01. Verification of ohm's law & Kirchoff's law

Aim:- To verify ohm's law for a given Resistive Network

Apparatus Required:-

S.NO	Apparatus Name	Range	Quantity
1.	DC Regulated power supply	0-30V	1
2.	Ammeter	(0-200)mA	1
3.	voltmeter	0-30V	1
4.	Resistor	1kΩ	1
5.	Rheostat	300Ω/2A	1
6.	Bread board & connecting wires	------	Required.

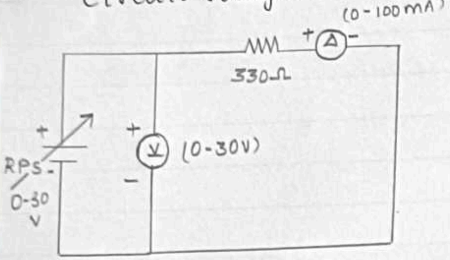
Theory: Ohm's law:— Ohm's law states that the current flowing through a conductor is directly proportional to the potential difference across its ends, provided the temperature and physical conditions remains constant. $\boxed{V = IR}$; V = voltage ; I = current, R = Resistance.

procedure:-

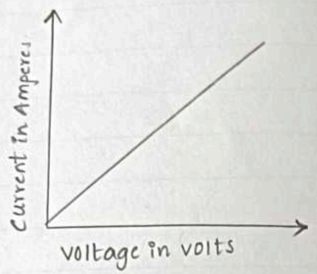
1. Make the connections as per circuit diagram.
2. switch on the power supply to RPS and apply a voltage and take the reading of voltmeter and Ammeter.
3. Adjust the rheostat in steps and take down the reading of Ammeter & voltmeter
4. plot a graph with V along x-axis and I along y-axis.
5. The graph will be a straight line which verifies ohm's law
6. Determine the slope of the V-I graph. The required slope give resistance of the wire.

Result:- Thus, the Ohm's law is verified for the given circuit.

Circuit Diagram:-



Model Graph:-



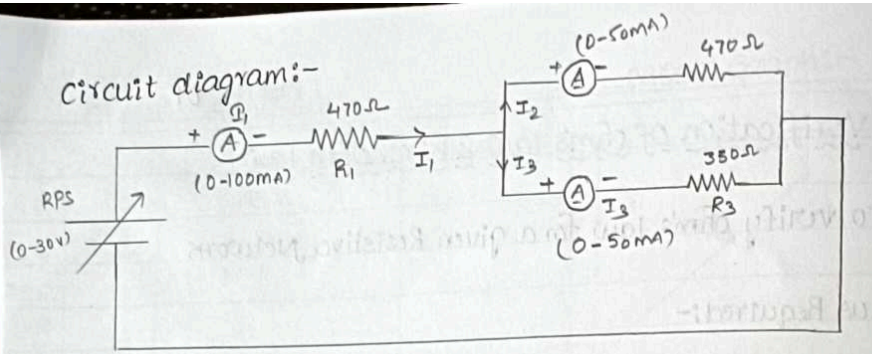
Tabulation Values:-

S.NO	Voltage (V)	current (mA)	Experiment Value R=V/I in Ω	Theoretical Value R=V/I in Ω
1	1	5	200	220Ω
2	2	10	200	220Ω
3	3	16	187.5	220Ω
4	4	20	200	220Ω
5	5	24	208.3	220Ω
6	6	28	214.28	220Ω
7	7	32	218.75	220Ω

Theoretical Values:- $(V = IR)$

1. $I = V/R = 1/220 = 4.5454mA$; $R = V/I = 1/4.5454 \times 10^{-3} = 220\Omega$
2. $I = V/R = 2/220 = 9.0909mA$; $R = V/I = 2/9.0909 \times 10^{-3} = 220\Omega$
3. $I = V/R = 3/220 = 13.6363mA$; $R = V/I = 3/13.6363 \times 10^{-3} = 220\Omega$
4. $I = V/R = 4/220 = 18.1818mA$; $R = V/I = 4/18.1818 \times 10^{-3} = 220\Omega$
5. $I = V/R = 5/220 = 22.7272mA$; $R = V/I = 5/22.7272 \times 10^{-3} = 220\Omega$
6. $I = V/R = 6/220 = 27.2727mA$; $R = V/I = 6/27.2727 \times 10^{-3} = 220\Omega$
7. $I = V/R = 7/220 = 31.8181 mA$; $R = V/I = 7/31.8181 \times 10^{-3} = 220\Omega$

Circuit diagram:-



Tabulation:-

parameter	Experimental value				Theoretical value			
Supply Voltage	current I_1(mA)	current I_2(mA)	current I_3(mA)	$I_1=I_2+I_3$ (mA)	current I_1(mA)	current I_2(mA)	current I_3(mA)	$I_1=I_2+I_3$ (mA)
10V	19.5	11.5	8	19.5	21.64	12.98	8.657	21.64

Theoretical calculation:-

To find Req:-

$R_{eq} = R_1 + R_2 || R_3$

$= 330 + \left[\frac{330 \times 220}{330+220}\right]$

$= 330 + 132$

$= 462\Omega$

$V = 10V$

$I_1 = V/R = \frac{10}{462} = 0.02164A = 21.64mA$

$V_1 = I_1 R_1 = 0.02164 \times 330 \Rightarrow \boxed{7.14V}$

$V = V_1 + V_2$

$10 = 7.14 + V_2$

$\boxed{V_2 = 2.857V}$

$I_2 = \frac{V_2}{R_2} = \frac{2.857}{220}$

$I_2 = 0.01298$

$\boxed{= 12.98mA}$

$I_3 = \frac{V_3}{R_3} = \frac{2.857}{330}$

$\boxed{I_3 = 8.6575mA}$

01b. Verification of Kirchoff's current law.

Aim:- To verify Kirchoff's current law for the given circuit.

Apparatus Required:-

S.NO	Apparatus Name	Range	Quantity
1.	DC Regulated power supply	0-30V	1
2.	Ammeter	0-100mA	3
3.	Resistor	470,330Ω	2
4.	Bread board & connecting wires	-	Required

Theory:-

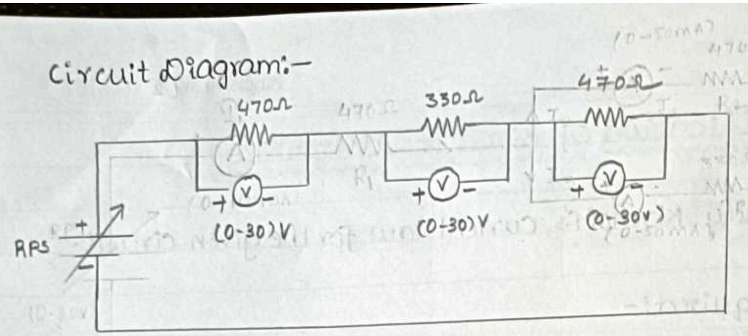
Kirchoff's current law states that the algebraic sum of currents at any junction in an electrical circuit is zero. This means the total current entering a junction is Equal to the current leaving junction.

procedure:-

1. Give the connections as per the circuit diagram.
2. Set a particular value in RPS
3. Note down the corresponding ammeter reading.
4. Repeat the same for different voltages

Result:- Thus, the kirchoff's current law is verified for a given circuit.

Circuit Diagram:-



Tabulation:

⊗ - wrong Table - ⊗

parameter	Experimental value				Theoretical value			
Supply voltage	current I_1(mA)	current I_2 (mA)	current I_3(mA)	$I_1 = I_2 + I_3$ (mA)	current I_1(mA)	current I_2(mA)	current I_3(mA)	$I_1 = I_2 + I_3$ (mA)
10V	19.5	11.5	8	19.5	21.64	12.98	8.657	21.64

Theoretical calculation:-

$V = 20V$

$R = 330 + 330 + 220 = 880\Omega$

$V = I/R = 20/880 = 0.022mA$

$V_1 = IR_1 = 0.022 \times 330 = 7.5V$

$V_2 = IR_2 = 0.022 \times 330 = 7.5V$

$V_3 = IR_3 = 0.022 \times 220 = 5V$

$V = V_1 + V_2 + V_3 \Rightarrow 7.5 + 7.5 + 5 \Rightarrow \boxed{20V}$

$V = 10V$

$R = R_1 + R_2 + R_3$

$R = 330 + 330 + 220 \Rightarrow 880\Omega$

$V = I/R = 10/880 \Rightarrow 0.011A$

$V_1 = I_1 R_1 = 0.011 \times 330 \Rightarrow V_1 = 3.65V$

$V_2 = I_2 R_2 = 0.011 \times 330 \Rightarrow V_2 = 3.65V$

$V_3 = I_3 R_3 = 0.11 \times 220 \Rightarrow V_3 = 2.42V$

$\therefore V = V_1 + V_2 + V_3 \Rightarrow 3.65 + 3.65 + 2.42$

$\boxed{V = 9.72V}$

Tabulation:-

Supply voltage	Theoretical value				Experimental value			
	V_1	V_2	V_3	KVL $V = V_1 + V_2 + V_3$	V_1	V_2	V_3	KVL $V = V_1 + V_2 + V_3$
20V	7.5V	7.5V	5	20V	7.2	7.3	4.5	21
10V	9.72V	12.84V	8.65V	21.64V	3.5	3.3	2.42	9.72

Kirchoff's voltage law

1.(C).

Aim:- To verify Kirchoff's voltage law for the given circuit.

Apparatus required:-

S.NO.	Apparatus Name	Range	Quantity
1.	DC Regulated power supply	0-30V	2
2.	Voltmeter	0-30V	3
3.	Resistor	1KΩ, 220Ω, 330Ω	Each one
4.	Bread board & connecting wires	-	required.

Theory:-

Kirchoff's voltage law (KVL) states that the sum of the all voltages around a closed loop in a circuit is always equal to zero.

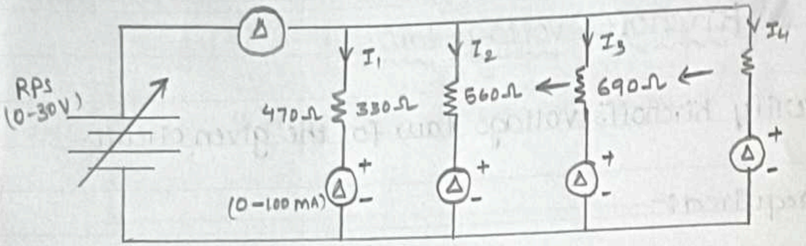
Procedure:-

1. Give the connections as per the circuit diagram.
2. Set a particular value in the RPS.
3. Note the corresponding voltage readings.
4. Repeat the same for different voltage.

Result:-

Thus, the Kirchoff's Voltage law is verified for given circuit.

Circuit diagram:-



Tabulation Values:

S.No	Voltage	Current (mA)			
		I_1	I_2	I_3	I_4
1.	5	5	10.64	15.15	8.03
2	10	10	21.28	30.3	17.86
3.	15	15	31.91	45.45	26.79
4.	20	20	42.55	60.61	35.71
5.	25	25	53.19	75.76	44.64

Calculation:-

For voltage (V) = 5V

Resistor (R_1) = 470kΩ

$R.I_1 = V/R_1 = 5/470 = 10.64mA$

$R_2 = 330k\Omega$

$I_2 = V/R_2 = 5/330 = 15.15mA$

$R_3 = 560k\Omega$

$I_3 = V/R_3 = 5/560 = 3.93mA$

$R_4 = 690k\Omega$

$I_4 = V/R_4 = 5/690 = 7.25mA$

For Voltage (V) = 15V

$R_1 = 470k\Omega$

$I_1 = V/R_1 = 3.19mA$

$R_2 = 330k\Omega$, $I_2 = V/R_2 = 45.45mA$

$R_3 = 560k\Omega$

$I_3 = 15/560 = 26.77mA$

$I_4 = V/R_4 = 15/690k\Omega = 21.74mA.$

For Voltage (V) = 10V.

$R_1 = 470k\Omega$ $R_2 = 330k\Omega$ $R_3 = 560k\Omega$ $R_4 = 690k\Omega$

$I_1 = V/R_1$ $I_2 = V/R_2$ $I_3 = 17.86 mA$ $I_4 = 14.49mA$

$I_1 = 21.28mA$ $I_2 = 30.30mA$

For Voltage (V) = 20V.

$R_1 = 470k\Omega$, $I_1 = 20/470 = 42.55mA$

$R_2 = 330k\Omega$, $I_2 = 20/330 = 60.61mA$

$R_3 = 560k\Omega$, $I_3 = 35.71 mA.$

$R_4 = 690k\Omega$, $I_4 = 44.64mA$

02. 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.	Apparatus NAME	Range	Quantity
1.	DC Regulated power supply	0-30V	1
2.	Ammeter	0-200mA	4
3.	Resistor	1kΩ, 220Ω	Each two
4.	Bread board & connecting wires	-	Required

Theory:-

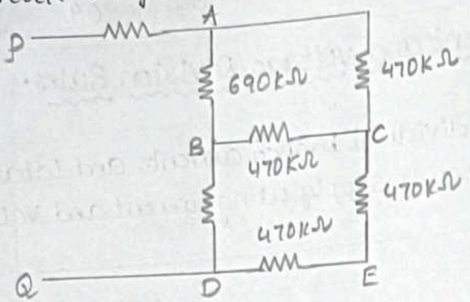
The voltage division rule states that in a series circuit, the voltage across a resistor is proportional to it's resistance. The Current division rule states that in a parallel circuit, inversely proportional to resistance.

Procedure:-

1. Give the connections as per the circuit diagram
2. Set a particular value in RPS
3. Note down the corresponding ammeter reading.
4. Repeat the same for different voltages

Result:- Thus power supply is calculated using current & voltage division rules.

Circuit diagram:-



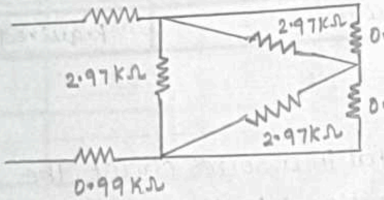
Tabulation:-

S.NO	Theoretical value (RPQ in ohm)	Measured value (RPQ in ohm)
1.	2.97kΩ	2.97kΩ

Calculation:

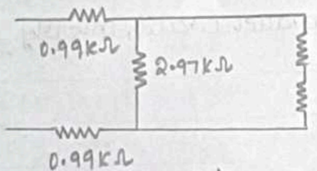
$$R_{AB} = \frac{R_A R_B + R_B R_C + R_C R_A}{R_C}$$

$$= \frac{2.9403 \times 10^6}{0.99 \times 10^3} = 2.97k\Omega$$

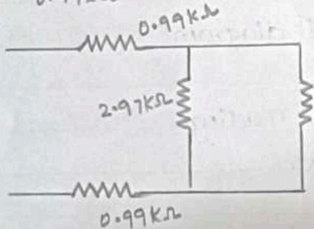


$$R_{BC} = \frac{R_{AB} + R_{BC} + R_{CA}}{R_A} = 2.97k\Omega$$

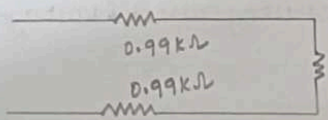
$$R_{CA} = \frac{R_{AB} + R_{BC} + R_{CA}}{R_B} = 2.97k\Omega$$



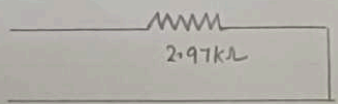
$$\frac{0.99 \times 2.97}{0.99 + 2.97} = 0.7425k\Omega$$



$$0.7425 + 0.7425 = 1.485k\Omega$$



$$\frac{(2.97 \times 1.485) \times 10^6}{(2.97 \times 1.485) \times 10^3} = 0.99k\Omega$$



$$R_{eq} = (0.99 + 0.99 + 0.99) \times 10^3 \Rightarrow 2.97k\Omega$$

03. Verification of star-delta transformation.

Aim:- To calculate the equivalent circuit resistance using star delta transformation technique.

Apparatus Required:-

S.NO	Apparatus Name	Range	Quantity
1.	Resistor		
2.	Bread board	-	Required.

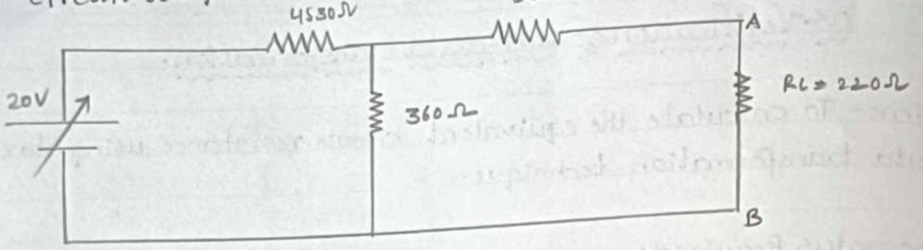
procedure:-

1. Give the connections as per the circuit diagram
2. Determine the equivalent resistance of the circuit between P and Q using star-delta transformation technique.
3. Verify the Same by connecting multimeter across PQ.

Result:-

Thus, the equivalent circuit resistance is obtained using star-delta transformation, techniQue.

Circuit Diagram:-

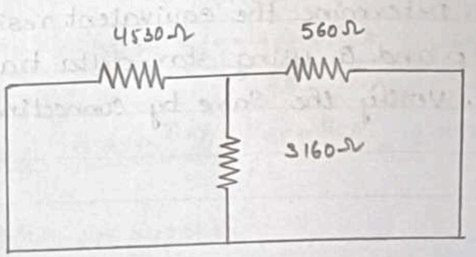


Tabulation:-

Supply voltage	Theoretical Values			Experimental Values		
	R_{th}	V_{th}	I_L	R_{Th}	V_{th}	I_L
20V	2421.4	8.2	3.3	2401	75	3.1

Calculation:

$R_{Th} = 560 + \left[\dfrac{4530 \times 3160}{4530+3160}\right]$

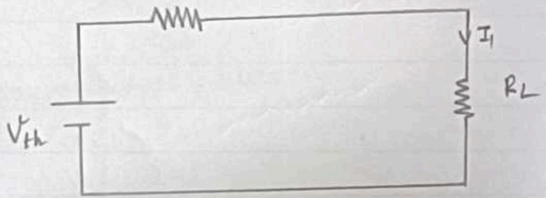


$\therefore R_{Th} = 2421.48\ \Omega$

$V_{th} = \dfrac{20 \times 3160}{4530+3160}$

$= \dfrac{63200}{7690}$

$\therefore V_{th} = 8.21\ V$



$I_L = \dfrac{8.21}{2421.48+220}$

$\therefore I_L = 0.0031\ A$

04. Verification of Thevenins theorem and Norton's theorem.

Aim:- To verify the equivalent circuit parameters of Thevenins and Norton's theorems theoretically and practically.

Apparatus Required:-

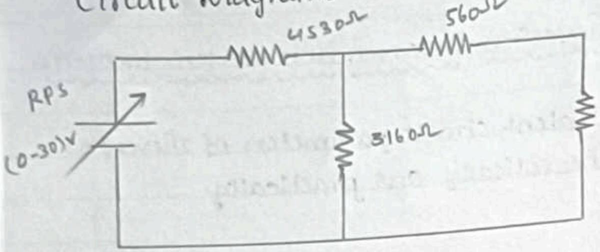
S.NO.	Apparatus Name	Range	Quantity
1.	DC Regulated power supply	0-30V	1
2.	Voltmeter	0-30V	1
3.	Ammeter	(0-200) mA	1
4.	Resistor	330Ω, 220Ω, 470Ω, 560Ω 100Ω	Required
5.	Multimeter	-	1
6.	Bread board & connecting wires	-	Required.

Procedure:-

1. Give the connections as per circuit diagram.
2. Measure Rth using a multimeter by killing sources (O.C the current source and S.C the voltage source) and open-circuit R_L.
3. Measure V_{th} across A and B (open circuit R_L)
4. Measure load current I_L through R_L.

   $I_L = V_{th} / R_{th} + R_L$
5. Draw the Thevenins Equation Equivalent circuit.

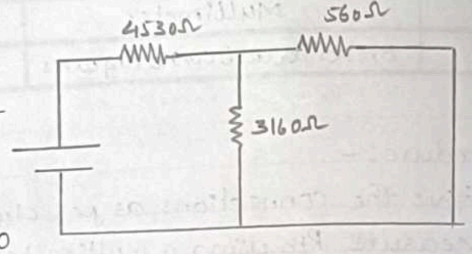
Circuit Diagram:-



Tabular observations:-

Supply Voltage	Theoretical Values			Measured values		
	R_{Th}	I_{sc} (mA)	I_L (mA)	R_{Th}	I_{sc} (mA)	I_L (mA)
20	242.14	3.3	3.0	2421.48	3.3	3.1

Calculations:

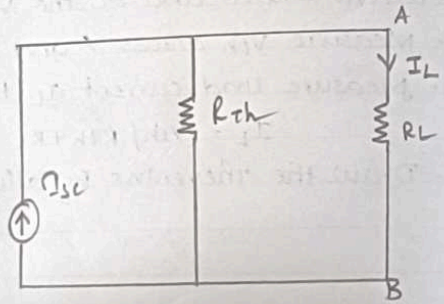


$$R_{Th} = 560 + \frac{4530 \times 3160}{4530 + 3160}$$

$$R_{Th} = 2421.48\ \Omega$$

$$R_{eq} = 4530 + \frac{560 \times 3160}{360 + 3160}$$

$$R_{eq} = 5005.69\ \Omega$$



$$I_T = \frac{20}{5005.69}$$

$$I_T = 0.00019\ A$$

$$I_{sc} = \frac{I_T \times 3160}{560 + 3160}$$

$$= 0.003312\ A$$

$$I_L = \frac{I_{sc} \times R_{Th}}{R_{Th} + R_L}$$

$$\therefore I_L = 0.003303 A.$$

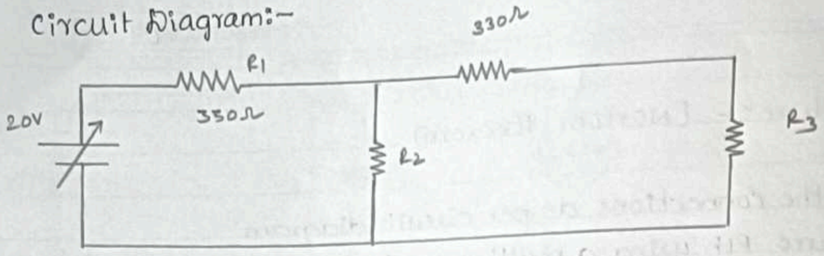
Procedure:- [Norton's theorem].

1. Give the connections as per circuit diagram
2. Measure Rth using a multimeter by killing sources [O.c the current Source and s.c the voltage source] and open circuit R_L.
3. Measure load current I_L through R_L.
4. Measure I_N through A and B.
5. Draw the Norton's Equivalent circuit.

Result:-

Thus, the equivalent circuit parameters are obtained using Thevenins and Norton's theorems.

Circuit Diagram:-



Tabular observations:

Supply voltage	Theoretical values			Measured value			Max. Power (W)
	R_{Th} (Ω)	V_{th} (Ω)(V)	I_L (mA)	R_{Th} (Ω)	V_{th} (V)	I_L (mA)	
20V	462	8	12	448	7.5	11.8	0.0306W

Theoretical calculations:

$$R_{Th} = 330 + \frac{330 \times 220}{330+220}$$

$R_{Th} = 462\,\Omega$

$$V_{th} = \frac{20 \times 220}{330+220}$$

$V_{th} = 8V$

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

$I_L = 12\,mA$

P_{max} calculation:

$$\frac{V_{th}^2}{4R_{Th}} = \frac{8^2}{4 \times 462} = 0.0346\,W.$$

05. Verification of Max-power Transfer Theorem and Superposition theorem

5a. Max-power Transfer theorem :-

Aim:- To verify maximum power transfer theorem.

Apparatus Required :-

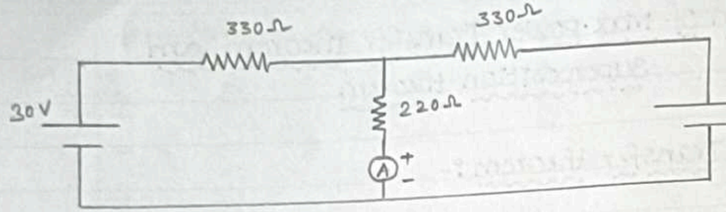
SNO.	Apparatus Name	Range	Quantity
1.	DC Regulated power supply	0-30V	1
2.	Voltmeter	0-30V	1
3.	Ammeter	0-200mA	1
4.	Resistor	330Ω, 220Ω	Each two
5.	Multimeter	–	1
6.	Bread board & connecting wires		Required

procedure:-

1. Give the connections as per the circuit diagram
2. Measure the Rth using a multimeter.
3. Measure the Vth across 220Ω (R_L).
4. Measure load current (I_L) through R_L.
5. calculate the maximum power transferred to the load.

Result:- Thus, the maximum power transfer theorem is verified.

Circuit Diagram:-



Tabular calculation:

Meas-urement	calculated current		Measured current		Net. Current (mA)
	V=20V	V=15V	V=20V	V=15V	
45.2	25.8	19.4	27.2	19.5	46.8

V=20V

$R_{eq} = 330+132$

$= 462\Omega$

$I = \frac{20}{462} = 43mA$

$I_L' = 25.8\ mA$

$V = 15V$

$R_{eq} = 462\Omega$

$I = \frac{15}{462} = 32.4mA \Rightarrow I_L'' = 19.4mA$

$I_L = I_L' + I_L''$

$= 25.8 + 19.4$

$= 45.2mA$

5b. Superposition Theorem:-

Aim:- To determine the current flow through the load Resistor using superposition theorem.

Apparatus Required:-

S.NO.	Apparatus Name	Range	Quantity
1.	DC Regulated power supply	0-30V	2
2.	Voltmeter	0-30V	1
3.	Ammeter	0-200mA	1
4.	Resistor	1kΩ, 220Ω, 330Ω	Each-1
5.	Multimeter	-	1
6.	Bread board & connecting wires	-	Required

Procedure:-

1. Give the connections as per circuit.
2. Measure current flow through 1kΩ by connecting both supplies.
3. Short circuit 20v source
4. Measure current flow through 1kΩ by the connecting 20v supply
5. Short circuit 20v source
6. Measure current flow through 1kΩ by connecting 15V supply.
7. Verify the net current through 1kΩ resistor.

Result:- Thus, the current flow through the load resistor using Superposition theorem.

Model calculations:-

S.NO	Load current (I_2)	Secondary voltage (V_2)	Primary voltage (V_1)	Primary current (I_1)	Power output	Efficiency (P_o/P_i)%	Power input	Voltage Regulation (%)
1.	0	230	230	0	0	0	0	$\frac{230-230}{230} = 0$
2.	0.3	220	228	1	200	94.3	212	$\frac{230-220}{220} = 4.5\%$
3.	0.8	216	228	1.8	480	96	500	$\frac{230-216}{216} = 6.4\%$
4.	2.1	212	224	2.6	720	97.2	740	$\frac{230-212}{212} = 8.4\%$
5.	3	208	224	3.4	940	98.9	960	$\frac{230-208}{208} = 10\%$

06. Load test on single phase transformer

Aim:- To Evaluate the transformer performance under full load - conditions

Apparatus Required:-

S.NO.	Apparatus Name	Range	Quantity
1.	Single phase transformer	1 ϕ	1
2.	voltmeter	0-50V	1
3.	Ammeter	0-300V	1
4.	Supply source	0-10A	1
5.	Load Bank	5KW-230W	1
6.	Wattmeter	-	1

Theory:-

A load test on a single phase transformer is used to determine it's efficiency and voltage regulation under various load conditions. The test measures parameters such as power loss, output voltage and current.

procedure:-

1. connect the primary winding of the transformer to the A/c power source.
2. connect the secondary winding to load bank.
3. connect the voltmeter across the secondary winding to measure the Secondary Voltage.

Model Calculation

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

$$= \frac{200}{212} \times 100$$

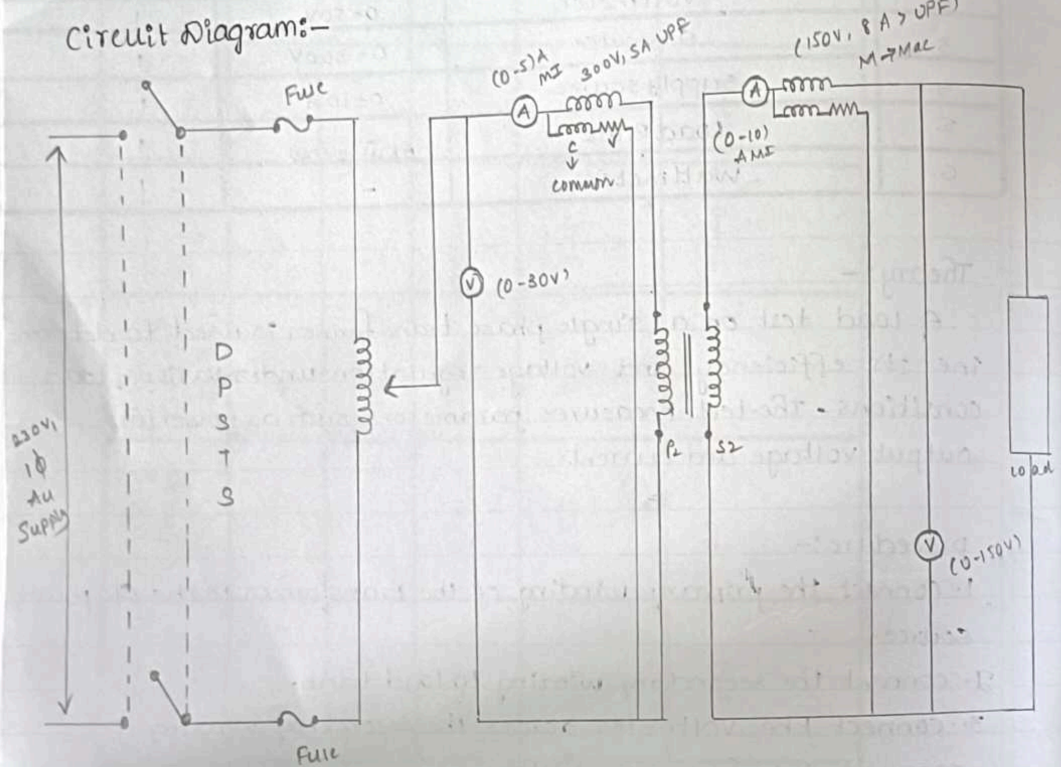
$$= 94.3\%$$

$$\text{Voltage Resolution} = \frac{V_{noload} - V_{Full\ load}}{V_{Full\ load}} \times 10$$

$$= \frac{230-220}{220} \times 100$$

$$= 4.5\%$$

Circuit Diagram:-



Adjust the load:-

1. Start the no. load on the secondary side and gradually increase the load by adjusting variables.
2. Increasing the load unit the rated current flows through the winding.
3. Record readings. [V_1, V_2, I_1, I_2 and P]
4. Calculate Efficiency

Result:- Thus, the load test on single phase transformer is conducted.

observation:-

Open circuit Rated voltage.

V	A	W (Experiment)	W (Theoretical)
230	0.3	64	69

short circuit Rated voltage.

V	A	W (Experiment)	W (Theoretical)
24	4.2	76	100.8

calculation:

$P = VI$

$P = 230 \times 0.3$

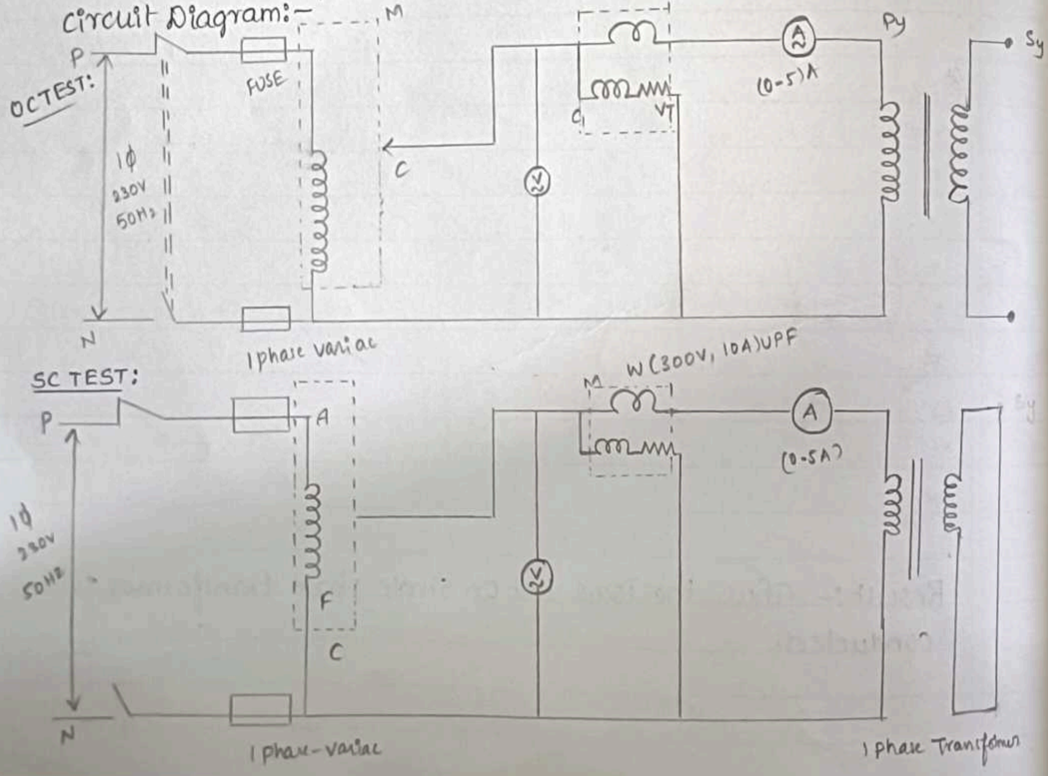
$P = 69W$

$P = VI$

$P = 24 \times 4.2$

$P = 100.8W$

Circuit Diagram:-



07. OC and SC Test on single phase transformers.

Aim:- To conduct load test on single phase transformers and find the efficiency.

Apparatus Required:-

S.NO.	Apparatus Name	Range	Type
1.	Ammeter	0-10A	MI
2.	Voltmeter	0-130 A	MI
3.	Wattmeter	300V, 5A	UPF
4.	Auto transformer	1ϕ, (0-260V)	-
5.	Resistive load	5kW, 230V	-

Theory:-

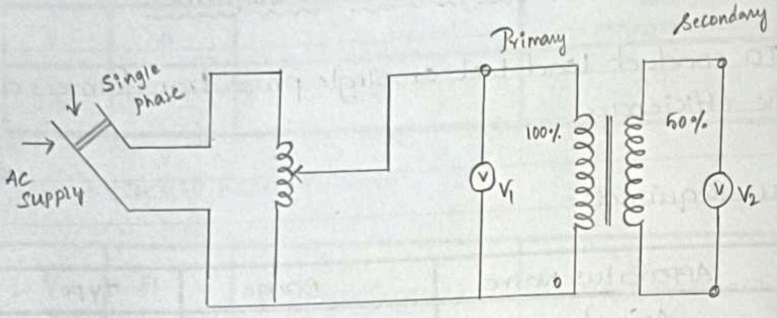
The open circuit and short-circuit tests are essential tests that helps to determine the transformer's core losses, copper losses and parameters like Equivalent resistance.

procedure:-

1. Connect Voltmeter, ammeter and wattmeter to the primary windings.
2. Leave the secondary winding open.
3. Apply the voltage and record the readings.

Result:- Thus, the OC and SC test on single phase transformers is conducted.

Circuit diagram:-



Observation:-

Secondary voltage = 50% of primary voltage.

S.NO.	Primary Voltage (V)	Secondary voltage (V)
1	40	20
2	60	31
3	80	40
4	100	50
5	120	60

08. Calculations of secondary Turns and current in a transformer

Aim:- To Evaluate the secondary turns of current in transformer.

Apparatus Required:-

S.NO.	Name	Range	Quantity
1.	Single phase transformer	1ϕ (0-260V)	1
2.	voltmeter	0-150V	1
3.	Ammeter	10A	1
4.	watt meter	300V, 5A	1
5.	Variable Resistance Load	5kW, 230W	1

Theory:-

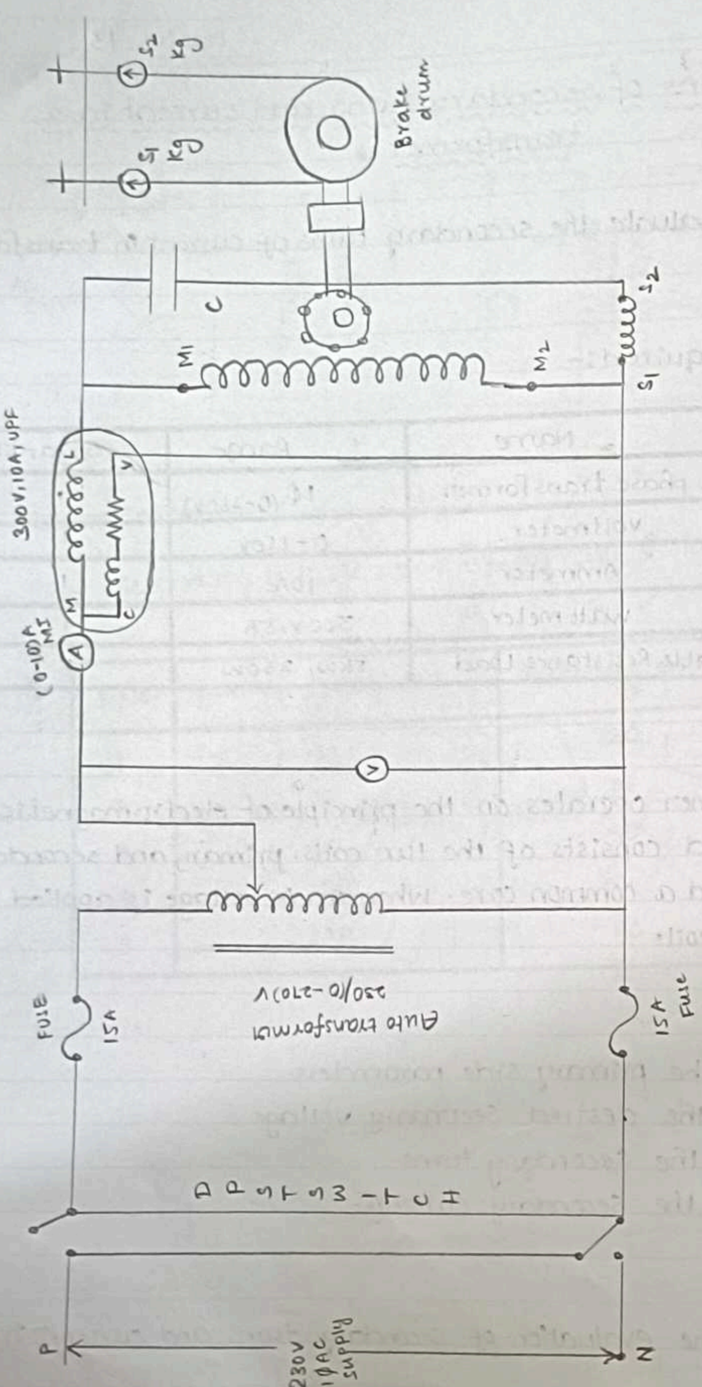
A transformer operates on the principle of electromagnetic induction and consists of the two coils, primary and secondary wound around a common core. When an AC voltage is applied to the primary coil.

Procedure:-

1. Identify the primary side parameters.
2. Measure the desired secondary voltage.
3. calculate the secondary turns
4. Determine the secondary current.

Result:-

Thus, the evaluation of secondary turns and current is done.



09. Load test on single phase Induction motor

Aim:- To conduct the load test on the given single phase induction motor and to plot its performance.

Apparatus required:-

S.NO	Apparatus required	Range	Quantity
1.	Voltmeter	(0-300V) MI	1
2.	Ammeter	(0-10A) MI	1
3.	Watt meter	300V, 10A	1
4.	Tacho meter	10-10000 RPM	1

Theory:-

A load test on a single phase Induction motor is performed to evaluate its performance under different load conditions.

procedure:-

1. Make connections as per diagram.
2. The DPST switch is closed and the single phase supply is given
3. By adjusting the variance, the rated voltage is applied, no load values of speed, balance and meter readings
4. The procedure is repeated till rated current of the machine.

observations:

S.NO	Volts (V_l)	Amps (A)	Speed	Watt-meter readings	Spring Balance Readings S_1	S_2	S_2-S_1	Torque = $9.81 \times R \times (S_2-S_1)$	Input ($V_L I_L$)	Output $\frac{2\pi NT}{60}$	power factor W/VI	N = O/P / I/P	$S = \frac{N_S-N}{N_S}$
1	230	3.2	1490	300	0.	0	0	0	716	0	0.407	0	0.006
2	230	3.5	1480	540	0.8	1	0.2	0.446	805	30.392	0.670	3.77	0.013
3	228	4	1460	760	1.6	2	0.392	0.392	912	59.963	0.533	6.37	0.036
4	226	4.5	1450	900	2	2.8	0.8	0.784	1017	119.106	0.884	11.71	0.033

Model calculations:-

$T = 9.81 \times 0.1 \times 0.2$

$\boxed{T = 0.1962 \text{ NM}}$

Input power $= 230 \times 3.5$

$\boxed{= 850 \text{ W}}$

output power $= \frac{2 \times 3.14 \times 0.1962 \times 1480}{60}$

$\boxed{Power_{out} = 30.392 \text{ W}}$

$P_F = 540/230 \times 3.5$

$\boxed{P_F = 0.670}$

$\eta = \frac{O}{I} = \frac{30.392}{805}$

$\boxed{\eta = 3.77\%}$

$Slip = \frac{1500-1480}{1500}$

$\boxed{Slip = 0.013.}$

Result:- Thus, the performance of DC single phase induction is noted.

observations:-

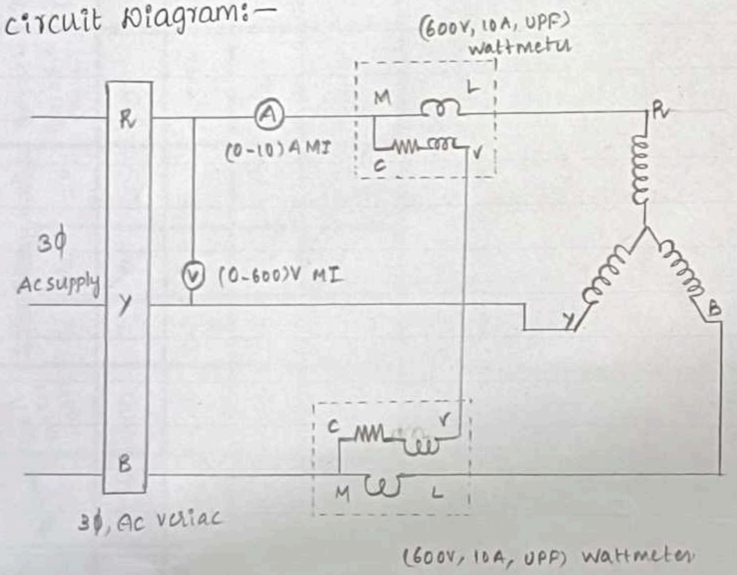
S.NO.	voltage (V)	Amphere (A)	watt 1 (W)	watt 2 (W)	Total power (W)
1	415	2.4	688	0	688
2	415	2.5	944	0	944
3	415	2.9	1112	400	1512
4	415	3	1200	480	1680
5	415	3.5	1440	880	2320

calculation:- $W = W_1 + W_2$

$W = 688 + 0$

$W = 688W.$

circuit Diagram:-



10. power measurement using TWO WATTMETER METHOD

Aim:- To Evaluate no load parameters in a circuit with open circuit test.

Apparatus Required:-

S.NO	Name	Range	Quantity
1.	voltmeter	(0-30)V	1
2.	Ammeter	(0-20)A	1
3.	wattmeter	(0-270V) 50Hz	1
4.	Auto-Transformer	(0-150) LPF	1
5.	Transformer	(V-115V	1

Theory:-

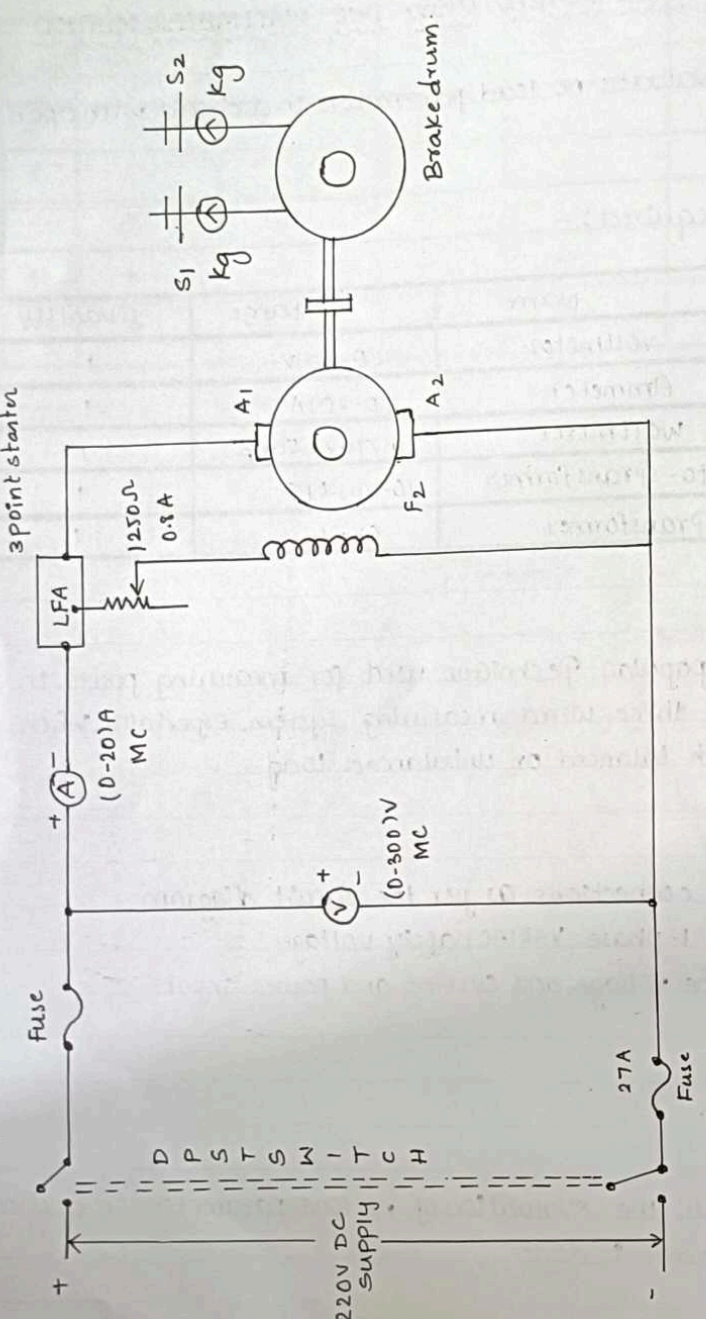
This is a popular Technique used for measuring power in three phase, three-wired measuring system especially when dealing with balanced or unbalanced load.

procedure:-

1. Make the connections as per the circuit diagram
2. By using 1-phase VARIAC, apply voltage.
3. Measure the voltage and current and power input

Result:- Thus, the evaluation of no load parameters in a circuit with open-circuit is done.

CIRCUIT DIAGRAM:-



11. Load test on DC SHUNT MOTOR

Aim:– To conduct the brake load test on DC shunt motor and determine it's performance.

Apparatus Required:

S.NO.	Apparatus Name	Range	Quantity
1.	220V DC Supply	0-20 N	1
2.	Ammeter	0-300 A	1
3.	Voltmeter	0-300 V	1
4.	Rheostat	370/1.7	1
5.	RPM meter	(0-199)um	1
6.	Connecting wires	–	–

Theory:-

It is a direct method in which a braking force is applied to the pulley mounted on the motor shaft. A belt is wound round the pulley and it's turn ends are attached to the frame through two spring balanceh S_1 and S_2.

procedure:-

1. make the connections as shown in the circuit diagram.
2. keep the field rheostat at minimum position; switch on the supply.
3. Adjust the speed of the motor ON, NO Load to it's started value by means of the field rheostat.
4. put on the load by tighting the strings of the spring balanceh.

OBSERVATION:-

S.NO	Voltage (V)	Current (A)	Speed (V)	Spring Balance		$f_1 = S_1 - S_2 V$ 9.81 T = $F_1 \times R$ (Torque)	I/P Power $V_L \times I_L$	O/P Power $2\pi NT/60$	Efficiency in % OP/IP
				S_1	S_2				
1	220	1.6	1480	0	0	0	352	0	0 %
2	220	4	1422	0.6	2.2	1.412	880	210.15	23.8 %
3	220	6.	1400	0.8	5.2	3.884	1320	569.135	43.1 %
4	220	8	1382	1	8	6.1803	1760	893.9	50.7 %
5	218	10	1378	1.2	10.2	7.946	2180	1146.05	52.5 %
6	219	12	1359	1.8	18	9.88	2406	1406.4	54 %

CALCULATION:-

$F = S_1 - S_2 \times 9.81$

$= (0.6) - 2.2 \times 9.81$

$= (1.6) \times 9.81$

$F = 15.696$

$T = F * R \; [R = 0.09]$

$T = 15.696 \times 0.09$

$T = 1.412$ N-M

Input power $= I_L \times V_L$

$= 40 \times 220$

$= 880W$

Output power $= \frac{2\pi NT}{60}$

$= \frac{2 \times 3.14 \times 1422 \times 1.412}{60}$

$= 210.156W$.

Efficiency $= \frac{\text{output power}}{\text{Input power}} \times 100$

$= \frac{210.156}{880} \times 100$

$= 0.23881 \times 100$

$= 23.88\%$

Result:- Thus, the performance characteristics of DC shunt motor was obtained by conducting brake test.

OBSERVATION:-

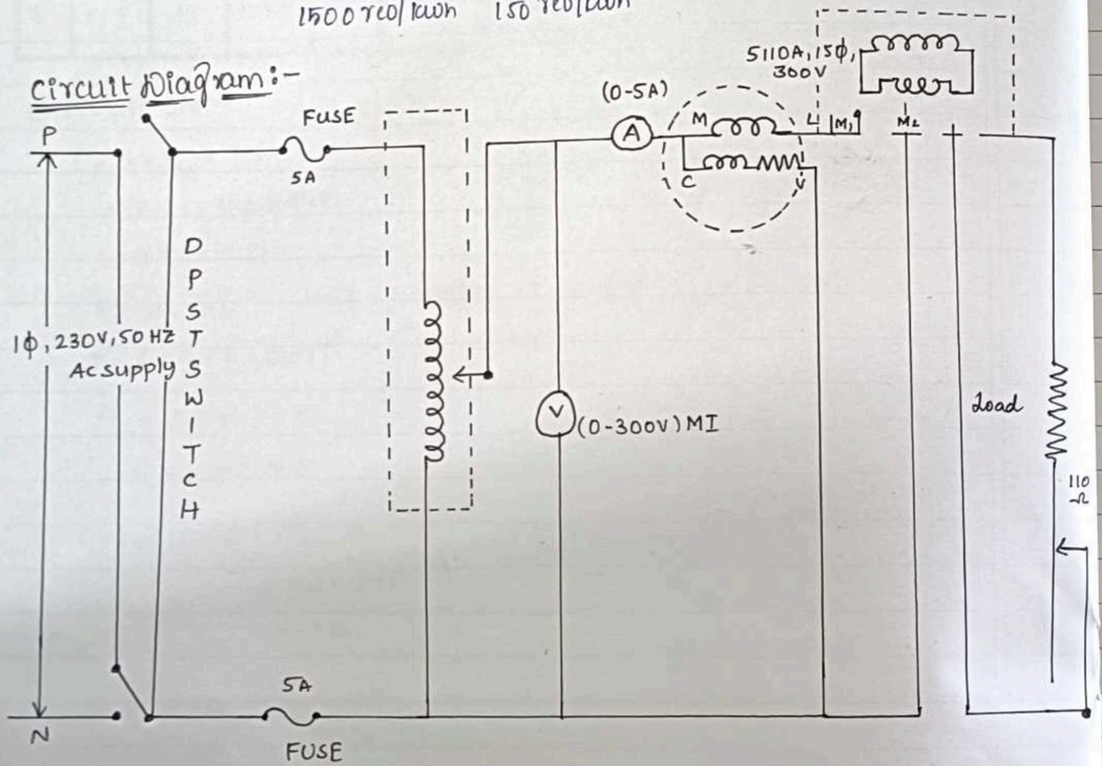
S.NO	line voltage V_L(V)	Line current I_L(A)	Time taken for 10 revolutions (sec)	no. of revolution (n)	Energy calculations (kwh)	Measure Energy (kwh)
1	230	1	85sec	10	5.43×10^{-3}	6.66×10^{-3}
2	225	3	38sec	10	7.125×10^{-3}	6.66×10^{-3}

Model calculations:-

calculated Energy $= \frac{V \times I \times t}{3600} = \frac{5.43}{1000} = 5.43 \times 10^{-3}$ kwh.

Measured Energy $= \frac{n}{1500 \text{ rev/kwh}} = \frac{16 \text{ rev}}{150 \text{ rev/kwh}} = 6.66 \times 10^{-3}$ kwh.

Circuit Diagram:-



12. Calculation of Energy consumption using Energy Meter.

Aim:- To calibrate and test the given Single phase Energy meter.

Apparatus Required:-

S.NO.	Name	Range	Quantity
1.	Single phase Energy Meter	1500REV	1
2.	Wattmeter	UPF	300V
3.	Voltmeter	MI	(0-50)A
4.	Ammeter	MI	(0-5)A
5.	Single phase variac	1-ϕ	230A
6.	Rheostat	WW	100Ω, 15A
7.	Stop watch	-	1

Theory:-

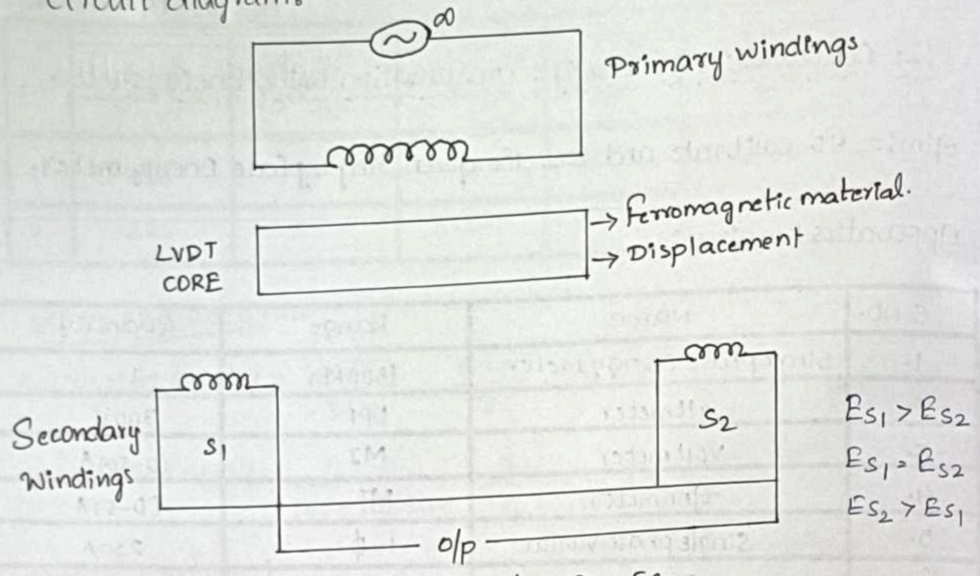
Induction type of Energy meters are universally used for measuring of Energy in domestic and industrial Ac circuits Industrial type of meters posses lower fritch and higher torque.

procedure:-

1. Connection is made as per the circuit diagram
2. Keep the Single phase variac at zero volt position
3. Vary the voltage to rated voltage and variac to zero volt position
4. Calculate the readings.

Result:- Thus, the given Single phase Energy meter is tested at the different loads.

circuit diagram:-



$o/p = E_{S_1} - E_{S_2}$

observations:-

S.NO	Displacement (mm)	voltage (V)
1.	0	5.58
2.	1	4.95
3.	2	4.35
4.	3	3.76
5.	4	3.11
6.	5	2.38
7.	6	1.76
8.	7	1.00
9.	8	0.48
10.	9	-0.17
11.	10	-0.85

13. Output Characteristics of LVDT.

Aim:- To plot the output characteristics of LVDT.

Apparatus Required:-

S.NO	Name	Quantity
1.	LVDT KIT	1
2.	MULTIMETER	1
3.	CONNECTING WIRES	-

Theory:-

The linear variable Differential Transformer (LVDT) is an electro-mechanical Transformer used to convert linear displacement to an electrical signal.

Procedure:-

1. connect as per diagram.
2. switch on the power and make the core NULL.
3. first turn the nut in clock-wise direction, move core inwards
4. Take the readings.

Result:-

Thus, the output characteristics of LVDT is noted.

14. find stability of a system using Routh Hurwitz criterion.

Aim:- To determine the stability of the closed-loop System using Routh Hurwitz criterion.

for: (i). (S) = $s^4 + 2s^2 + 3s^2 + 4s + 5$ and

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

Tools:- SCILAB SOFTWARE & PC.

Program code:-

```
clear;
clc;
xdel(winsid());
mode(0);
s=%s;
H= s^4+s*s^3+3*s^2+4*s+5;
disp(H, "The given characteristics Equations 1-G(S) H(S)");
C= coeff(H);
len= length(c);
r= routh-t(H);
disp(r,"Routh 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 seen that the system is unstable");
else
printf("From Rouths table; it is evident that the system is stable");
```

End.

Result:- Thus, the stability of a system using routh hurwitz criterion is verified.

Observation:-

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

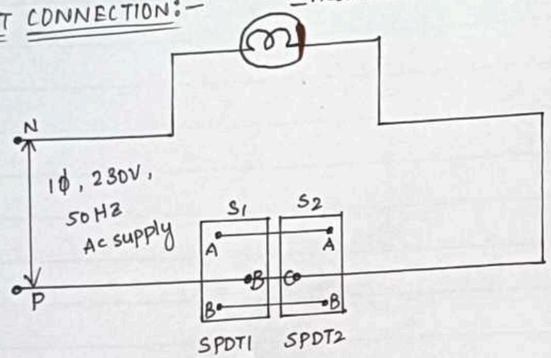
Indirect connection:-

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

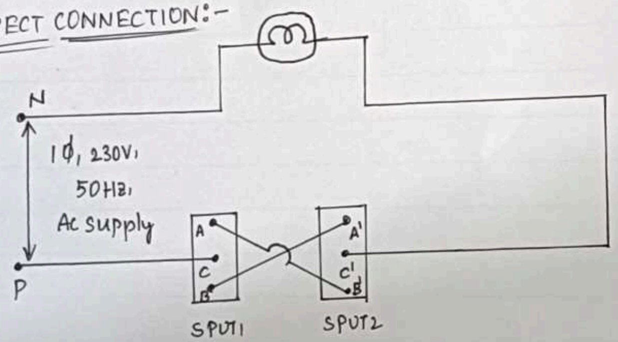
Circuit Diagram:-

DIRECT CONNECTION:-

Incandescent Lamp (40W/60W)



INDIRECT CONNECTION:-



15. STAIRCASE WIRING

(a.)

Aim:- To control the status of the lamp using a two-way switches.

Apparatus required:-

S.NO.	Name	Range	Quantity
1.	Incandescent lamp	60W/40W	1
2.	SPDT, Throw 2-way switch	5A, 230V	2
3.	Lamp holder	Pendant type	1
4.	Line Tester	500V	1
5.	3 pin plug	5A, 230V	1
6.	Wire stripper	PYE 950	1

Theory:-

Staircase wiring is a common multi-way switching connection are one lamp is connected by 2-switches from two different position that is to operate from above the stairs and below.

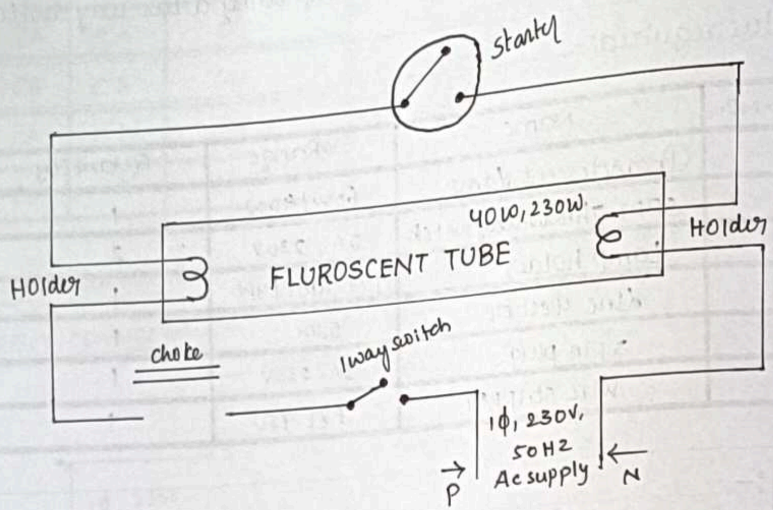
Procedure:-

1. A wire is connected to the phase side and other side to the mid point of SPDT switch.
2. Another point of lamp holder is connected to the neutral wire.
3. Upper point of SPDT switch is connected to switch 2 and lower point of switch 2 to switch 1.

Result:-

Thus, the given lamp was controlled by direct and indirect connections using 2-way switches.

Circuit Diagram:-



16. FLUORESCENT TUBE WIRING.

(b).

Aim:- To prepare wiring for a flurorcent tube light with switch control.

Apparatus Required:-

S.NO.	Name	Quantity
1.	Tubelight with fittings	1
2.	Joint clips & wires	Required
3.	Switch	1
4.	Screws	Required

Theory:-

The furoscent lamp circuit consists of a choke a starter, a furoscent of the commonly used furoscent tube is 100cm.

procedure:-

1. Draw the wires on the wooden board.
2. place the wires on the lines and fix with clips.
3. fix switch & Tube light in marked positions.
4. complete wirings as per diagram.

Result:-

Thus, the wiring for the tube light is completed and also tested.

16. Generation of common Discrete time signals.

Aim:- To Generate impulse Signals, unit step signals, unit Ramp signals. Sinusoidal signals and Exponential signals.

Software required:- Scilab 6.1.0

Procedure:-

1. Start the Scilab program.
2. open Scinotes, type the program & Save it.
3. Compile & Run the program
4. Stop the program.

Theory:-

unit step signals v[n]:- It is a basic discrete time signal that takes the value 1 (n>=0) for non-negative time indices.

Impulse signal:- Also known as the discrete-time delta function. It has a value of 1 at n=0 & is 0 for other indices.

Exponential signals:- Defined as x[n] = A *α^n, where A is amplitude, α is Exponential factor and depending on whether α is greater or less than 1, the signal grows or delays.

Sinusoidal signals:- It has the form x[n] = A * cos (wn+ϕ). where A is amplitude. w is angular frequency & n is time.

program:-

unit step:

```
t=-5:0.1:5;
y=zeros(1,length(t));
y(t>=0)=1;
plot(t,y,"line-width",2);
xlabel("time(t)");
ylabel("u(t)");
```

Exponential:

```
t=0:0.1:10;
x=exp(t);
plot(t,x);
title("Exponential wave);
xlabel('t');
ylabel('x');
```

RAMP:

```
t=0:0.1:10;
ramp=t;
plot(t,ramp);
xlabel("time(t)");
ylabel("Amplitude");
```

Impulse:

```
t=-5:0.1:5;
impulse=zeros(t);
impulse(t==0)=1;
plot(t,impulse);
xlabel("Time");
ylabel("Amplitude");
```

Sinusoidal:

```
f=50%
t=0:0.001:0.02;
x=sin(2*%pi*t*f);
plot(t,x)
xlabel('t');
ylabel('x';
```

Result:-

Thus, the discrete-time signals were successfully generated.

17. DIT-FFT & DIF-FFT ALGORITHMS.

[a]. DIT-FFT:-

Aim:- To compute the DFT for sequence
$x[n] = [1,-1,-1,-1,1,1,1,-1]$ using DIT-FFT Algorithm.

Software Required: Scilab 6.1.0.

procedure:-
1. start the scilab program.
2. open scinotes & type the program.
3. compile and run the program.
4. observe and Record output, stop the program.

Theory:

The decimation in-Time fast fourier Transform (DIT-FFT) algorithm is a method to compute the discrete fourier transformation of a sequence.

$$X[K] = \sum_{n=0}^{N-1} x[n], e^{\frac{-j2\pi kn}{N}}, \quad (N = 0,1,2 \cdots N-1)$$

program:-
```
clear;
clc;
close;
x=[1,-1,-1,-1,1,1,1,-1];
x=fft(x,-1);
disp(x,x'(z)=1);
```

Result:-

Thus, the DFT for the given sequence is Implemented and Observed.

17.

[b]. DIF-FFT:-

Aim:- To compute the DFT of the sequence $x[n] = [1,2,3,4,4,3,2,1]$ using the decimation-in frequency FFT.

procedure:

1. Start the scilab program.
2. open scinotes and type the code.
3. compile & Run the program.
4. observe the output & stop the program.

Theory:-

DIF-FFT Algorithm is used for computing the discrete fourier transformation (DFT). complexity is Expressed.

$$X[K] = \sum_{n=0}^{N-1} x[n] \cdot e^{-j\frac{2\pi kn}{N}}, \quad K = 0,1,2 \ldots N-1$$

program:-

```
clear;
clc;
close;
x=[1,2,3,4,4,3,2,1];
//FFT computationn
X=FFT(x,-1);
disp(X, x'(z)=1);
```

Result:-

Thus, the DFT of the sequence $x[n] = [1,2,3,4,4,3,2,1]$ using DFT-FFT Algorithm.

18. Bilinear and Impulse invariant Transform.

[a]. Bilinear:-

Aim:- To convert the continuous-time analysis transfer function H[S] = S^2 + 4.525S2 + 0.692S^2 + 0.504 into discrete time transfer function using bilinear transformation.

procedure:-

1. Start the scilab program.
2. open scinotes and type the program
3. compile and Run the program.
4. Records the output and stop the program.

Theory:-

The digital signal processings convertion, an analog filter design into discrete filter which is crucial for Implementing filters.

program:-

```
Clear;
clc;
close;
S = %.S;
Z = %.Z;
Hs = (S^2 + 4.5) | (S^2 + 0.692 * s + 0.504);
T=1;
Hz = horner (Hs, (2/T) * (z-1)/(z+1));
disp (Hz, 'H(z) = ');
```

Result:-

Thus, DTTF is obtained after apply the bilinear transformation

18. [b]. Impulsive Invariant transformation.

Aim:- To convert the continous time, analog transfer functions: H(s) = 10/(s^2 + 7*s +10) into discrete time digital transfer functions.

procedure:-

1. start the scilab program.
2. open the scinotes & type the program.
3. compile & Run the program.
4. Record the output & exit.

program:-

```
clear;
clc;
close
s = %s;
T = 0.2;
Hs = 10/(s^2 +7*s +10);
e Hs = pfss(Hs);
disp(eHs, 'Factorized Hs = ');
p1 = -5;
p2 = -2;
z = %z;
Hz = T* ((-3.33)(1-%e^(p1*T)* z^(-1))) +(3.33/(1-%e^(p2*T)*
                                                   z^(-1)));
disp (Hz, 'Hz =');
Ts = 0.01;
s = tf('s');
sys = (10/s^2 +7* (s+10));
sysd = c2d, (sys, Ts, zoh]
tf(sysd)
step (sysd, 10)
Guid on
```

Result:-

Thus the discrete time transfer function is obtained.

19. Analog Butterworth filter.

[a]:

Aim:- To design a butterworth filter for processing audio signals that alternates frequencies above 0.2.

procedure:-

1. open the scilab software
2. open scinotes & type the program & compile.
3. Record the output and Exit.

Theory:-

The butter worth low pass filter is most used, type of analog filter that is known for it's maximum frequency response.

program:-

```
clear;
clc;
close
s=poly (0,'s');
Omegac = 0.2* %pi;
H= omegac/(s+omega);
z=poly (0,'z');
W= (0:%pi/511: %pi);
plot (W/% %pi,HN)
a=gca();
xgrid (1)
disp("HZ", HZ);
```

Result:- Thus, the butter worth filter has successfully altered frequencies above 0.2

15.[b]. Aim:- To design a butter worth high-pass filter for a digital audio processes.

Software Required: scilab 6.1.0

Procedure:-

1. Start the scilab program
2. open scinotes, type the program and compile it.
3. Record the output and Exit.

Program:-

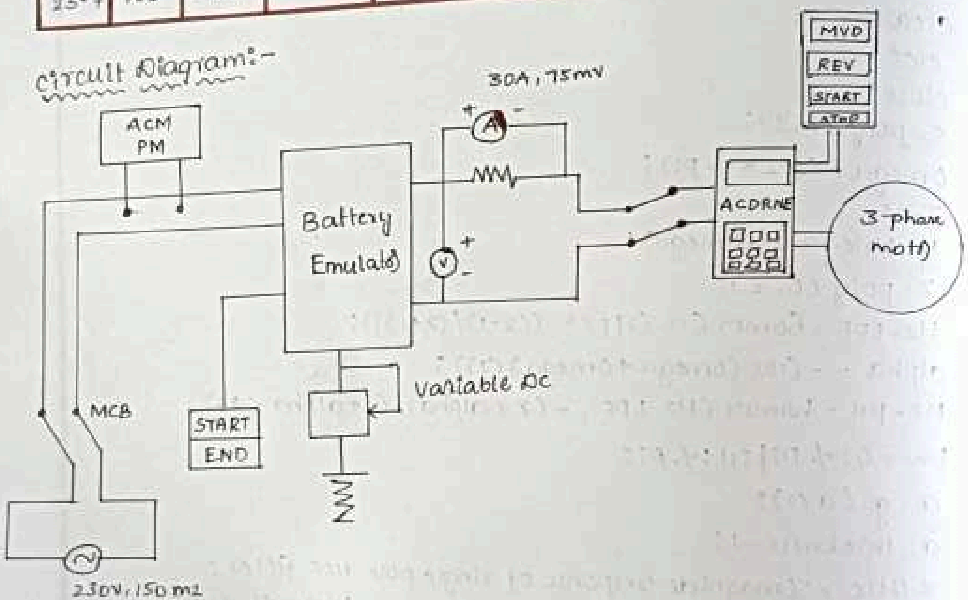
```
clear;
clc;
close;
s = poly (0,'s');
omega = (0.2 * %pi);
T=1;
H= omega /(s+omega);
z= poly (0, 'z');
HZ-LPF = horner (H, (2/T) * ((z-1)/(z+1)));
alpha = -(cos (omega+omega) (2));
HZ-PH = horner (HZ, LPF , -(z+alpha)/(1+alpha * 2))
HW = 0: %pi/511 : %pi;
a= g (a());
a, thickness =1;
x title = "(magnide response of single pole HPF filter;
                                          'magnitude');
```

Result:- Thus, the butter worth high-pass-filter for a digital audio process is successfully designed & Executed.

Tabulation:-

F (f)	V (v)	Ratio (V/F)	RPM $N_S = \frac{120f}{P}$	Tacho meter RPM	slip	No.of poles	Synchronous speed@50Hz	Synchronous speed@60Hz
8.6	40	4.6	258.6	250	0.033	2	3000	2600
12.3	56	4.5	370.8	370	0.02	4	1100	1800
14.5	65	4.4	436.5	436	0.01	6	1000	1200
18.2	82	4.4	548.7	548	0.001	8	780	900
23.7	106	4.4	713.7	713	0.0001	12	500	600

Circuit Diagram:-



20. THREE-PHASE INDUCTION MOTOR DRIVE SYSTEM.

Aim:- To study the function of three-phase induction motor drive system in auto mobiles.

Apparatus Required:-

S.NO.	Name	Quantity
1.	Three phase Induction motor	1
2.	Panel with DC Voltmeter, DC ammeter, AC ammeter	1
3.	Battery Emulator	1
4.	Human Machine Interface	1
5.	12V Alternator batteries for loader	1

Procedure:-

1. Give the AC supply to meter [5]. Battery Emulator
2. Fully rotate potentiometer of DC control
3. select forward mode using HM.
4. Vary the frequency using VFD
5. Calculate the different values given

Caution:-

→ Dont connect overload supply
→ check proper connection
→ Dont overload motor

Result:-

Thus, functions of three phase Induction motor Drive system is observed successfully.