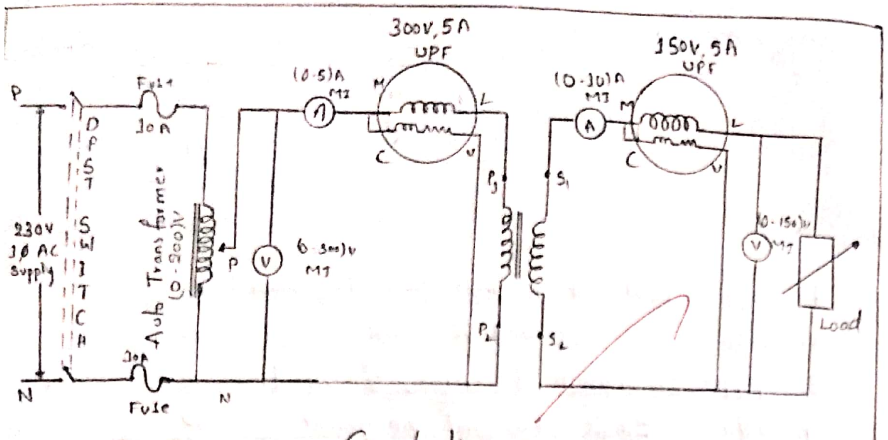


Circuit diagram

Tabulation:-

S. No	Load Current (I_2)	Secondary voltage (V_2)	Primary Current (I_1)	Primary Voltage (V_1)	Power i/p (mf=2) OB	Power i/p (W_{in})	Power o/p (mf=4) OB	Power o/p (W_{out})	efficiency (η)	Voltage Regulation (%)
1.	0.2A	230V	1A	230V	60	120W	0	0W	0%	–
2.	1A	228	2A	230V	110	220W	25	100W	45.4%	0.86%
3.	1.5A	226	3A	230V	160	320W	50	200W	62.5%	1.7%
4.	2A	224	3.7A	230	210	420W	80	320W	76.1%	2.7%

Calculations:-

Efficiency, $\eta = \frac{P_{out}}{P_{in}} \times 100$

1. $\eta = \frac{0W}{120W} \times 100 = 0\%$
2. $\eta = \frac{100}{220} \times 100 = 45.4\%$
3. $\eta = \frac{200}{320} \times 100 = 62.5\%$
4. $\eta = \frac{320}{420} \times 100 = 76.1\%$

Voltage Regulation, $(\%) = \frac{V_1 - V_2}{V_2} \times 100$

1. Voltage Regulation, $(\%) = \frac{230-230}{230} \times 100 = 0\%$
2. Voltage Regulation, $(\%) = \frac{230-228}{228} \times 100 = 0.87\%$
3. Voltage Regulation, $(\%) = \frac{230-226}{226} \times 100 = 1.77$
4. Voltage Regulation, $(\%) = \frac{230-224}{224} \times 100 = 2.68$

Exp. NO	1
Title	Load Test on Single phase Transformer

Aim:

A load test on a single-phase transformer is conducted to evaluate the transformer's performance under full load conditions.

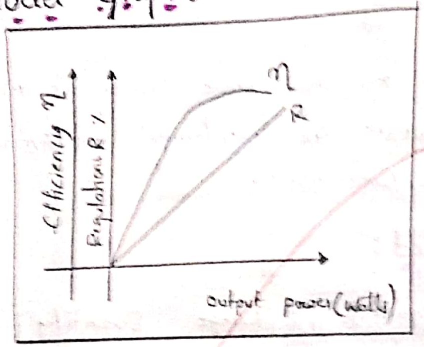
Apparatus Required:

S.NO	Apparatus Required	Range	Quantity
1.	Single-phase Transformer	1Φ, (0-260)V	1
2.	Voltmeter	(0-150)V (0-300)V MI TYPE	1 each
3.	Ammeter	(0-10)A (0-5)A MI-TYPE	1 each
4.	Wattmeter	(300V, 5A) (150V, 5A) UPF	1 each
5.	Supply Source (AC power Source)		
6.	Variable Resistive load	5kW, 230V	1
7.	Connecting wires	As required	

Procedure :-

* Connect the primary ~~binding~~ winding of the transformer to the AC power Source.
* Connect the secondary winding of the transformer to a variable resistive load or load bank.

Model Graph:-



* Connect the voltmeter accross the Secondary winding to measure the secondary voltage.

* Connect the ammeter in series with the load to measure the secondary voltage.

* Connect the wattmeter to measure the power consumed by the load.

$$\boxed{\text{Voltage Regulation}(\%) = \frac{V_1 - V_2}{V_2} \times 100}$$

$$\boxed{\eta = \frac{P_{output}}{P_{input}} \times 100}$$

Precautions:

* Ensure that transformer and the equipment used for testing are properly rated for the test conditions.

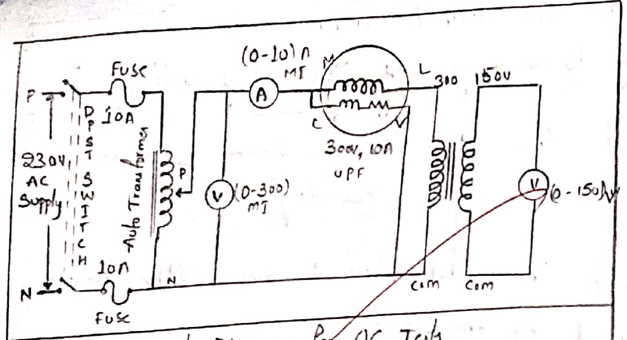
* Be cautious while handling electrical equipment and ensure all connections are secure to avoid short circuit or shocks.

* Gradually increase the load to prevent sudden surges that could damage the transformer.

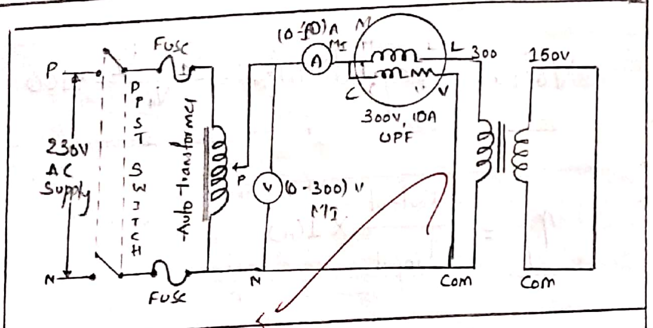
8/10

Results:-

* Thus the load test on single phase transformer is conducted and verified successfully.



Circuit Diagram for OC Tests



Circuit Diagram For SC Tests

Table :- OC

V_1	I_1	W_1	V_2
230	0.5	5	115

SC

V_1	I_1	W_1	I_2
115	2A	3W	4A

Experiment NO: 2	Load Test of a Single phase Transformer Using OC and SC Tests.
Date: 18-11-24	

Aim :-

→ To Conduct load test on single phase transformer and to find efficiency and percentage regulations.

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 - 5A) (150V, 5A)	MI MI	1 1
4.	Auto Transformer	1Ø, (0-260)V	-	1
5.	Resistive Load	5KW, 230V	-	1
6.	Connecting Wires	2.5 sq.mm	Copper	Few

Procedure :-

* Connect the primary winding of the transformer to the AC power source.
* Connect the secondary winding to a variable resistive load or load bank.
* Connect the voltmeter accross the secondary winding to measure the secondary voltage.

* Connect the ammeter in series with the load to measure the load current.

* Connect wattmeter to measure the power consumed by the load.

Precautions:

* Auto transformer should be in minimum position.

* The AC supply is given and removed from the transformer under no load condition.

$$\boxed{\text{Voltage Regulation } (\%) = \frac{V_2 - V_1}{V_1} \times 100}$$

$$\boxed{\text{Efficiency}, \eta = \frac{P_{output}}{P_{input}} \times 100}$$

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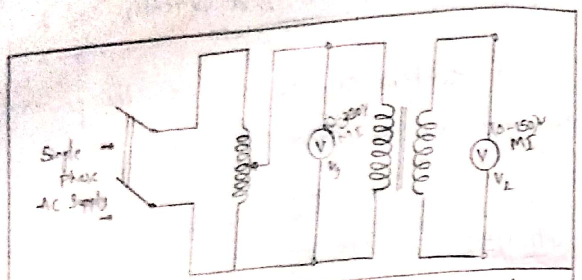
Result:

Thus, The OC and SC test on single phase transformer is connected and successfully verified.



Circuit Diagram: Secondary turns and current

Table:

S. No	Load (I_L) Current	Secondary Voltage (V_2)	Primary Voltage (V_1)	Primary current (I_1)	Power input obs	(W_{in})	Power output obs	(W_{out})
1.	0.5A	115 V	230V	1 A	60	120 W	0	0
2.	1 A	115 V	230V	2 A	110	220 W	25	100 W
3.	1.5A	115 V	230V	3 A	160	320 W	50	200 W
4.	2 A	115V	230V	~~3.7~~ 4 A	210	420 W	80	320 W

Calculations:

Here, $N_p = 110$

Turn Ratio (N_s) $= \frac{V_s}{V_p} \times N_p \Rightarrow \frac{N_s}{N_p} = \frac{V_s}{V_p} = K$

$K = \frac{115}{230}$

$\frac{N_s}{N_p} = \frac{230}{115}$

$K = 1/2$

$\frac{N_s}{N_p} = K$

$N_s = K \times N_p$

$N_s = \frac{1}{2} \times 110$

$\boxed{N_s = 55}$

Exp. No : 3	Calculation of Secondary Turns And Current in a Transformer
Date : 15-11-24	

Aim:-

To evaluate secondary turns and currents in a transformer. The test helps determine the voltage regulation, efficiency and overall behavior of the transformer when it is delivering power to a load.

Apparatus Required:-

S.No	Apparatus Required	Range	Quantity
1.	Single phase Transformer	1ϕ, (0, 260) V	1
2.	Voltmeter	(0-150) V, (0-300) V MI type	1 Each
3.	Ammeter	(0-10) A, (0-5) A MI type	1 Each
4.	Wattmeter	(300 V, 5 A), (150 V, 5 A) UPF	1 Each
5.	Supply Source (AC)		
6.	Variable Resistive Load	5KW, 230 V	1
7.	Connecting Wires.	As Required	

Procedure :-

* A transformer operates on the principle of electromagnetic induction and Consists of:

Primary Winding: Connected to input voltage source.

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$$I_S = \frac{N_P}{N_S} \times I_P$$

$$\boxed{I_S = 2 \times I_P}$$

S.NO	V_1	V_2	K	N_1	N_2
1.	60V	30V	1/2	110	55
2	80V	40V	1/2	110	55
3	100V	50V	1/2	110	55
4	120V	60V	1/2	110	55
5	140V	70V	1/2	110	55

Secondary Winding: Connected to load.

Turn Ratio :- The ratio of the no.of turns in the primary winding (N_p) to the no.of turns in the secondary winding (N_s).

$$\boxed{N_S = \frac{V_s}{V_p} \times N_p}$$

$$\boxed{I_S = \frac{N_p}{N_S} \times I_p}$$

Precautions:-

* Ensure that the transformer and the equipment used for testing are properly rated for the test conditions.

* Be Cautious while handling electrical equipment and ensure all connections secure to avoid short circuits.

* Gradually Increase the load to prevent sudden surges that could damage the transformer.

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Result:

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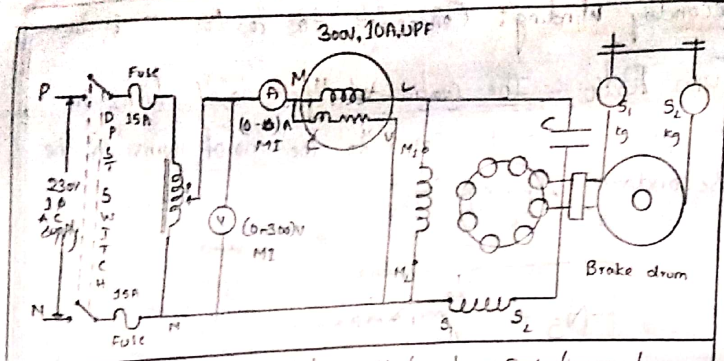
Thus, The Calculation of secondary turns and current in a transformer is done.



CIRCUIT DIAGRAM: Load test on single phase Induction motor

Table:-

MF = 4.

Diameter, D = 24 cm = 0.24m

S. No	V Volts	I Amps	Speed N (rpm)	Wattmeter Readings OBS	Wattmeter Readings ACT	Spring balance readings S_1	Spring balance readings S_2	Spring balance readings $S_1 - S_2$	Torque (T) = 9.81*R*($S_1 \sim S_2$)	o/p power W	Power factor $\cos\phi$	Efficiency η = O/P / I/P
1.	220V	6.2	1470	40	160	0	0	0	0	0	0	0%
2	220V	6.5	1460	130	520	0.6	2.6	2	2.3 N-m	351.4	0.24	67.57%
3.	218V	7.0	1450	180	720	0.8	3.4	2.6	3.06 N-m	467.6	0.3	64.94%
4.	218V	7.5	1440	220	880	1.0	4.2	3.2	3.7 N-m	565.4	0.34	64.25%
5.	218V	8.0	1430	250	1000	1.2	5.4	4.2	4.9 N-m	748.7	0.42	74.87%

Slip $S = \frac{N_s - N}{N_s} \times 100$
2%
2.67%
3.33%
4%
4.67%

Calculations:-

Torque, $T = 9.81 * R * (S_1 \sim S_2)$

1. $T = 9.81 * 0.12 * 0 = 0$
2. $T = 9.81 * 0.12 * 2.0 = 2.3$
3. $T = 9.81 * 0.12 * 2.6 = 3.06$
4. $T = 9.81 * 0.12 * 3.2 = 3.7$
5. $T = 9.81 * 0.12 * 4.2 = 4.9$

Exp.No: 4	Load Test on Single phase Induction Motor
Date:- 19-11-24	

Aim:-

To Conduct load test on the given single phase induction motor and to plot its performance characteristics.

Apparatus Required:-

S.No	Apparatus	Specifications	Quantity
1.	Voltmeter	(0-300V) MI	1
2.	Ammeter	(0-10 A) MI	1
3.	Wattmeter	(300V, 10A, UPF)	1
4.	Tachometer	(0-10000 RPM)	1

Formulae:

1. Circumference of the brake drum = $2\pi R$ (m)
   R = Radius of brakedrum
2. Input power W (Watts)
   W = Wattmeter readings
3. Torque (T) = $9.81 * R * (S_1 - S_2)$. (N-m)
   S_1, S_2 = Spring balance readings.
4. Output power = $\frac{2\pi NT}{60}$ (Watts), N = Speed in rpm.
5. % Efficiency (η) = $\frac{\text{output power}}{\text{Input power}} \times 100$
6. Power factor, $\cos\phi$ = $\cancel{\frac{N_s - N}{N_s} \times 100}$ = $\frac{W}{VI}$
7. % Slip, $S = \frac{N_s - N}{N_s} \times 100$, N_s = Synchronous Speed = $\frac{120f}{P}$ (rpm)
   P = no. of poles
   f = frequency of supply (Hz)

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Output Power = $\frac{2\pi NT}{60} = W$

1. Output power = $\frac{2*3.14*1470*0}{60} = 0$

2. Output power = $\frac{2*3.14*1460*2.3}{60} = 351.4$ Watts

3. Output power = $\frac{2*3.14*1450*2.06}{60} = 467.60$ watts

4. output power = $\frac{2*3.14*1440*3.7}{60} = 565.4$ watts

5. output power = $\frac{2*3.14*1430*4.9}{60} = 748.7$ watts

Power Factor: $\cos\phi = \frac{W}{V*I}$

1. $\cos\phi = \frac{0}{220*6.2} = 0$

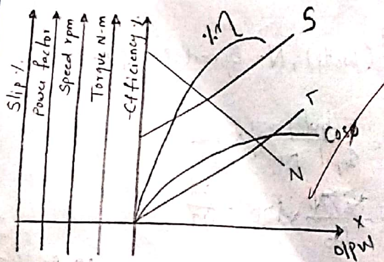
2. $\cos\phi = \frac{351.4}{220*6.5} = 0.24$

3. $\cos\phi = \frac{467.6}{218*7} = 0.306$

4. $\cos\phi = \frac{565.4}{218*7.5} = 0.34$

5. $\cos\phi = \frac{746.7}{218*8} = 0.429$

Model Graph:



Efficiency (%) $\eta = \frac{\text{output power}}{\text{in power}}$

1. $\eta = \frac{0}{880} \times 100 = 0$

2. $\eta = \frac{351.4}{520} \times 100 = 67.57\%$

3. $\eta = \frac{467.6}{720} \times 100 = 64.94\%$

4. $\eta = \frac{565.4}{880} \times 100 = 64.25\%$

5. $\eta = \frac{748.7}{1000} \times 100 = 74.87$

$\text{Slip}(s) = \frac{N_s - N}{N_s} \times 100$

$N_s = \frac{120*f}{P} = \frac{120*50}{4}$

$N_s = 1500$ RPM

1. $S = \frac{1500-1470}{1500} \times 100 = 2\%$

2. $S = \frac{1500-1460}{1500} \times 100 = 2.67\%$

3. $S = \frac{1500-1450}{1500} \times 100 = 3.33\%$

4. $S = \frac{1500-1440}{1500} \times 100 = 4\%$

5. $S = \frac{1500-1430}{1500} \times 100 = 4.67\%$

Procedure:-

- Connections are as per the circuit diagram.
- The DPST switch is closed and the single phase supply is given.
- By adjusting the VARIAC the rated voltage is applied and the corresponding no load values of speed, spring balance and meter readings are noted down
- This procedure is repeated till the rated current of the machine.
- The motor is unloaded, the auto transformer is brought to the minimum voltage position, and the DPST switch is opened.
- The radius brake drum is measured

Precautions:-

- The Auto transformer is kept minimum voltage position.
- The motor is started at no load condition.

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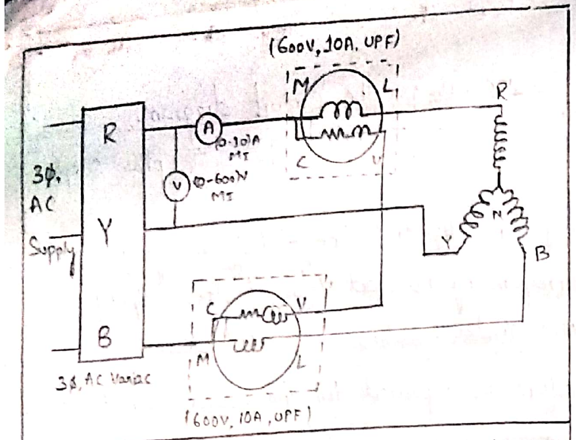
Result:-

The load test was conducted on 1φ induction motor and the performance characteristics were drawn and verified successfully.



CIRCUIT DIAGRAM FOR STAR CONNECTED LOADS

Table:-

MF = 4 (OBS, ACT) MF = 4

S.No	VL (volts)	IL (Amps)	W1 OBS	W1 (Watts)	(W2) OBS (Watts)	P = W1+W2 (Watts)	P= √3 VL IL V Cosφ (Watts)	Cosφ
1.	400	0.8A	-100	-400W	100, 400 W	0W ~~800W~~	554.25	0
2.	400	0.8	0	0	(125W, 500)	~~125W~~ 500W	554.25	0.9 ~~0.964~~ ~~1.5~~

0.9

Calculation:-

$P = W_1 + W_2$

1. $P = -400 + 400 = 0\,W$

2. $P = 0 + 125 = 125\,W$

$\cos\phi = \frac{W}{VI} = \frac{W}{VI} = \sqrt{3}\, V_L I_L$

1. $\cos\phi = \frac{0}{400 \times 0.8} = 0$

2. $\cos\phi = \frac{500}{400 \times 0.8} = \frac{500}{320} = 1.5\;0.9$

P.F = P3 IL V cosφ

1. P.F = 554.25

2. P.F = 554.25.

Ex.No:-5	Measurement of Power by Two Wattmeter Method
Date: 19-11-24	

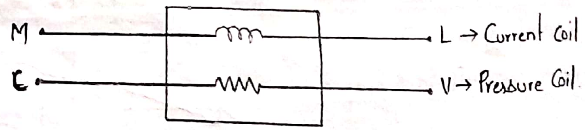
Aim:-

3 phase, three wire power measurement by using two wattmeter method for balance load in one star connection.

Apparatus Required

S.No	Apparatus	Specifications	Quantity
1.	Wattmeter	600V, UPF	2
2.	Balanced Resistive Load	3 phase	1
3.	3-phase VARIAC	415/470V, 4A	1
4.	Digital A.C Voltmeters	600V	1

Symbol of Wattmeter:



Procedure:-

* Connect the load with help of the switches and patch chords.
* Connect the 3-phase VARIAC to mains supply
* Connect the Voltmeter across 2-phases.
* Connect the circuit as shown below either in star connection.

$$\boxed{\text{Total Power, } P = W_1 + W_2}$$

$$\boxed{\text{Power factor, } PF = \sqrt{3}\, V_L \cdot I_L \cos\phi}$$

Precautions:-

- Avoid loose Connections.
- Take readings without errors.
- Live terminals should not be touched.

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Result:

Hence, The power measured for a balanced load Connected in star is the sum of both meter and Verified successfully.

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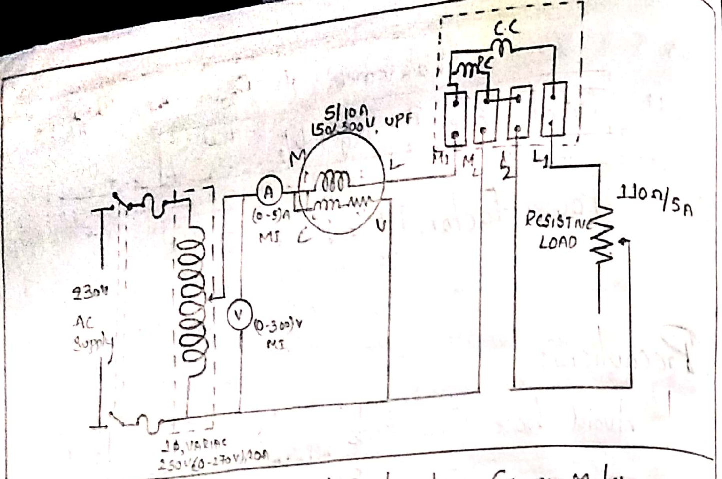


CIRCUIT DIAGRAM: Testing of Single phase Energy Meter

Table:-

S.NO	Voltmeter (V)	Ammeter (A)	Wattmeter (Watt)	Time for 5 rev (S)	Theoritical Reading (E_1)	Practical Reading ($E_2 = W*t$)	% Errors $= \frac{E_2 - E_1}{E_1} \times 100$
1.	220V	1.0A	40 W	38.5 S	3.3 Wh	0.42 wh	- 87.75 %
2.	220V	2.1A	63 W	20.5 S	3.3 Wh	0.35 wh	- 91.4 %
3.	220V	3 A	87 W	18 S	3.3 Wh	0.43 wh	- 89.5 %
4.	220V	3.7A	112.5W	15.5 S	3.3 wh	0.48 wh	- 88.2 %
5.	220V	4.5 A	130 W	13 S	3.3 wh	0.46 wh	- 88.7 %

Theoritical Reading:-

$$E_1 = \frac{\text{No. of Revolutions}}{K}$$

$K = 1200$ rev/kWh

$$E_1 = \frac{5 \text{ rev}}{1200 \text{ rev/kWh}}$$

$= 0.00418$ kwh

$E_1 = 3.33$ w*h

$= 4.1$ W*h

Practical Readings

$$E_2 = W*t/3600 \ (W*h).$$

1. $E_2 = 40 * \frac{38.5}{3600} = 0.42$ wh
2. $E_2 = 63 \times \frac{20.5}{3600} = 0.35$ wh
3. $E_2 = 87 \times \frac{18}{3600} = 0.43$ wh
4. $E_2 = \frac{112.5 \times 15.5}{3600} = 0.48$ wh
5. $E_2 = 130 \times \frac{13}{3600} = 0.469$

Exp.No: 6	Calibration and Testing of Single Phase Energy Meter.
Date: 19-11-24	

Aim:-

To Calibrate and test the given single phase energy meter by direct loading.

Apparatus Required:-

S.NO	Name	Type	Range	Quantity
1.	Single phase Energy Meter	Induction	1500REV/kWH	1
2.	Wattmeter	UPF	300V/5A	1
3.	Voltmeter	MI	(0-300)V	1
4.	Ammeter	MI	(0-5) A	1
5.	Single phase VARIAC	1-ϕ	230V/(0-270V), 10 A	1
6.	Stop Watch	Digital	-	1
7.	Connecting Wires	-	-	Required
8.	Rheostat	WW	110Ω/5A	1

Procedure:-

* Connect the Circuit as per the circuit diagram
* Keep the single phase Variac at zero Volt position
* Now, Switch on the power supply.
* Gradually Vary the Variac to apply the rated voltage For different Values of load, Note down the readings of the ammeter, Voltmeter, Wattmeter and time taken

$$\% \text{ Error} = \frac{E_2 - E_1}{E_1} \times 100\%$$

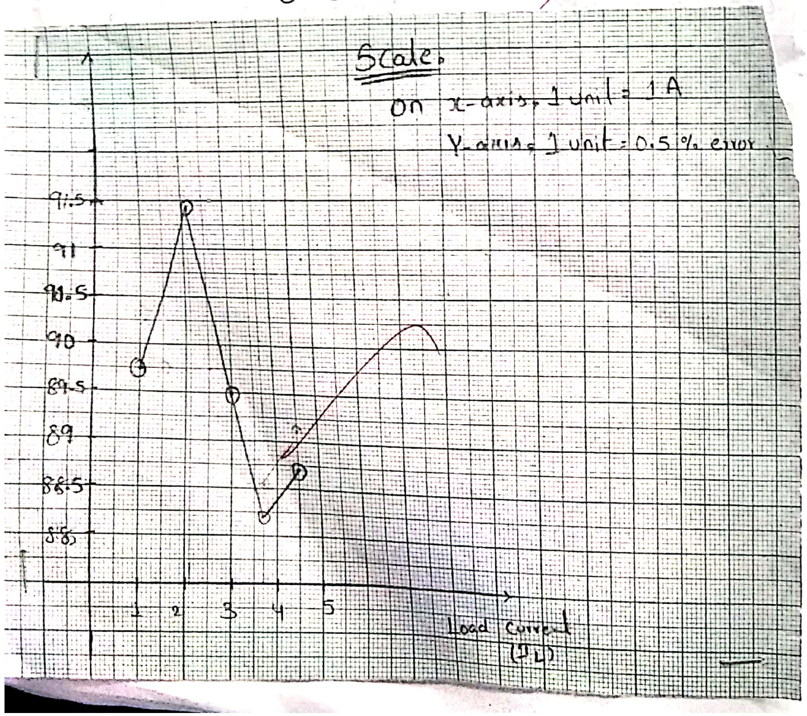
1. $\text{Error} = \frac{0.42 - 4.13}{4.1} \times 100 = -89.75$

2. $\% \text{ Error} = \frac{0.35 - 4.13}{4.1} \times 100 = -91.4$

3. $\% \text{ Error} = \frac{0.43 - 4.13}{4.1} \times 100 = -89.5$

4. $\% \text{ Error} = \frac{0.48 - 4.13}{4.1} \times 100 = -88.2$

5. $\% \text{ Error} = \frac{0.46 - 4.13}{4.1} \times 100 = -88.7$



for 5-revolutions of disc

* Gradually vary the Variac to minimum
* Switch off the power supply
* Calculate the Observed readings, Actual reading % error, % Corrections
* Draw the graph b/w Load current (vs) % Error.

Precautions:-

* Avoid loose Connections
* Be Careful while observing the revolutions with stop watch
* Take readings without Errors

Theoritical reading, $E_1 = \frac{\text{No. of Revolutions}}{\text{Energy meter Constant (K)}}$ K = 1800 rev/kWh.
Practical Reading, $E_2 = W * t$.
$\% \text{ Error} = \left[\frac{E_1 - E_2}{E_2}\right] * 100$
% Correction = − % Error.

10

Result:-

Hence, Calibrated the given single phase energy meter and tested at different loads and the graph is plotted and verified succesfully.

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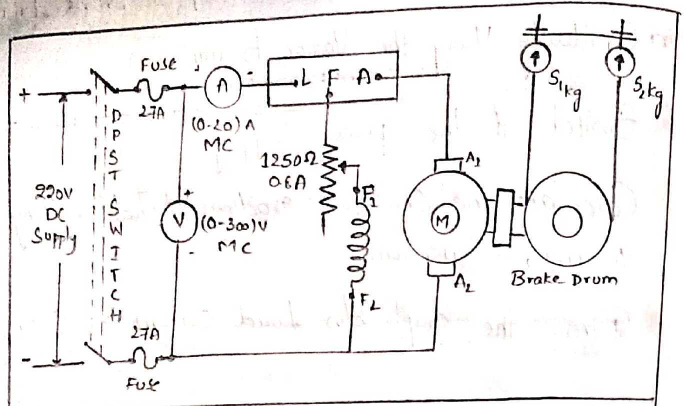


CIRCUIT DIAGRAM: Load Test on DC Shunt Motor

Table :-

MF=2

S. NO	Voltage (V)	Current obs	Current (A)	Speed (N) (rpm)	Spring balance S_1	S_2	$S_1 \sim S_2$	$F=(S_1 \sim S_2) * 9.81$	Torque (NM)	Output power (W)	Input power (W)	Efficiency η in(%)
1.	220V	0.8	1.6A	1453	0	0	0	0	0	0 W	352	0%
2.	220V	1	2A	1447	1.5	1	0.5	4.9	0.49	74.21	440	16.8%
3.	220V	1.5	3 A	1434	3	1.5	1.5	14.7	1.47	220.63	660	33.4%
4.	220V	2	4 A	1420	4	1	3	29.4	2.94	436.96	880	49.6%
5.	220V	2.5	5 A	1407	5	1.5	3.5	34.3	3.43	505.12	1100	45.92

Here, R = 0.1 m

Calculations:-

$F = |S_1 \sim S_2| * 9.81$

1. $F = 0 * 9.81 = 0$
2. $F = 0.5 * 9.81 = 4.9$
3. $F = 1.5 * 9.81 = 14.7$
4. $F = 3 * 9.81 = 29.43$
5. $F = 3.5 * 9.81 = 34.3$

Torque, $T = F*R = F*0.1$

1. $T = 0 * 0.1 = 0$ N-m
2. $T = 4.9 * 0.1 = 0.49$ N-m
3. $T = 14.7 * 0.1 = 1.47$ N-m
4. $T = 29.4 * 0.1 = 2.94$ N-m
5. $T = 34.3 * 0.1 = 3.43$ N-m

Exp.No: 7

Date: 1~~04~~-11-24

Load Test on DC Shunt Motor

Aim:-

To Conduct the brake load test on DC shunt motor and determine its performance characteristics

Apparatus Required:-

S. NO	Apparatus Name	Range	Type	Quantity
1.	Ammeter	(0-20) A	Digital	1
2.	Voltmeter	(0-300) V	Digital	1
3.	Rheostat	370/1.7A	Wire Wound	1
4.	RPM meter	(0-9999) rpm	Digital	1
5.	Connecting Wires	-	-	As required

Procedure:-

* Make the Connections as shown in the Circuit diagram.
* Keeping the field Rheostat (Rf) at the minimum position switch on the supply and start motor.
* Adjust the speed of the motor on no load to its rated by means of the Rheostat. Do not disturb the position of the Rheostat throughout the test.
* Put on the load by tightening the screws

Motor O/p power = $\frac{2\pi NT}{60}$ Watts

1. output power = $\frac{2*3.14*1453*0}{60}$ = 0. W

2. Output power = $\frac{2*3.14*1447*0.49}{60}$ = 74.21 W

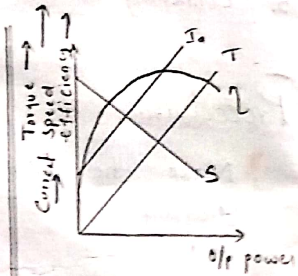
3. Output power = $\frac{2*3.14*1434*1.47}{60}$ = 220.63 W

4. Output power = $\frac{2*3.14*1420*2.94}{60}$ = 436.96 W

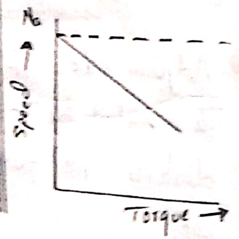
5. output power = $\frac{2*3.14*1407*3.43}{60}$ = 505.12 W

Input Power:- = V*I (Watts).

1. Input power = 220*1.6 = 352
2. Input power = 220*2 = 440
3. Input power = 220*3 = 660
4. Input power = 220*4 = 880
5. Input power = 220*5 = 1100



Model Graphs



of the spring balances. Note down the spring tensions, the speed, the voltage and the currents at different loads until full load current obtained.

Torque (T) = $(S_1 * S_2) R \times 9.81$ (N-m)
Motor Output = $\frac{2\pi NT}{60}$ (Watts).
Motor Input = V*I (Watts)
Efficiency = $\frac{\text{Motor Output}}{\text{Motor Input}} = \frac{2\pi NT}{60(V*I)}$

Precautions:-

* Avoid loose Connections
* Take readings without errors.
* Do not touch the live terminals.

24

Result:

Hence, The load Test on DC Shunt motor is conducted and Verified successfully.

$$\text{Efficiency } (\eta) = \frac{\text{Output Power}}{\text{Input power}} \times 100$$

1. $\eta = \frac{0}{352} \times 100 = 0\ \%$

2. $\eta = \frac{74.21}{440} \times 100 = 16.8\ \%$

3. $\eta = \frac{220.63}{660} \times 100 = 33.4\ \%$

4. $\eta = \frac{436.98}{880} \times 100 = 49.6\ \%$

5. $\eta = \frac{505.12}{1100} \times 100 = 45.92$

```
5 +4s +3s^2 +2s^3 +s^4
"The given characteristics equation 1-G(s)H(s)="
 1.   3.   5.
 2.   4.   0.
 1.   5.   0.
-6.   0.   0.
 5.   0.   0.
"Rouths table="
From Rouths table, it is clear that the system is unstable.
-->
```

output for 8(i)

Calculation:-

s^4	1	3	5
s^3	2	4	0
s^2	1	5	0
s^1	-6	0	0
s^0	5	0	0

$\begin{vmatrix} 2 & 3 \\ 2 & 4 \end{vmatrix} = \frac{6-4}{2} = \frac{2}{2} = 1$

$\begin{vmatrix} 1 & 5 \\ 2 & 0 \end{vmatrix} = 5$

$\begin{vmatrix} 2 & 4 \\ 1 & 5 \end{vmatrix} = -6$

$\begin{vmatrix} 1 & 5 \\ -6 & 0 \end{vmatrix} = 5$

Two sign changes, occurs, so the given system is unstable.

Exp. NO: 8	Find Stability of a System using Routh Hurwitz Criterion.
Date: 20-11-24	

Aim:-

To determine the stability of the closed loop system using Routh Hurwitz Criterion for the given polynomial characteristics equations.

(i) (S) $= S^4+2S^3+3S^2+4S+5$

(ii) (S) $= S^5+7S^4+6S^3+42S^2+8S+56$.

Tools Used:-

SCILAB software, PC

Procedure:-

* Start the SCILAB software
* Open SCINOTES, Type the program and the current directory.
* Save the program in the current directory
* Compile and run the program.
* If any error occur in the program, correct the error and run the program.
* For the output, check the console window
* Stop the program

Program:-

```
clear;
clc;
```

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```
56 +8s +42s^2 +6s^3 +7s^4 +s^5
"The given characteristics equation 1-G(s)H(s)="
 1.          6.    8.
 7.          42.   56.
 28.         84.   0.
 21.         56.   0.
 9.3333333   0.    0.
 56.         0.    0.
"Rouths table="
From Rouths table, it is clear that the system is stable
```

o/p for 8(ii)

Calculation:-

s^5	1	6	8
s^4	7	42	56
s^3	$\boxed{0 \quad 0} \rightarrow$ differential		
	28	84	
s^2	21	56	0
s^1	9.33	0	0
s^0	56	0	0

$$\begin{vmatrix} 1 & 6 \\ 7 & 42 \end{vmatrix} = \frac{42-42}{7} = 0$$

$$7s^4 + 42s^2 + 56 = 28s^3 + 84s$$

$$\begin{vmatrix} 7 & 42 \\ 28 & 84 \end{vmatrix} = \frac{1176 - 585}{28} = 21$$

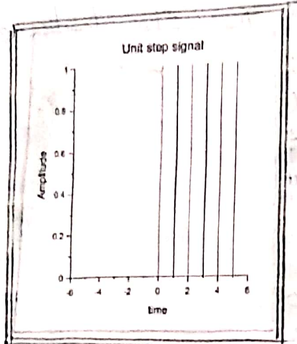
$$\begin{vmatrix} 28 & 84 \\ 21 & 56 \end{vmatrix} = \frac{1764 - 1568}{21} = 9.33$$

No sign changes but we differiantial $7s^4 + 42s^2 + 56$. So the given statement is stable

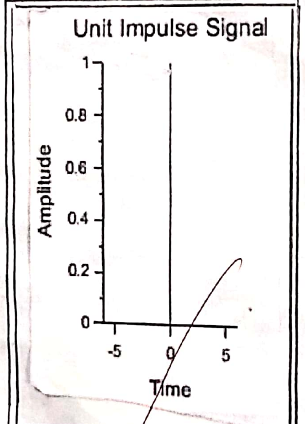
```
xdel(winsid());
mode(0);
s= %s;
H= s^4+ 2*s^3+ 3*s^2+ 4*s+5
disp(H, "The given Characteristics equation 1-G(s)H(s)=");
C=coeff(H);
len= length(c);
r= routh_t(H);
disp(r, "Rouths table=");
x=0;
for i=1: len
if (r(i,1)<0):
    x=x+1;
end
end
if (x>=1)
Printf("From Rouths table, It is clear that rouths
        Table is stable");
else
Printf("From Rouths table, It is clear that system
        is unstable");
```

Result:-

Thus, The stability of a system using Routh hurwitz criterion is verified successfully.



UNIT STEP SIGNAL



Unit Impulse Signal

Exp.No: 9	Generation of Common Discrete time Signals.
Date: 20-11-24	

Aim:-

Generate and plot the unit step signal, unit impulse signal, unit ramp signal, Sinusoidal signal. Exponential Signal.

Tools used:-

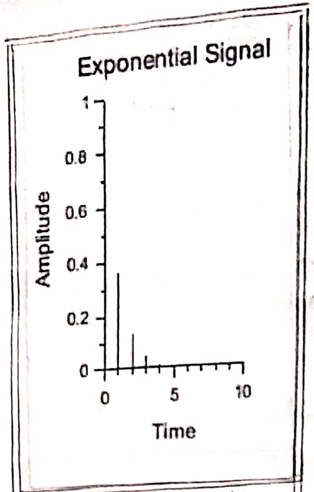
SCILAB Software, PC

Procedure:-

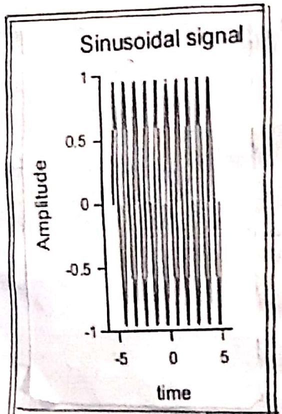
* Start the SCILAB software.
* Open the SCINOTES, Type the program and save the program in the current directory.
* Compile and run the program.
* If any error occur in the program, correct the error and run the program.
* For the output, check the console window
* Stop the program.

Program:-

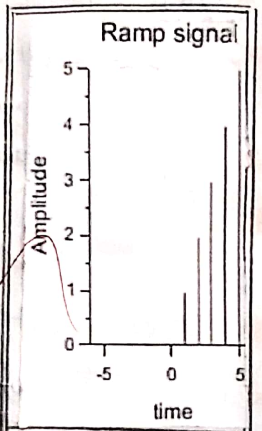
```
clear all;
close;
// Unit Step Signal
N=5
t1 = -5:5;
x1 = [zeros (1,N), ones (1,N+1)];
Subplot (3, 4, 1);
Plot2d3 (t1,x1);
```



Exponential Signal



Sinusoidal Signal



Ramp Signal

```
xlabel ('time');
y label ('Amplitude');
title ('Unit Step Signal');
// UNIT IMPULSE SIGNAL
N=5
t2=-5:5;
x2= [zeros(1,N), ones(1,1), zeros(1,N)];
Subplot (2,4,2);
Plot2d3 (t2,x2);
x label ('time');
y label ('Amplitude');
title('Unit Impulse Signal');
//Exponential Signal.
t3 = 0:1:20;
x3 = exp(-t3);
Subplot (2,3,3);
Plot2d3(t3, x3);
x-label('time');
ylabel(Amplitude');
title ('Exponential Signal');
// unit RAMP Signal 4
t4 = 0:20;
x4 = t4;
Subplot(2,3,4);
x lable (time);
Plot2d3(t4, x4);
y-label ('Amplitude');
title(" unit Ramp Signal 4');

//Sinusoidal signal
t5=0:0.04:1;
x5= sin(2*%pi *t5);
Subplot(2,3,5);
plot2d3(t5, x5);
x-label ('time');
ylabel ('Amplitude');
title ('Sinusoidal signal')
// Random Signal
t6= 10:1:20;
x6 = rand (0,11);
subplot (2,3,6);
plot2d3( t6, x6)
xlabel ('time ');
ylabel (Amplitude);
title(Random signal');
```

Result:-

The following discrete time signals were sucessfully generated and verified with x-axis labeling time and y-axis labelling Amplitude.

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```
column 1 to 6
0. - 0.i   -1.4142136 + 3.4142136i   2. - 2.i   1.4142136 - 0.5857864i   4. + 0.i   1.4142136 + 0.5857864i
column 7 to 8
2. + 2.i   -1.4142136 - 3.4142136i
"X(z) = "

-->
```

Output : DIT - FFT

```
column 1 to 5
20. + 0.i   -5.8284271 - 2.4142136i   0. + 0.i   -0.1715729 - 0.4142136i   0. + 0.i
column 6 to 8
-0.1715729 + 0.4142136i   0. + 0.i   -5.8284271 + 2.4142136i
"X(z) = "
```

Output : DIF - FFT

Exp.No: 10	DIT-FFT and DIF-FFT algorithm
21-11-24	

Aim:-

(i) To compute the DFT of the given sequence $x[n] = [1,-1,-1,-1,1,1,1,-1]$ using DIT-FFT Algorithm.

(ii) To compute the DIF of the given sequence $x[n] = [1,2,3,4,4,3,2,1]$ using DIF-FFT algorithm

Tools used:

SCILAB, PC

Procedure:-

* Start the SCILAB software.
* Open SCINOTES, Type the program and save the program
* Compile and run the program.
* For the o/p, check the console window
* Stop the program.

Program:-

DIT-FFT

```
x=[1,-1,-1,-1,1,1,1,-1];
x=fft(x,-1);
disp(x,'x(z) = ');
```

DIF-FFT

```
x = [1,2,3,4,4,3,2,1];
x = fft(x,-1);
disp(x,'x(z) = ');
```

10/10

Result:-

Thus, DIT-FFT, DIF-FFT is executed and verified sucessfully.

Exp No.: 11
21-11-24

Analog Butterworth Filter

Aim:

To design a butterworth filter of:

(i) Low pass filter.
(ii) High pass filter.
(iii) Band pass filter.
(iv) Band reject filter.

Tools:-

SCILAB Software, PC

Procedure:-

* Start the SCILAB Software.
* Open SCINOTES. Type the program and save the program
* Compile and run the program
* For the output, check the console window.
* Stop the program.

Program:-

Low pass filter

```
clear;
clc;
close;
s= poly(0,'s');
Omegac =0.2*%pi;
H= Omegac/(s+omegac).
T= 1 ;
z= Poly(0,'z');
Hz= horner(H,(2/T)*((z-1)/(z+1)))
HW = frmag(Hz(2), Hz(3), 512);
W= 0: %pi/511 : %pi;
```

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```
plot(w/%pi,HW);
a=gca();
a.thickness= 3;
a.foreground=1;
a.font_style=9;
x_grid(1);
xtitle('Magnitude Response
  of single pole LPF filter
  Cutoff frequency =
  0.2*pi, Digital frequency
  --->','Magnitude');
Disp("Hz", Hz);
```

2. High pass filter:

```
S=poly(0,'S');
Omegac =0.2*%pi;
H= Omegac/(S+Omegac);
T= 1;
z=poly(0,'z');
Hz_LPF = horner(H,(2/T)*(z-1)/(z+1));
alpha= -(cos((omegac+omegac)/2)
        /cos((omegac-omega)/2));
HZ_HPF= horner(Hz_LPF, -(z+alpha)
                        /(1+alpha*z))
HW = frmag(HZ_HPF(2),HZ,HPF(3)
      ,512);
W=0:%pi/511:%pi;
Plot(W/%pi,HW)
a=gca();
a.Thickness =3;
a.foreground =1;
a.font_style = 9;
x_grid(1).
disp("HZ_HPF", Hz_HPF);
```

3. Band Pass Filter:-

```
OmegaP = 0.2*%pi;
OmegaL = (2/5)* %pi;
OmegaU = (3/5)*%pi;
z = poly(0,'z');
H_LPF = (0.245)*(1+(z^-1)
        /1-0.509*(z^-1)
k
~~alpha = cos((omegal+omegal)/2))
          /sin((omegal omegal)/2))~~ * tan(omega/2);
alpha= cos((omegaU+omegaL)/2)
       /cos((omegaU-omega)/2);
HZ_BPF = horner(H_LPF, NUM/DEN);
disp(HZ_BPF, Digital BPF IIR filter H(z)=1);
HW =frmag(HZ_BPF(2), HZ_BPF(3),512);
W = 0: %Pi/511: %Pi;
Plot (w/%pi/511 HW);
a= gca();
x grid (1);
Disp("HZ_BPF", HZ_BPF);
```

4. Band Reject Filter:

```
omegap = 0.2*%pi;
omegaL = (2/5)*%pi;
omegaU = (3/5)*%pi;
z= poly(0,'z');
H_LPF = (0.245)*(1+(z^-1))/(1-0.509*(z^-1));
alpha = (cos((omegaU+omegaL)/2)/cos((omegaU-omegaL)/2));
K = tan((omegaU-omegaL)/2)*tan(omegaP/2);
Hz-BSF = horner(H_LPF, NUM/DEN);
W =0:%pi/512:%pi;
Plot(W/%pi, HW)
a=gca();
a.thickness =3
a.foreground=1;
a.font-style=9;
x-grid(1)
Disp("Hz-BFz", Hz-BSF);
```

10/10

25/11

Result:-

The butterworth filters successfully designed and verified.

```
(1): [rational]
(2): [rational]
"Factorized HS = "
        0.2014254z
  --------------------------------
  0.246597 -1.0381995z +z^2
"HZ = "
```

Bilinear Transformation

```
1.4478601 +0.1783298z +1.4478601z^2
-----------------------------------------
      0.5298913 -1.1875z +z^2
"H(z) ="
```

Impulse Invariant trmns.

Exp. No: 12	Analog Filter design using Transformation Method.
21-11-24.	

Aim:-

To design a filter using Transformation method.

(i) Bilinear Transformation.

(ii) Impulse Invariant Transformation.

Tools:-

SCILAB Software, PC.

Procedure:-

* Start the SCILAB software.
* Open SCINOTES, Type the program and save it.
* Compile and run the program.
* For output, Check console window.
* Stop the program.

Program:-

Bilinear Transformation

```
s = %s;
z = %z;
HS = (s^2+4.525)/(s^2+0.625*s+0.504);
T = 1;
Hz = horner(HS, (2/T)*(z-1)/(z+1));
disp('Hz', Hz);
```

Impulse invariant Transformation

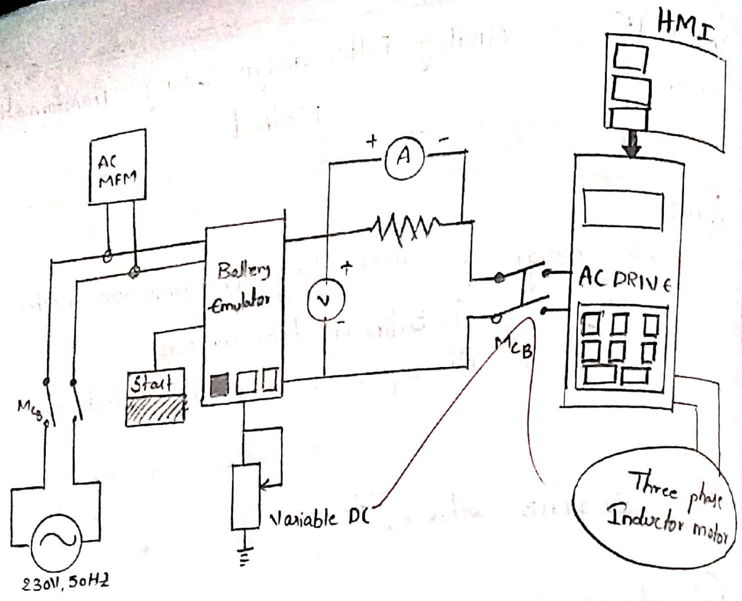
```
s = %s;
T = 0.2;
HS = 10/(s^2+7*s+10);
elts = pfss(HS);
disp(elts, 'Factorized HS = ');
P1 = -5;
P2 = -2;  z = %z;
dis(Hz, 'Hz' = ');
```

10/10

Result:-

Thus, the designing of a filter using transformation method is designed and verified successfully.

5/5



Exp. No: 13	Function of three phase Induction Motor drive
21-11-24	System in E-Mobility.

Aim:-

To study the function of three phase induction motor drive systemin E-mobility.

Apparatus Required:-

S.No	Name	Quantity
1.	750 W Three phase Induction motor	1
2.	Panel with DC Voltmeter, DC Ammeter & AC Meter	1
3.	750 W Variable Frequency AC Drive (VFD)	1
4.	Battery Emulator / DC Drive	1
5.	Human machine Interface (HMI)	1
6.	12V Alternator with 12V Batteries for Electrical Loading	1

Procedure:-

Give AC Supply to meter(s), Battery Emulator / DC drive and HMI etc.

Fully rotate potentiometer of DC control connected with battery Emulator.

Select forward / Reverse Mode Using HMI

Vary the Frequency using VFD.

Connect 12 V Battery in exitation pabel of alternator according to connection diagram and make sure to switch on the toggle switch.

Calculate the different values given on the below table to understand the working Characteristics of VFD and three phase induction motor drive system.

Precautions:-

Do not connect overvoltage supply

Check proper connection before testing.

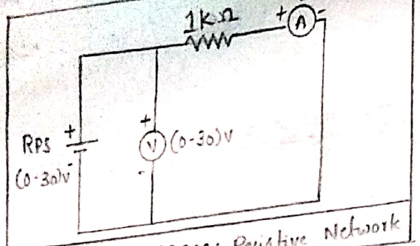
Do not overload the motor.

10/10

25/11

Result :-

Thus, The test on three phases induction motor drive system in E-mobility is performed successfully.



CIRCUIT DIAGRAM: Resistive Network

Table:-

S.No	PS	Voltage (V)	Current (mA)	Experimental Value (kΩ)	Theoritical Value (kΩ)
1.	5	4	4	1kΩ	1kΩ
2.	10	8	8	1kΩ	1kΩ
3.	15	13.5	12	1kΩ	1.1kΩ
4.	20	18.5	18	1kΩ	1kΩ
5.	25	24	20	1kΩ	1.2kΩ

Calculation:- Theoritical Value (kΩ) $R = \frac{V\,(V)}{I\,(A)}$

1. $R = \frac{4}{4\times10^{-3}} = 1000\,\Omega = 1\,k\Omega$

2. $R = \frac{8}{8\times10^{-3}} = 1000\,\Omega = 1\,k\Omega$

3. $R = \frac{13.5}{12\times10^{-3}} = \frac{13.5}{12\times10^{-3}} = 1125\,\Omega = 1.1\,k\Omega$

4. $R = \frac{18.5}{18\times10^{-3}} = 1027\,\Omega = 1\,k\Omega$

5. $\frac{24}{20\times10^{-3}} = 1200\,\Omega = 1.2\,k\Omega.$

Exp. No:- 14 a,
23-11-24

Verification of OHM's LAW

Aim:-

To verify ohm's law for a given resistive Network

Apparatus Required:-

S.No	Name	Range	Quantity
1.	RPS	(0-30)V	1
2.	Ammeter	(0-200)mA	1
3.	Voltmeter	(0-300)V	1
4.	Resistor	1kΩ	1
5.	Rheostat	300Ω/2A	1
6.	Bread Board and Connecting wires	-	as required

Procedure:-

Make sure the connections as per diagram

Switch on the power supply to Rps and apply a Voltage and take readings

Adjust the rheostat and Note readings.

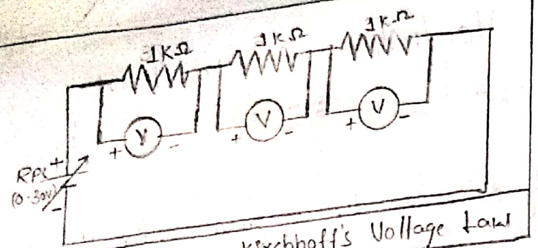
Plot a graph with V on x-axis and I on Y-axis.

The graph will be a Straight line which verifies Ohm's law.

$$\boxed{R = \frac{V_{(V)}}{I_{(A)}}\,(\Omega)}$$

Result:-

Thus, The OHM's law is verified for the given Circuit sucessfully.



CIRCUIT DIAGRAM: Kirchhoff's Voltage Law

Tabulation For KVL:-

S. No	V	Experimental			Theoritical Value		
		V_1	V_2	V_3	V_1	V_2	V_3
1.	0	0	0	0	0	0	0
2.	10	3	3	4	3.33	3.33	3.33
3.	15	4.5	5	5.5	5	5	5
4.	20	6.5	6.5	7	6.67	6.67	6.67
5.	5	1.5	1.5	2	1.67	1.67	1.67

$R_{th} = 1+1+1$

$R_{th} = 3k\Omega$

$V = V_1 + V_2 + V_3$

1. $V = 0$, $V_1 + V_2 + V_3 = 0$
   $V = V_1 + V_2 + V_3 = 0$

2. $V = 10$, $V_1 + V_2 + V_3 = 3+3+4 = 10$
   $V = V_1 + V_2 + V_3 = 10$

3. $V = 15$, $V_1 + V_2 + V_3 = 4.5+5+5.5 = 15$
   $V = V_1 + V_2 + V_3 = 15$

4. $V = 20$, $V_1 + V_2 + V_3 = 6.5+6.5+7 = 20$
   $V = V_1 + V_2 + V_3 = 20$

5. $V = 5$, $V_1 + V_2 + V_3 = 1.5+1.5+2 = 5$
   $V = V_1 + V_2 + V_3 = 5$

$I_L = \frac{V}{R_{th}}$

1. $I_L = 0$

2. $I_L = \frac{10}{3} = 3.33\,mA$

3. $I_L = \frac{15}{3} = 5\,mA$

4. $I_L = \frac{20}{3} = 6.67\,mA$

5. $I_L = \frac{5}{3} = 1.67\,mA$

Exp No: 14 b,
23-11-24

Verifications of Kirchhoff's Law

Aim:-

To verify Kirchhoff's Voltage Law (KVL).
To verify Kirchhoff's Current Law (KCL).

Aparatus Required:-

S.No	Name	Type	Range	Qty
1.	RPS	-	(0-15) V	1
2.	Bread Board	-	-	1
3.	Ammeter	MC MC	(0-10) mA (0-5) mA	1 2
4.	Voltmeter	MC MC	(0-10) V (0-15) V	1 1
5.	Resistor	-	470Ω, 330Ω 4kΩ, 4.7kΩ	each 3
6.	Connecting Wires	-	-	as Required

Procedure:-

Connections are given as per circuit diagram.

Apply DC Voltage to the circuit from the given RPS.

Tabulate the Voltmeter and Ammeter readings for the corresponding experiment.

Increase the votage bit by bit to get different readings till the voltage reached upto 15V.

Repeat Step 3 for different values.

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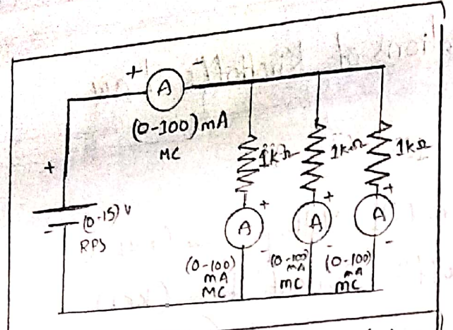

CIRCUIT DIAGRAM: Kirchhoff's Current Law

$R_{th} = \frac{1\times1}{1+1} = \frac{1}{2} = 0.5$

$R_{th} = \frac{0.5\times1}{0.5+1} = \frac{0.5}{1.5} =$

$R_{th} = 0.33$

Tabulation for KCL:-

S.No	Experimental				Theoritical		
	I	I_1	I_2	I_3	I_1	I_2	I_3
1	6	2	2	2	1.92	1.92	1.92
2.	12	4	4	4	3.96	3.96	3.96
3.	18	6	6	6	5.94	5.94	5.94
4	24	8	8	8	7.92	7.92	7.92

$I = I_1 + I_2 + I_3$

1. $I = 6$, $I_1 + I_2 + I_3 = 2+2+2 = 6$

   $I = I_1 + I_2 + I_3 = 6$

2. $I = 12$, $I_1 + I_2 + I_3 = 4+4+4 = 12$

   $I = I_1 + I_2 + I_3 = 12$

3. $I = 18$, $I_1 + I_2 + I_3 = 6+6+6 = 18$

   $I = I_1 + I_2 + I_3 = 18$

4. $I = 24$, $I_1 + I_2 + I_3 = 8+8+8 = 24$

   $I = I_1 + I_2 + I_3 = 24$

$V = IR_{th}$

1. $V = 6\times0.33 = 1.98$
2. $V = 12\times0.33 = 3.96$
3. $V = 18\times0.33 = 5.94$
4. $V = 24\times0.33 = 7.92$

Do same like Step-3 but Now take Ammeter readings.

Repeat Step-5 for different Ammeter readings.

Precautions:-

Keep RPS at maximum when switching ON and OFF the power supply.

Connections should properly check before switching ON the supply.

For KVL, $R = R_1 + R_2 + R_3$ $V = V_1 + V_2 + V_3$
For KCL, $R_T = \frac{R_2 R_3}{R_2 + R_3}$ [Parallel Circuit] $I_1 = I_1 + I_2$

10/10

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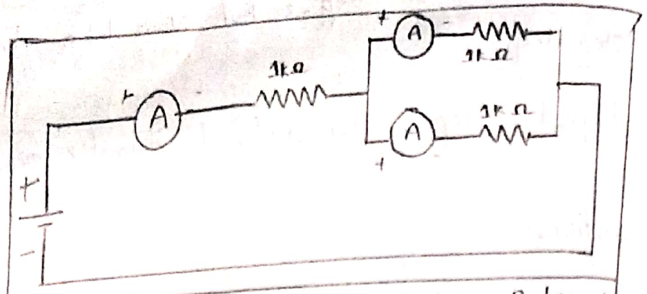
Result:

Thus, The kirchhoff's Voltage Law and Current is verified for the given circuit successfully.



CIRCUIT DIAGRAM : Current Division Rules

Tabulations:-

S.No	V	Experimental Values			Theoritical values		
		I	I_1	I_2	I_L	I_1	I_2
1.	8V	5	2.5	2.5	5.3	2.65	2.65
2.	16V	10	5	5	10.6	5.3	5.3
3	18.9V	12	6	6	12.6	6.3	6.3

$R_{th} = \frac{1\times1}{1+1} = 0.5k\Omega$

$R_{th} = 1+0.5 = 1.5k\Omega$

Calculations:

$I_L = \frac{V}{R_{th}}$

1. $I_L = \frac{8}{1.5} = 5.3\,mA$

2. $I_L = \frac{\cancel{8}16}{1.5} = 10.66\,mA$

3. $I_L = \frac{18.9}{1.5} = 12.6\,mA$

$I_1 + I_2 = \frac{I_L}{2}$

1. $I_1 + I_2 = \frac{5.3}{2} = 2.65\,mA$

2. $I_1 + I_2 = \frac{10.66}{2} = 5.3\,mA$

3. $I_1 + I_2 = \frac{12.6}{2} = 6.3\,mA.$

Exp.NO: 15

23-11-24

Verification of Current and Voltage Division Rules

Aim:-

To Calculate the individual branch Currents and total Current drawn from the power supply using current and Voltage division rules.

Apparatus Required:-

S.No	Name	Range	Qty
1.	DC Regulated power Supply	(0-30) V	1
2.	Ammeter	(0-200) mA	4
3.	Resistor	1kΩ, 220Ω	Each two
4.	Bread Board & Connecting wires	--	Required

Procedure:-

Given the Connections as per the circuit diagram.

Set a particular value in RPS.

Note down the corresponding ammeter readings.

Repeat the Same for different Voltages

Precautions:-

Keep the RPS at maximum at when Switching OFF and ON the power Supply.

Connection should properly check before Switch ON the Supply.

$I = \frac{V(v)}{R(\Omega)}$ (A)
$V = IR$ (V)

Result:-

Thus, the individual branch currents of total current drawn from power current and voltage division rules verified.

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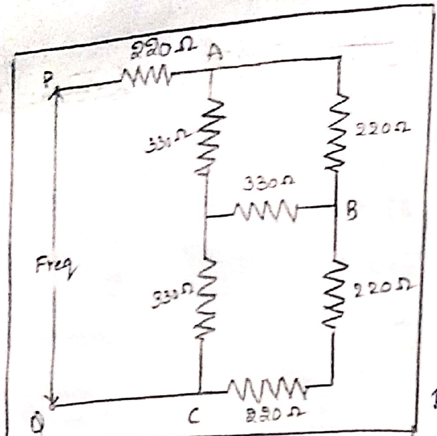

$R_{th} = 547\,\Omega$

Star Delta Transformation

Calculation:-

$$R_{AB} = \frac{R_A R_B + R_B R_C + R_C R_A}{R_C} = \frac{330\times330+330\times330+330\times330}{330} = \frac{316{,}800}{330}$$

$R_{AB} = 960\,\Omega$

$$R_{BC} = \frac{R_A R_B + R_B R_C + R_C R_A}{R_A} = \frac{330\times330+330\times330+330\times330}{330}$$

$$= \frac{316800}{330}$$

$R_{BC} = 960\,\Omega$

$$R_{CA} = \frac{R_C R_A + R_B R_C + R_A R_B}{R_B} = \frac{330\times330+330\times330+330\times330}{330}$$

$$= \frac{316800}{330}$$

$R_{CA} = 960\,\Omega$

Experimental	Theoritical
R_{th}	R_{PQ}
547Ω	550Ω

Exp No:- 16	Verification of Star Delta Transformation Using Resistance Reduction Technique
23-11-24	

Aim:-

To Calculate the equivalent circuit resistance using Star delta technique

Apparatus Required :-

Resistors, Bread board and Connecting wires.

Procedure:-

Give the connections as per the circuit diagram

Determine the Equivalent resistance of the circuit b/w P and Q using - delta transformation technique

Verify the same by connecting Multimeter across PQ

Precautions:-

Check the all the connection before switching ON the power supply

Do not touch the live connection.

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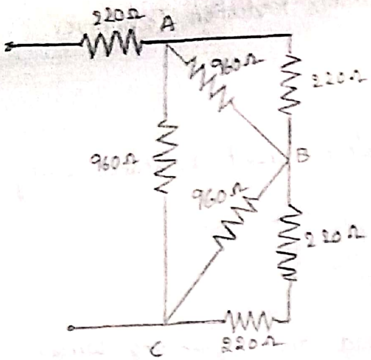
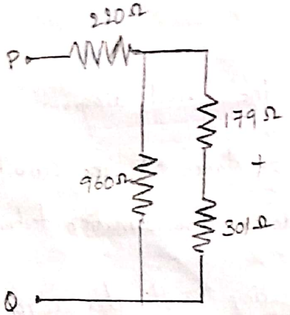
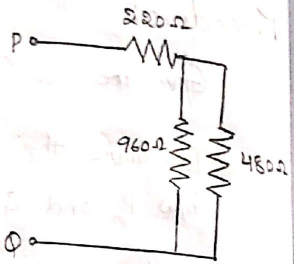


$$R_{AB} = \frac{960 \times 220}{960+220} = 179\,\Omega$$

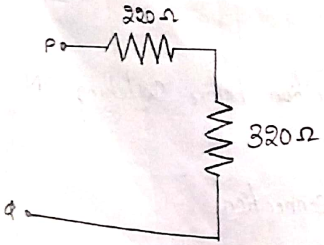
$$R_{BC} = \frac{960 \times (220+220)}{960+(220+220)}$$

$$R_{BC} = 301\,\Omega$$





$$R_{T_1} = \frac{960 \times 480}{960+480} = 320\Omega$$



$$R_{PQ} = 220+320$$

$$R_{PQ} = 550\,\Omega$$

$$\boxed{R_{PQ} \simeq R_{th}}$$

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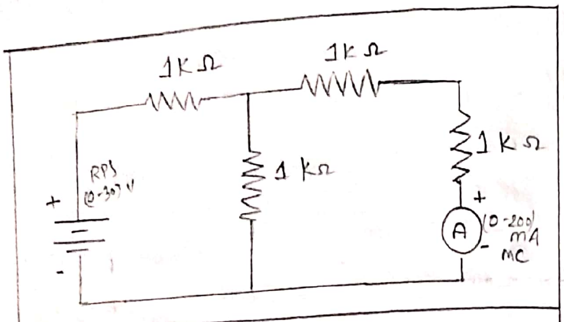
Result:-
Thus the equivalent circuit resistance is obtained using star delta transformation techniques.



CIRCUIT DIAGRAM: Thevenin's Theorem

Tabel:- Thevenins

S.No	V_S	I_L	I_2
1.	10	2	2
2.	20	4	4
3.	30	5	6

$$\Delta I_2 = \begin{vmatrix} 2 & 20 \\ -1 & 0 \end{vmatrix} = 20$$

$$I_2 = \frac{\Delta I_2}{\Delta} = \frac{20}{5} = 4$$

$$\Delta I_2 = \begin{vmatrix} 2 & 30 \\ -1 & 0 \end{vmatrix} = 30$$

$$I_2 = \frac{30}{5} = 6.$$

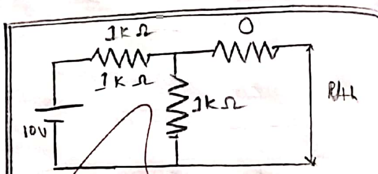
Calculation:

$$\begin{vmatrix} 2 & -1 \\ -1 & 3 \end{vmatrix} \begin{vmatrix} I_1 \\ I_2 \end{vmatrix} = \begin{vmatrix} V_S \\ 0 \end{vmatrix}$$

$$\Delta = \begin{vmatrix} 2 & -1 \\ -1 & 3 \end{vmatrix} = 5$$

$$\Delta I_2 = \begin{vmatrix} 2 & 10 \\ -1 & 0 \end{vmatrix} = 10$$

$$I_2 = \frac{\Delta I_2}{\Delta} = \frac{10}{5} = 2$$



$$I_1 = \frac{V}{R_{th}} = \frac{10}{2} = 5mA$$

$$V_{th} = I_1 \times R_L = 1k\Omega \times 5mA$$

$$V_{th} = 5V$$

Exp.No: 17

23-11-24

Verification of Thevenin's and Norton's Theorem

Aim:-

To verify the equivalent circuit parameters of thevenin and Norton's theorem Theoritically and practically.

Apparatus Required:-

S. No	Name	Range	Qty
1.	DC Regulated power Supply	(0-30)V	1
2.	Voltmeter	(0-30) v	1
3.	Ammeter	(0-200) mA	1
4.	Resistor	330Ω, 220Ω, 470Ω, 560Ω, 100Ω	as Required
5.	Multimeter	-	1
6.	Bread board & Connecting wires	-	as Required

Procedure for Thevenin's theorem:-

Give Connections as per the circuit diagram

Measure R_{th} using a multimeter by killing Sources (O.C the Current source and S.C the Voltage Source) and open R_L.

Measure Vth across A & B.

Measure Load Current I_L through R_L

$$\boxed{I_L = \frac{V_{th}}{R_{th} + R_L}}$$

Draw the Thevenin's Equivalent Circuit

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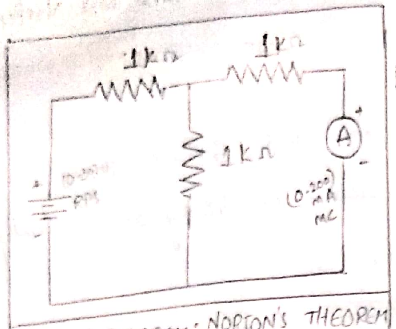


CIRCUIT DIAGRAM: NORTON'S THEOREM

$\Delta = \begin{vmatrix} 2 & -1 \\ -1 & 2 \end{vmatrix} = 3$

For V = 10

$\Delta I_{sc} = \begin{vmatrix} 2 & 10 \\ -1 & 0 \end{vmatrix} = 10$

$I_{sc} = \frac{\Delta I_2}{\Delta} = \frac{10}{3} = 3.33$

For V = 20

$\Delta I_{sc} = 20$

$I_{sc} = 6.67$

For V = 30

$\Delta I_{sc} = 30$

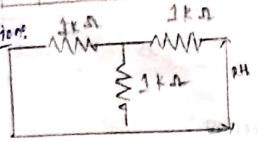
$I_3 = 10$

Tabulation:- Norton's theorem

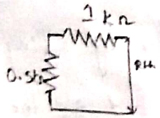
S.No	V_s	V_{th}	V_{th}
1.	10	3	5
2.	20	6	10
3	30	9	15

S.No	V_s	I_{sc}	I_{sc}
1	10	4	3.33
2.	20	8	6.67
3	30	12	10

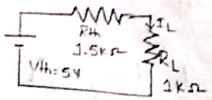
Calculation:



$R_1 = \frac{1\times1}{1+1} = \frac{1}{2} = 0.5$

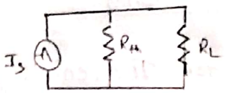


$R_{th} = 0.5+1 = 1.5k\Omega$



$I_L = \frac{V_{th}}{R_{th}+R_L} = \frac{5}{1.5+1}$

$I_L = \frac{5}{2.5} = 2\,mA$



For 10V $I_L = \frac{I_{sc} \times R_{th}}{R_{th}+R_L} = \frac{3.3\times1.5}{1.5+1} = 2A$

For 20V $I_L = \frac{6.67\times1.5}{1.5+1} = 4A$

For 30V. $I_L = \frac{10\times1.5}{1.5+1} = 6A.$

S.No	V_{th}	R_{th}	R_L	I_L
1	4	1.5	1	2
2	8	1.5	1	4
3	12	1.5	1	6

Procedure for Norton's Theorem:

Give the connections as per the circuit diagram.

Measure R_{th} using a multimeter by killing sources and open circuit R_L.

Measure I_N through A & B

Measure Load current I_L through R_L

$$\boxed{I_L = \frac{I_N}{R_{th}+R_L}}$$

Draw the Norton's Equivalent circuit.

Precautions:-

Check the connections before switching ON the Power Supply.

Be sure to keep a safe distance from live connection

V_{th}	I_L
5	2
10	4
15	6

I_{sc}	I_L
3.33	2
6.67	4
10	6

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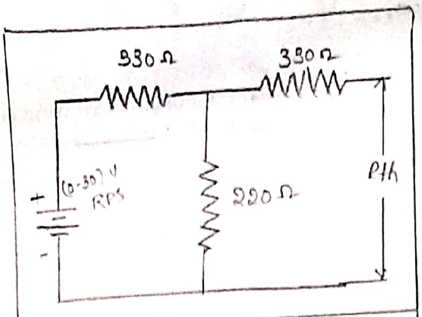
Result:

Thus, The equivalent circuit parameters and obtained using Thevenin and Norton's theorem.



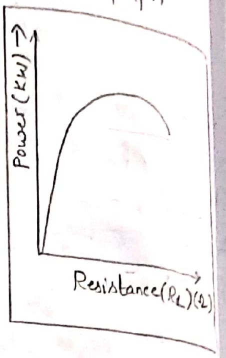
Circuit Diagram: Maximum Power transfer Theorem

Tabulation:-

Here, V=10V

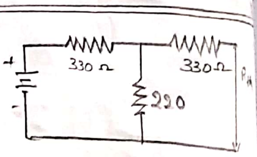
1.	R_L	I_L	P
1.	100 Ω	7.1 A	5kW
2.	200 Ω	6A	7.2kW
3.	460 Ω	4.3 A	8.5 kW
4.	300 Ω	5.2 A	8.1 kW
5.	400 Ω	4.6 A	8.4 kW
6.	500 Ω	4.1 A	8.4 kW
7.	600 Ω	3.7 A	8.2kW
8.	700 Ω	3.4 A	8kW
9.	800 Ω	3.1 A	7.6 kW
10	900 Ω	2.8 A	7kW

Model Graph

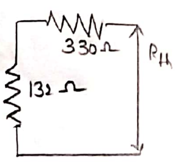


Calculations:- Power, $P = I_L^2 R_L$

1. P = 100*7.1*7.1 = 5041 W = 5kW
2. P = 200*6*6 = 7200 W = 7.2kW
3. $\boxed{\text{P = 460*4.3*4.3 = 8505 W = 8.5 kW}}$
4. P = 300*5.2*5.2 = 8112 W = 8.1 kW
5. P = 400*4.6*4.6 = 8464 W = 8.4kW
6. P = 500*4.1*4.1 = 8405 W = 8.4kW
7. P = 600*3.7*3.7 = 8214 W = 8.2kW
8. P = 700*3.4*3.4 = 8092 W = 8kW
9. P = 800*3.1*3.1 = 7688 W = 7.6kW
10. P = 900*2.8*2.8 = 7056 W = 7kW



$R_t = \frac{330 \times 220}{330+220} = 132\,\Omega$



$R_{th} = 132 + 330 = 462\,\Omega$

$R_{th} = 462$

$\boxed{R_{th} \approx R_L}$

Exp.No: 18	Verification of Maximum Power Transfer and Superposition theorem.
23-11-24	

Aim:-

To verify maximum power transfer theorem.

Apparatus Required:

SNO	Name	Range	Qty
1.	DC Regulated power supply	(0-30)V	1
2.	Voltmeter	(0-30)V	1
3.	Ammeter	(0-200)mA	1
4.	Resistor	330Ω, 220Ω	Each two
5.	Multimeter	-	1
6.	Bread Board & Connecting wires	-	As Required

Procedure:-

Give the connections as per circuit diagram.

Measure R_{th} using a multimeter.

Measure V_{th} accross 220 Ω (R_L).

Measure load current I_L through R_L

Calculate the maximum power transfered to the load.

$\boxed{V = IR}$

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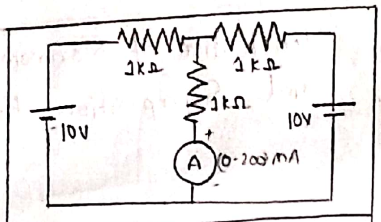


Superposition Theorem.

Calculation:-

$$\begin{vmatrix} 2 & -1 \\ -1 & 2 \end{vmatrix} \begin{vmatrix} I_1 \\ I_2 \end{vmatrix} = \begin{vmatrix} 10 \\ -10 \end{vmatrix}$$

$\Delta = 3$

$I_1 = \frac{\Delta I_1}{\Delta} = \frac{10}{3} = 3.33$

$I_2 = \frac{-10}{3} = -3.33.$

$I_L = I_1 - I_2$

$= 3.33 + 3.33$

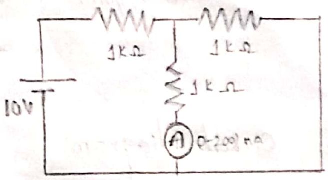
$I_L = 6.6$

Tabulations:-

S.No	V_1	I	I_L (TV)
1	10	3.1	3.3
2.	20	6.2	6.6
3.	30	9.8	9.9

S.No	V_2	I_L	I_L T(V)
1.	10	3.1	3.3
2.	20	6.2	6.6
3	30	9.8	9.9

S.No	V_1	V_2	I_L
1.	10	10	6.2
2.	20	20	12.7
3.	30	30	20

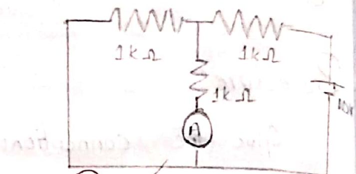


$\Delta = 3$

$I_1 = \begin{vmatrix} 10 & -1 \\ 0 & 2 \end{vmatrix} \times \frac{1}{3} = \frac{20}{3} = 6.67$

$I_2 = \Delta I_2 \times \frac{1}{3} = \begin{vmatrix} 2 & 10 \\ -1 & 0 \end{vmatrix} \times \frac{1}{3} = 3.33$

$I_{L_1} = I_1 - I_2 = 6.66 - 3.33 = 3.33$



$\Delta = 3$

$I_1 = \begin{vmatrix} 10 & -1 \\ 0 & 2 \end{vmatrix} \times \frac{1}{3} = \frac{20}{3} = 6.67$

$I_2 = \begin{vmatrix} 2 & 10 \\ -1 & 0 \end{vmatrix} \times \frac{1}{3} = 3.33$

$I_{L_2} = I_1 - I_2 = 6.67 - 3.3 = 3.33$

$I_L = \cancel{8}\, I_{L_1} + I_{L_2} = 3.33 + 3.33.$

$\boxed{I_L = 6.66}$

Precautions:-

Check the connections before turning ON the power supply.

Be sure to keep a certain distance from live connection.

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Results:-

Thus, the current flow through load resistance using superposition theorem and maximum power theorem is verified.

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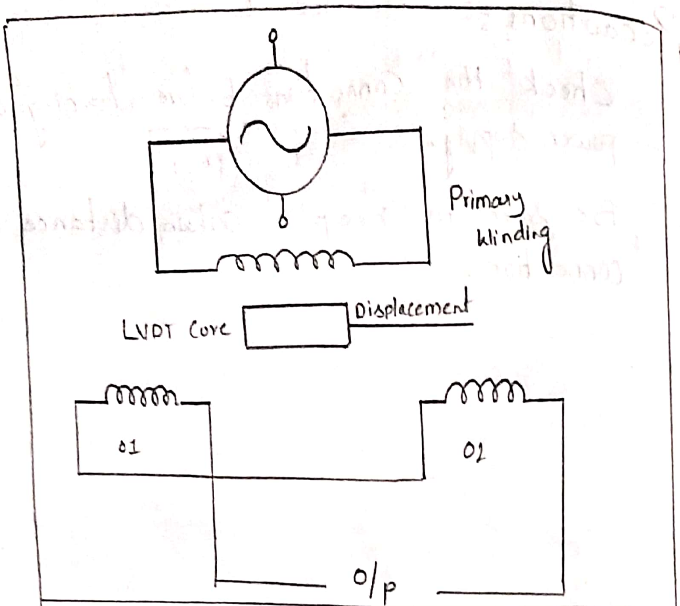
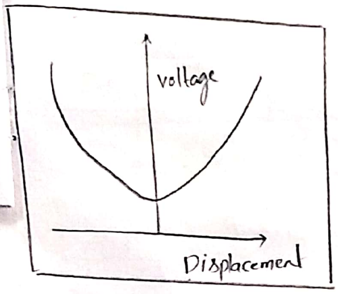


CIRCUIT DIAGRAM : LVDT (Linear Variable Differential Transducer)

Displacement (mm)	Voltage (V)
0	11.56
2	8.71
4	5.88
6	2.82
8	0
10	-3.09
12	-6.20
14	-9.31
16	-12.07



Exp. No: 19
22-11-24

Output Characteristics of LVDT

Aim:-

To plot the output characteristics of LVDT (Linear Variable Differential Transducer).

Apparatus Required:

LVDT kit, Multimeter, Connecting Wires.

Procedure:-

Connect the circuit according to circuit diagram.

Switch on the power supply.

The core is initially brought to null position.

First turn the nut in clockwise direction to move core inwards.

Now, Turn the nut in anticlockwise direction to move the core towards right of Null point and take respective readings.

Plot the graph from the observations taken.

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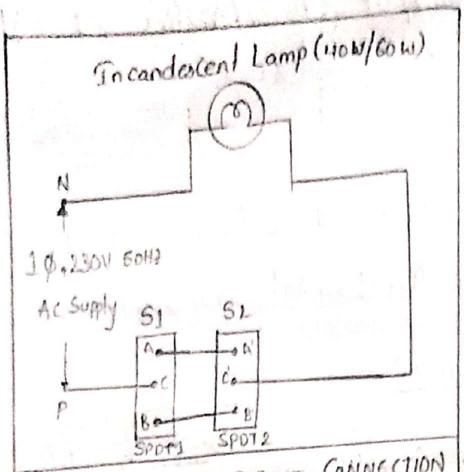
Results:-

Thus, the output characteristics of LVDT is plotted.



CIRCUIT DIAGRAM: DIRECT CONNECTION

S.No	S_1	S_2	Lamp Status
1.	CA	C'A'	ON
2.	CB	C'B'	ON
3.	CA	C'B'	OFF
4.	CB	C'A'	OFF

Exp. No: 20
22-11-24

Staircase Wiring

Aim:-

To Control the status of the given lamp using two-way switches.

Apparatus Required:

S.No	Name	Range	Qty
1	Incandescent Lamp	60W/40W	1
2	SPDT	5A, 230V	2
3.	Lamp holder	Pendent type	1
4.	Line tester	500V/Taparia 813	1
5.	3 pin plug	5A, 230V	1
6.	Wire Stripper cum cutter	Pye 950	1
7.	Connecting Wires	12A/1.5 sq mm	As required

Procedure:-

A piece of wire is Connected to the phase and Other end to the middle of the SPDT Switch1.

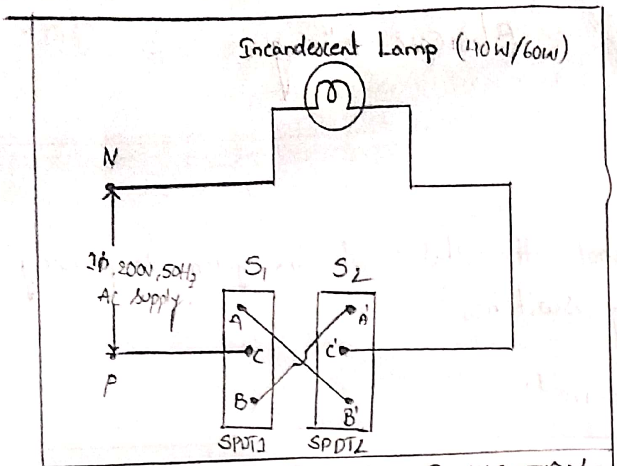
Another point of lamp holder is Connected to nuetral line.

upper point of SPDT switch 1 is Connected to the upper point of SPDT switch 2.

Lower point of SPDT switch 1 is connected to the lower point of switch 2.

Circuit is test that all Combinations of switch Connection.

Scanned with OKEN Scanner



CIRCUIT DIAGRAM: INDIRECT CONNECTION

S.No	S1	S2	Lamp Status.
1	CA	C'A'	OFF
2.	CB	C'B'	OFF
3.	CA	C'B'	ON
4.	CB	C'A'	ON

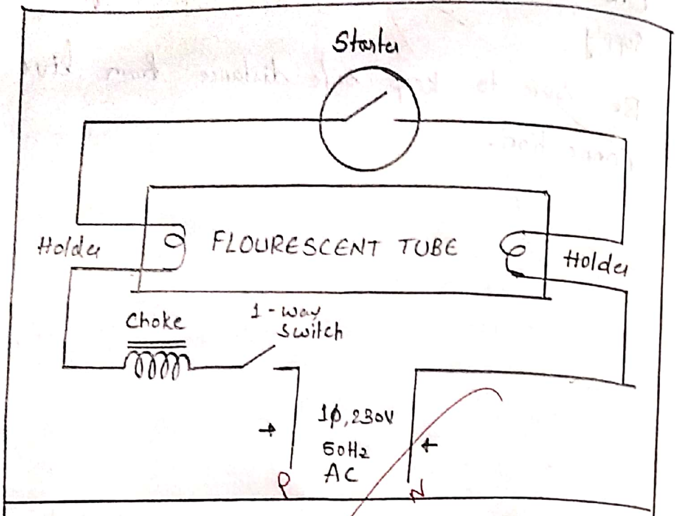
Precautions:-

Check the Connection before switching on the Supply.

Be sure to keep safe distance from live Connection.

Result:-

Thus, The status of the given lamp was Controlled and tested under direct and indirect Connection using two way switches.



CIRCUIT DIAGRAM: FLORESCENT TUBE.

Exp No:- 20 b

22-11-24

Floures cent Tube Wiring.

Aim:-

To prepare wiring for a flourescent tube light with switch Control.

Apparatus Required:-

S.NO	Name	Qty
1.	Tube light with fitting	1
2.	Joint clips	As required
3.	Switches	1
4.	Wire	As required
5.	Screws	As required
6.	Switch board	1

Procedure:-

Mark the switch and tube light location points and draw lines for wiring on the wooden board.

Place wiring along the lines and fix them with the help of clips.

Fix the switch and switch tube light fitting in the marked positions.

Completel the wiring as per wiring diagram.

10/10

26/11/24

Result:-

Thus, the wiring for the tube light is Completed and tested successfully.