is switched ON.
3. By slowly and carefully adjusting the auto transformer the rated current (which is calculated as H.V current = KVA rating * 1000 / H.V is circulated through the H.V winding.
4. Under this condition, the ammeter (ISC), the Voltmeter (VSC) and the Wattmeter (WSC) readings are noted down.
5. After the Experiment is completed, the auto transformer is brought back to its minimum position and main supply is switched OFF.

MODEL CALCULATIONS

1. To obtain the Equivalent circuit parameters w.r.t H.V side

(i) From the O.C test the; constant loss Iron loss is noted

$W_C = W_0 = 4$ watts

(ii) From the S.C test full load copper loss is noted

$W_{cu} = W_{SC} = 9$ Watts

For a transformer, the Equivalent circuit parameters can be determined Either w.r.t H.V side or L.V side. If the parameters are Estimated on the H.V Side; the resulting Equivalent circuit is called H.V side Equivalent circuit of the transformer.

From the O.C test R_0 and X_0 are calculated using the following Expressions,

$$R_0\ (L.V) = V_0 / I_W = 115/0.034 = 3.38\ \text{k ohms}$$

$$X_0\ (L.V) = V_0 / I_m = 115/0.398 = 289\ \text{ohms}$$

Where $I_W = I_0 \cos\theta = 0.4 \times \cos(85.09) = 0.034\,A$

$I_\mu = I_0 \sin\theta = 0.4 \times \sin(85.09)$ and $\theta = \cos^{-1}[W_0/V_0 I_0] = \cos^{-1}(0.086)$

Since these values are calculated w.r.t L.V side (because O.C test is conducted on the L.V side), the Equivalent values of 'R_0' and 'X_0' as referred to H.V side are determind as

$$R_0\ (H.V) = R_0(L.V)/K^2 = 3.38 \times 10^3/4 = 845\,\Omega$$

$$X_0\ (H.V) = X_0(L.V)/K^2 = 289/4 = 72.25\,\Omega$$

Where, K = (Secondary Voltage)/(Primary Voltage)

= 115/230 for a step down operation

= 230/115 for a step up operation

Since we are assuming a step down operation $K = 115/230 = 0.5$

$$R_T\ (H.V) = W_{sc}/I_{sc}^2 = 9/4.2^2 = 0.51\,\Omega$$

$$Z_T\ (H.V) = V_{sc}/I_{sc} = 12/4.2 = 2.85\,\Omega$$

$$X_T\ (H.V) = [Z_T^2(H.V) - R_T^2(H.V)]^{1/2} =$$

R_T (H.V) and X_T (H.V) are the total Equivalent resistance and reactance of the transformer as reffered to the H.V side whose values are

Calculated from the S.C test, Now the H.V Side Equivalent circuit is drawn.

2. To Predetermine The Efficiency:

The percentage Efficiency is then predetermined for different load conditions for a Specified load power factor using the Expression,

$$\% \text{ Efficiency} = \frac{X * KVA * \cos\phi * 1000}{(X * KVA * \cos\phi * 1000) + W_0 + X^2 W_{F.L}}$$

When X is the fraction of the full load which is 0.25 for 25% load, 0.5 for 50% load, 0.75 for 75% load, 1.0 for full load and 1.25 for 1.25 for 125% Load and $\cos\phi$ is the load P.F (Usually assumed as 0.8 lag) The Efficiency values so calculated are Entered in the tabular column as Shown. A graph is plotted betweenprecentage efficiency and the output as Shown in model graph.

3. To Pre-determine the percentage Regulation:

The regulation on full load for different leading and lagging power factors are predetermined by formula,

$$\% \text{ Regulation} = \frac{[I(H.V) * R_T(H.V)\cos\phi] + [I(H.V) * X_T(H.V)\sin\phi] * 100}{V(H.V)}$$

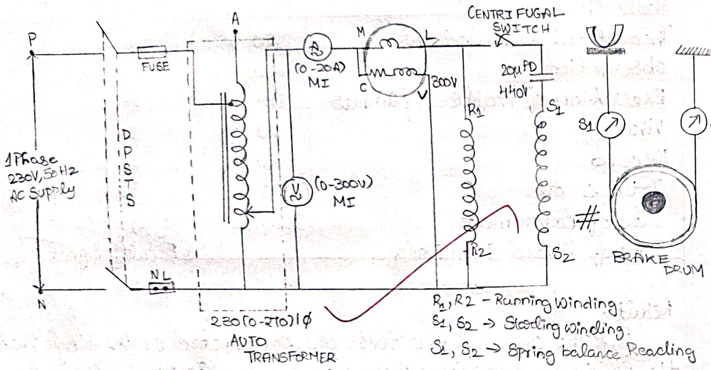
Where + for lagging power factor, - for leading Power Factor $I_{H.V}$ = Rated current on H.V Side, $V_{H.V}$ = Rated Voltage on H.V Side. By assumig different leading and lagging power factor such as 0.2, 0.4, 0.6, 0.8 and 1.0 the regulation of the transformer for full load are determined and tabulated as Shown below.

Marks Obtained

Theoretical calculations	20	20
observation	20	20
Execution of Practice Examples	30	30
Viva	10	8
Record	20	20
Total Score	100	98
Date of Experiment	20/2/25	
Date of record submission		Faculty Signature

Result:-

Thus the O.C and S.C tests are conducted on the single phase ~~the~~ Efficiency Transformer.



20/2/25

Expt. No. 11. Load test on a Single Phase Induction Motor

Aim: To Conduct load test on single phase Induction motor to plot the following performance characteristics

1) Output power Vs Efficiency
2) Output power Vs Speed
3) output power Vs % Slip
4) output Power Vs Torque
5) output Power Vs line current

Apparatus Required

S.No	APPARATUS	RANGE	TYPE	QUANTITY
1	Ammeter	(0-20)A	MI	1
2	Voltmeter	(0-300)V	MI	1
3	Watt meter	(300V, 10A)	UPF	1
4	Auto Transformer	(1ϕ, (0-270)V	-	1
5	Connecting Wires	2.5 Sq. mm	Copper	Few

Fuse rating calculations:

For the load test the required fuse ratings are 120% of motor rated current

Fuse Rating Current = (125/100) × Rated current

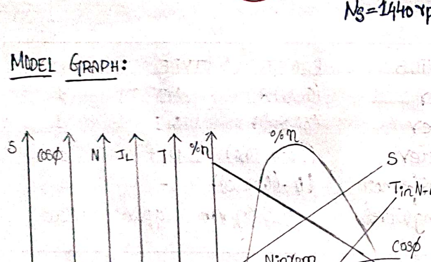
Precautions:

1. Remove the fuse carriers before wiring and start wiring as per the circuit diagram.
2. Check the position of the rheostat as specified.
3. The load on motor must be released initially.
4. Fuse Calculations: For load test the required fuse ratings are 120% of the rated current of the motor

S.NO	Line Voltage (V_L)	Line Current (I_L)	Input Power (W)	Spring Balance S1 (Kg)	S2 (Kg)	S1-S2 (Kg)	Torque (N)	Speed (N) rpm	Output Power (W)	η %	% S
1.	220	2.7	240	0.7	0	0.7	0.65	1430	98	41	0.7
2.	220	3	500	1.4	3.2	1.8	1.67	1410	247	49	2
3.	220	3.5	620	3	5.4	2.4	2.23	1390	325	52	3
4.	220	4	760	3.2	7.3	4.1	3.82	1370	550	72	5
5.	220	4.5	940	4	8.5	4.5	4.19	1350	594	63	6

$N_S = 1440$ rpm

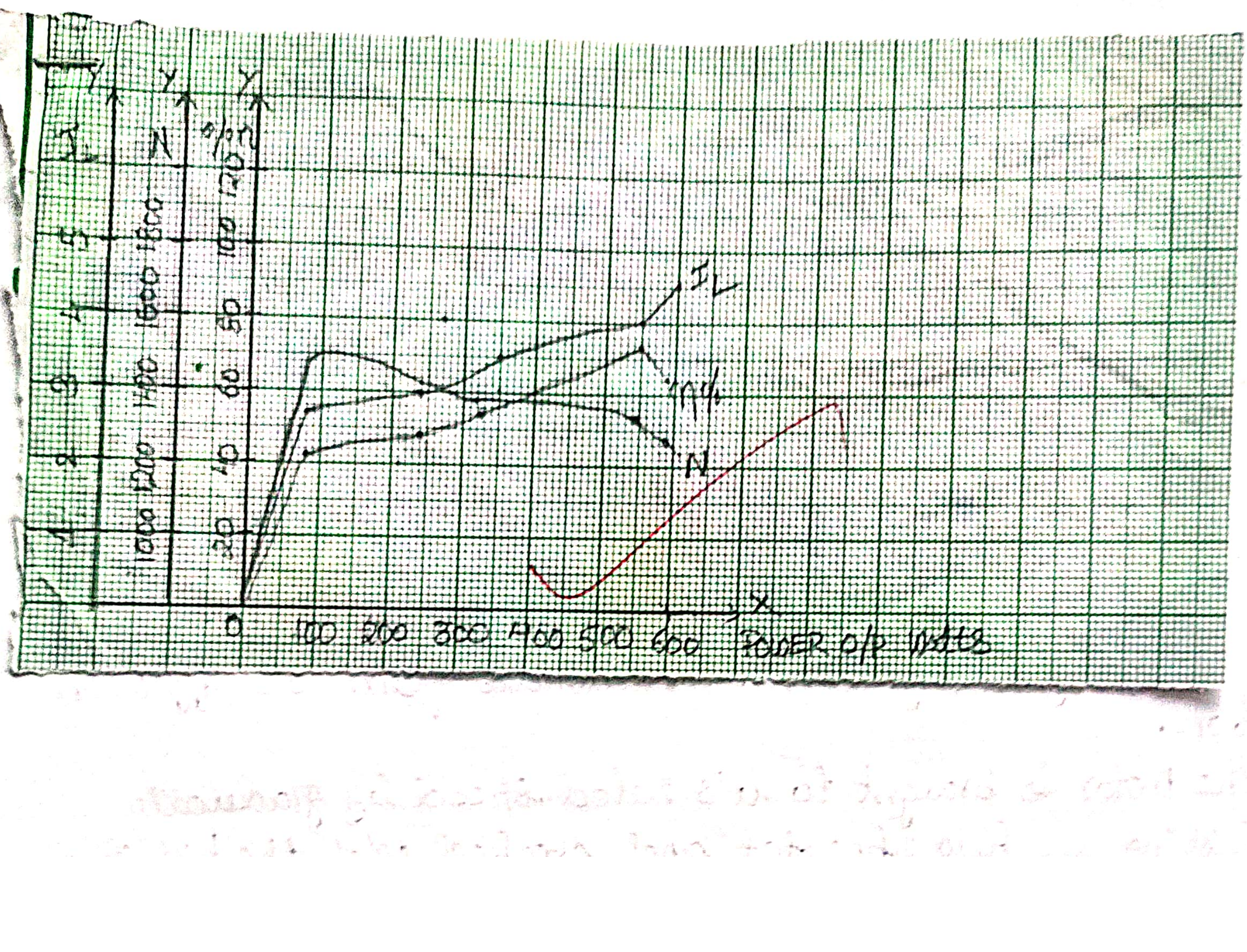
MODEL GRAPH:



5. Replace the fuse carriers with appropriate fuse wires after the Circuit connections are checked by the staff in Charge.

Procedure

1. The circuit connections are made as per the circuit diagram.
2. Keeping the motor field rheostat in its minimum position and the starter in its OFF position the main supply is switched ON to the circuit.
3. The motor is started using the three point starter by slowly and carefully moving the starter handle from it's off to on position.
4. The motor is brought to it's rated speed by gradually adjusting the field rheostat and checked with the help of a tachometer.
5. Under this no load condition one set of readings namely, applied voltage (V_L), line current (I_L), the two spring balance readings (S1 and S2) and motor speed (N) are noted down in the tabular columns.
6. The load on the motor is increased in steps gradually and at each step, all the meter readings and the motor speed are recorded in the tabular column. The above procedure is repeated until the motor is loaded to 120% of its rated current.
7. After the experiment is completed, the load on motor is gradually decreased to minimum and the rheostat is brought back to it's original position and then the main supply is switched off.
8. Plot the performance characteristics.


POWER O/P WATTS
I_L
N
$\eta\%$

Model calculations:

The circumference of the brake drum is measured and the radius of the drum is calculated using the Expression

$$r = C/2\pi$$

$$R = r + t/2$$

r - Radius of the Brake drum (m)

C - Circumference of the Brakedrum (m)

R - Effective Radius (m)

t - Thickness of the belt

The torque developed by the motor is given by

$$T = (S1 \sim S2) * R * 9.81$$

The output power of the motor is

$$P_{out} = 2\pi NT/60$$

The efficiency of the motor

$$\eta = (P_{out}/P_{in}) * 100$$

The % slip of the motor

$$\% S = (N_S - N/N_S) * 100$$

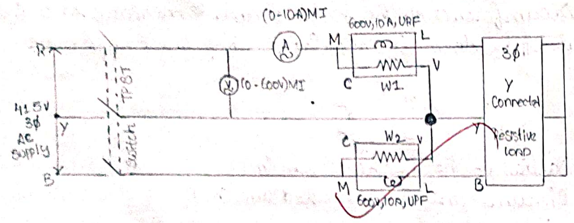
N_S — Synchronous Speed = $(120 * f)/P$

Marks obtained

Theoretical calculations	20	20
Observation	20	20
Execution of Practice Examples	30	30
Viva	10	8
Record	20	20
Total score	100	98
Date of Experiment	20/2/25	
Date of record submission		Faculty Signature

Result :- Thus the load-test on Single phase Induction motor is conducted and their Performance characteristics are Plotted.

CIRCUIT DIAGRAM



S.NO	Line Voltage (VL)	Line Current (I_L)	Watt meter (W1)		Watt meter (W2)		W=W1+W2	Calculated Power(W)
1.	400	2	170	680	0	0	680	692.8152
2.	400	3.6	340	1360	50	200	1160	1529.598
3.	400	4.2	400	1600	70	280	1880	1848.123
4.	400	4.7	450	1800	100	400	2200	2187.953

21/2/25

Expt. No. 12. Three Phase Power Measurement Using Two Wattmeter method

Aim:- To measure the power in three phase balanced star connected load using Wattmeter method.

Apparatus Required:

S.NO	APPARATUS	RANGE	TYPE	QUANTITY
1	Ammeter	(0-10)A	MI	1
2	Voltmeter	(0-600)V	MI	1
3	Watt meter	(600V, 10A)	LPF	2
4	Auto transformer	3φ, (0-600)V	-	1
5	Lamp load	-	-	1
6	Connecting wires	2.5 sq.mm	copper	Few

Procedure:

1. Make the connections as per the circuit diagram shown in Figure.
2. Switch ON 3 phase AC supply
3. Apply load and measure the values of watt meters, ammeter and Voltmeter
4. Switch off all the loads and supply

Model calculations

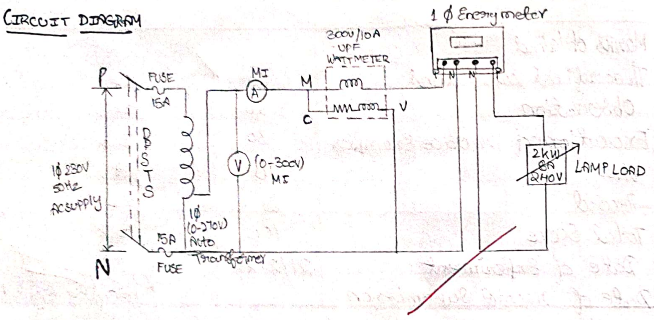
1. Total power, $P = W_1 + W_2$ Watts
2. Power Factor $\cos\phi = \cos[\tan^{-1}\{\sqrt{3}(W_1 - W_2)/(W_1+W_2)\}]$
3. calculated Power $= \sqrt{3}\ V_L * I_L * \cos\phi$

Marks obtained		
Theoretical calculations	20	20
Observation	20	20
Execution of Practice Examples	30	30
Viva	10	8
Record	20	20
Total Score	100	98
Date of Experiment	21/2/25	
Date of record Submission		Faculty Signature

Result:

Thus the power in three phase balanced star connected load using two watt meter method is measured and calculated

CIRCUIT DIAGRAM



TABULAR COLUMN

S.NO	Line Voltage V_L (V)	Line Current I_L (A)	Time taken for 2 revolution (Sec)	no. of revolutions (n)	Calculated Energy (Whr)	Measured Energy (Whr)
1	230	1.5	39	5	3.73×10^{-3}	3.33×10^{-3}
2	230	2.1	21	5	2.8×10^{-3}	3.33×10^{-3}

Meter Constant = 3600

Calculated Energy

① $CE = \frac{V\times I\times t}{3600} = \frac{230\times1.5\times39}{3600} = 3.73\times10^{-3}$

② $CE = \frac{230\times2.1\times21}{3600} = 2.8\times10^{-3}$

2/2/25

Expt. No. 13. Energy consumption measurement using a Single Phase Energy meter

Aim: To measure the Energy consumption using single phase Energy meter

Apparatus Required:-

S.No	APPARATUS	RANGE	TYPE	QUANTITY
1	Ammeter	(0-20)A	MI	1
2	Voltmeter	(0-300)V	MI	1
3	Auto transformer	1ϕ, (0-270)V	-	1
4	Lamp load	-	-	1
5	Connecting Wires	2.5 Sq.mm	Copper	Few

Procedure:-

1. Connect the circuit as shown in circuit diagram.
2. Connect the load rheostat 10 Ω /12 A in series with load.
3. Keep the variac in minimum output voltage position.
4. Keep the load in maximum position.
5. Adjust the variac output equal to the rated voltage of Energymeter.
6. Adjust the load till rated current of Energy meter passes through it.
7. Note down the time taken for 2 revolutions of disc in the Energy meter. Switch off the supply.
8. Note down the voltmeter and ammeter readings
9. Switch off the supply
10. Repeat the above steps for different currents.

Model calculations:

1. Calculated Energy consumed during 'n' revolutions $W_a = V^* I^* t / 3600$

   = (Watt-hour)

   Where, V = Voltage (V)

   I = Current (A)

   t = time (s)

2. Measured Energy by Energy meter $W_R = n$ / meter constant

Marks obtained:

Theoretical calculations	20	20
Observation	20	20
Execution of Practice Examples	30	30
Viva	10	8
Record	20	20
Total Score	100	98
Date of Experiment		
Date of record submission		Faculty Signature

Result:

Thus the Energy consumption using single phase Energy meter is measured.

Expt. No. 14 Load Test on DC Shunt motor

Aim:

- To conduct load test on DC shunt motor and to determine the efficiency using mechanical loading arrangement
- To Draw the following characteristics curves
- Torque VS Armature current (Electrical characteristics)
- Speed VS Armature current
- Speed VS Torque (mechanical characteristics)
- Performance curve

Apparatus Required:

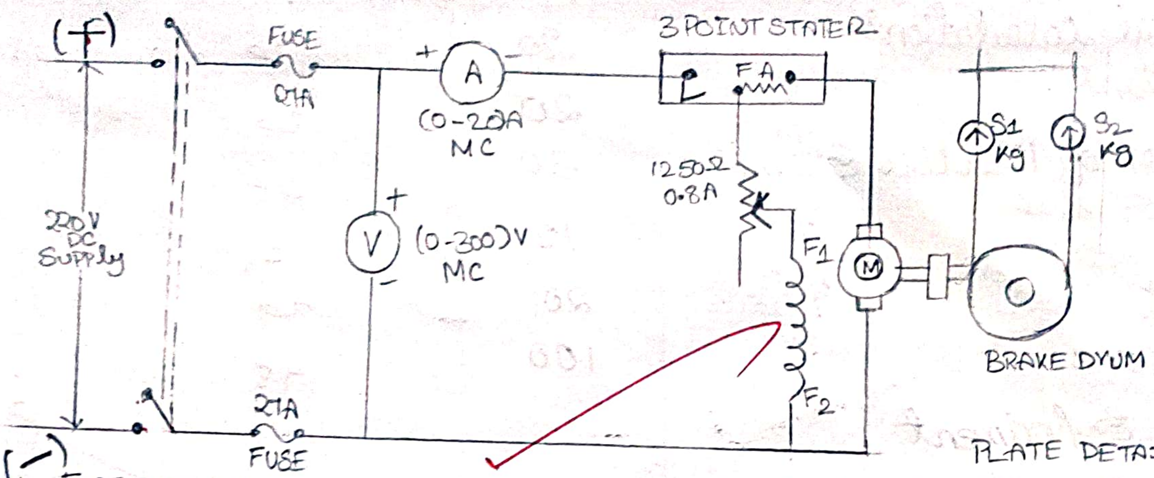
SI.NO	NAME	SPECIFICATION	QUANTITY
1	DC shunt motor, with Spring balance load	2HP, 1440rpm, 230V 18.1A	1 no
2	Voltmeter	(0-300)V, PMMC	1 no
3	Ammeter	(0-20)A, PMMC	1 no
4.	Rheostat	1250Ω, 0.8A	1 no
5.	Tachometer	Digital type	1 no
6.	Connecting wires	PVC insulated copper	As per Required

Precautions:

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

Procedure

- Connections are made up as per the circuit diagram
- After checking the no load condition and minimum field rheostat position starter resistance is gradually removed



FUSE RATING
125% rated current

$$\frac{125 \times 21}{100} = 26.25A$$

PLATE DETAILS
Rated voltage: 220V
Rated current: 21A
Rated Power: 3.5KW
Rated speed: 1500 RPM

S.NO	Input Voltage (V) in Volts	Armature current (I) in Amps	Speed (N) in RPM	W_1 in Kg	W_2 in Kg	W = (W_2 − W_1) in	Torque (T) in N-m	Output Power (P_o) in watts	Input Power (P_i) in watts	% efficiency
1.	219	1.4	1448	0	0	0	0	0	306.6	0
2.	219	2	1428	1	1	0	0	0	438	0
3.	219	4.8	1400	0.1	3.4	3.3	2.91	426.4	1051	41
4.	219	6	1379	0.4	5.6	5.2	4.6	664	1314	51

- The motor is brought to its rated speed by adjusting the field rheostat.
- Ammeter, voltmeter readings speeds and spring balance readings are noted under no load condition
- The load is often added to the motor gradually and for each load, Voltmeter, ammeter, Spring balance readings and speed of the motor are noted (Take readings up to rated current of the machine).
- The motor is then brought to no load condition and field rheostat to minimum position then switch off the supply.

Formulae used

- Torque $(T) = 9.81 \cdot (S_1 - S_2) \cdot r$

Where, $S_1, S_2 \Rightarrow$ Spring balance readings in Kg.

$r \Rightarrow$ Radius of brake drum in m

$9.81 \Rightarrow$ constant to convert kg to Newton

2. Output Power $(P_{out}) = 2\pi NT/60$

   Where N = Speed in rpm

3. Input power $(P_{in}) = V_L \cdot I_L$ Watts

   V_L = Input Voltage in Volts

   I_L = Input current in Amps

4. % Efficiency $= (P_{out}/P_{in}) * 100$

Date of record submission			signature

Result:

Thus, load test on DC Shunt motor in Experimentally Verified

MODEL GRAPH