DMI COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING LABORATORY MANUAL

REG NO	
CLASS	**I YEAR MECHANICAL**
SEMESTER	**II SEM**
SUBJECT CODE	**BE - 8261**

BE - 8261

BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING LABORATORY MANUAL

LIST OF EXPERIMENTS

BE 8261 - BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING LABORATORY

1. Load test on separately excited DC generator
2. Load test on Single phase Transformer
3. Load test on Induction motor
4. Verification of Circuit Laws
5. Verification of Circuit Theorems
6. Measurement of three phase power
7. Load test on DC shunt motor.
8. Diode based application circuits
9. Transistor based application circuits
10. Study of CRO and measurement of AC signals
11. Characteristics of LVDT
12. Calibration of Rotometer
13. RTD and Thermistor.

LIST OF EXPERIMENTS

CYCLE 1:

1. Verification of Circuit Laws
2. Verification of Circuit Theorems
3. Load test on Single phase Transformer
4. Load test on Single phase Induction motor
5. Load test on DC shunt motor.
6. Temperature Transducer

CYCLE 2:

7. Load test on separately excited DC generator
8. Measurement of three phase power
9. Diode based application circuits
10. Transistor based application circuits
11. Study of CRO and measurement of AC signals
12. Characteristics of LVDT
13. Calibration of Rotometer

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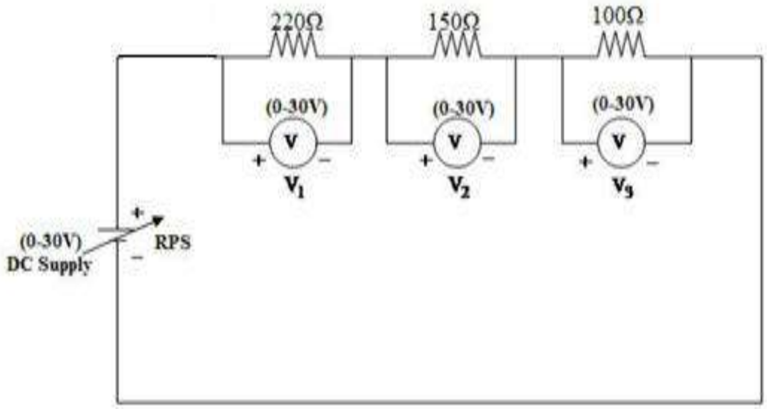
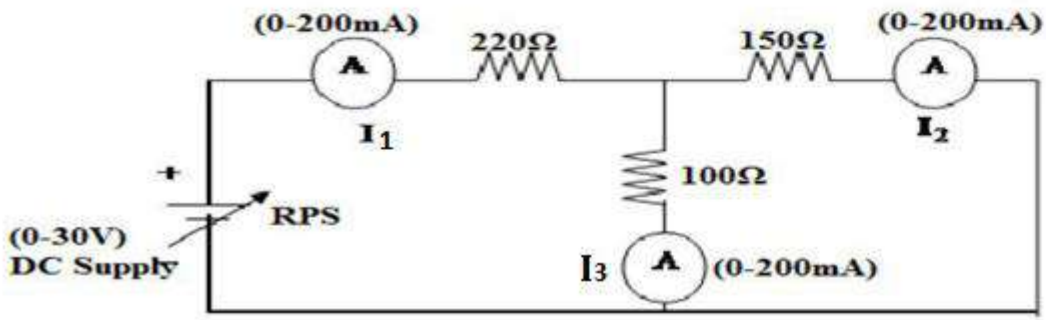
S.No	Date	Experiment Name	Marks	Staff Sign

CIRCUIT DIAGRAMS:



Figure–1.1Verification of KVL



Figure–1.2 Verification of KCL

OBSERVATIONS:

For KVL

Applied Voltage V (volts)	V_1(volts)		V_2(volts)		V_3(volts)		$V_1+V_2+V_3$(volts)	
	Theoritical	Practical	Theoritical	Practical	Theoritical	Practical	Theoritical	Practical

For KCL

Applied Voltage V (volts)	I_1(A)		I_2 (A)		I_3(A)		I_2+I_3(A)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

Ex.No:1 **<u>VERIFICATION OF KVL AND KCL</u>**

Date:

AIM:

To verify Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL) in a Passive Resistive Network .

APPARATUS:

S.No	Apparatus Name	Range	Type	Quantity
1	RPS			
2	Ammeter			
3	Voltmeter			
4	Resistors			
5	Bread Board	-	-	01
6	Connecting Wires	-	-	As required

THEORITICAL CALCULATION:

PRECAUTIONS:

1.Check for proper connections before switching ON the supply

2.Make sure of proper color coding of resistors

3.The terminal of the resistance should be properly connected.

PROCEDURE:

To Verify KVL

1. Connect the circuit diagram as shown in Figure 1.1
2. Switch ON the supply to RPS.
3. Apply the voltage (say 5v) and note the voltmeter readings.
4. Gradually increase the supply voltage in steps.
5. Note the readings of voltmeters.
6. Sum up the voltmeter readings (voltage drops) , that should be equal to applied voltage .
7. Thus KVL is Verified practically.

To Verify KCL

1. Connect the circuit diagram as shown in Figure 1.2.
2. Switch ON the supply to RPS.
3. Apply the voltage (say 5v) and note the Ammeter readings.
4. Gradually increase the supply voltage in steps.
5. Note the readings of Ammeters.
6. Sum up the Ammeter readings ($I_1$and I_2) , that should be equal to total current(I).
7. Thus KCL is Verified practically

RESULT:

CIRCUIT DIAGRAM:

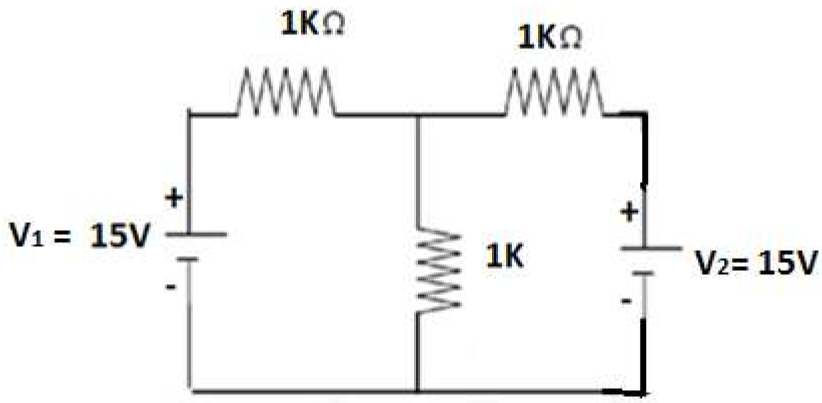


Fig-1 Actual Circuit

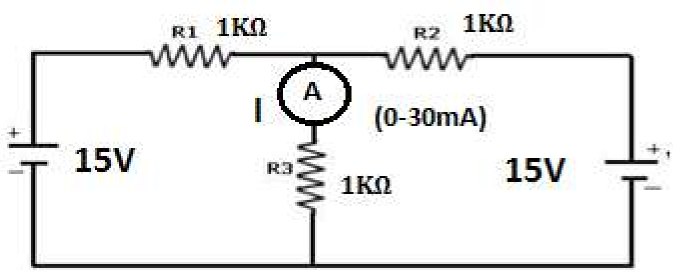


Fig-2 Both Voltage Sources are acting (V1&V2)

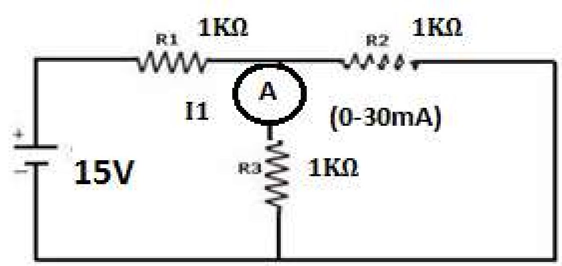


Fig -3 Voltage Source V1is acting Alone

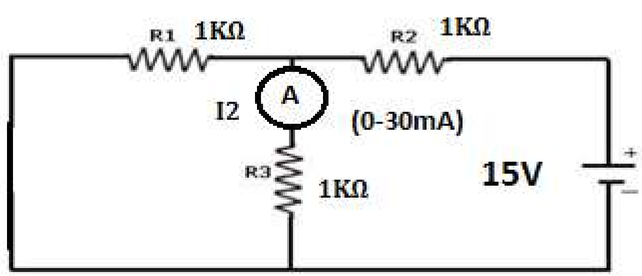


Fig -4 VoltageSource$V_2$is acting alone

Ex.No:2A **VERIFICATION OF SUPERPOSITION THEOREM**

Date:

AIM:

To Verify principle of Superposition theoretically and practically.

STATEMENT:

In an linear, bilateral network the response in any element is equal to sum of individual responses While all other sources are non-operative.

APPARATUS REQUIRED:

S.No.	Equipment	Range	Type	Quantity
1.	Resistors	-	-	
2.	Ammeter			
3.	R.P.S			
4.	Bread Board	-	-	
5.	Connecting Wires			required

TABULAR COLUMN:

PARAMETERS	WHEN BOTH V1 &V2≠0 (I)	WHEN V1≠0 &V2=0 (I_1)	WHEN V1=0&V2≠0 (I_2)	$I=I_1+I_2$
Current through R3(Theoretical Values)				
Current through R3(Practical Values)				

THEORITICAL CALCULATION:

PRECAUTIONS:

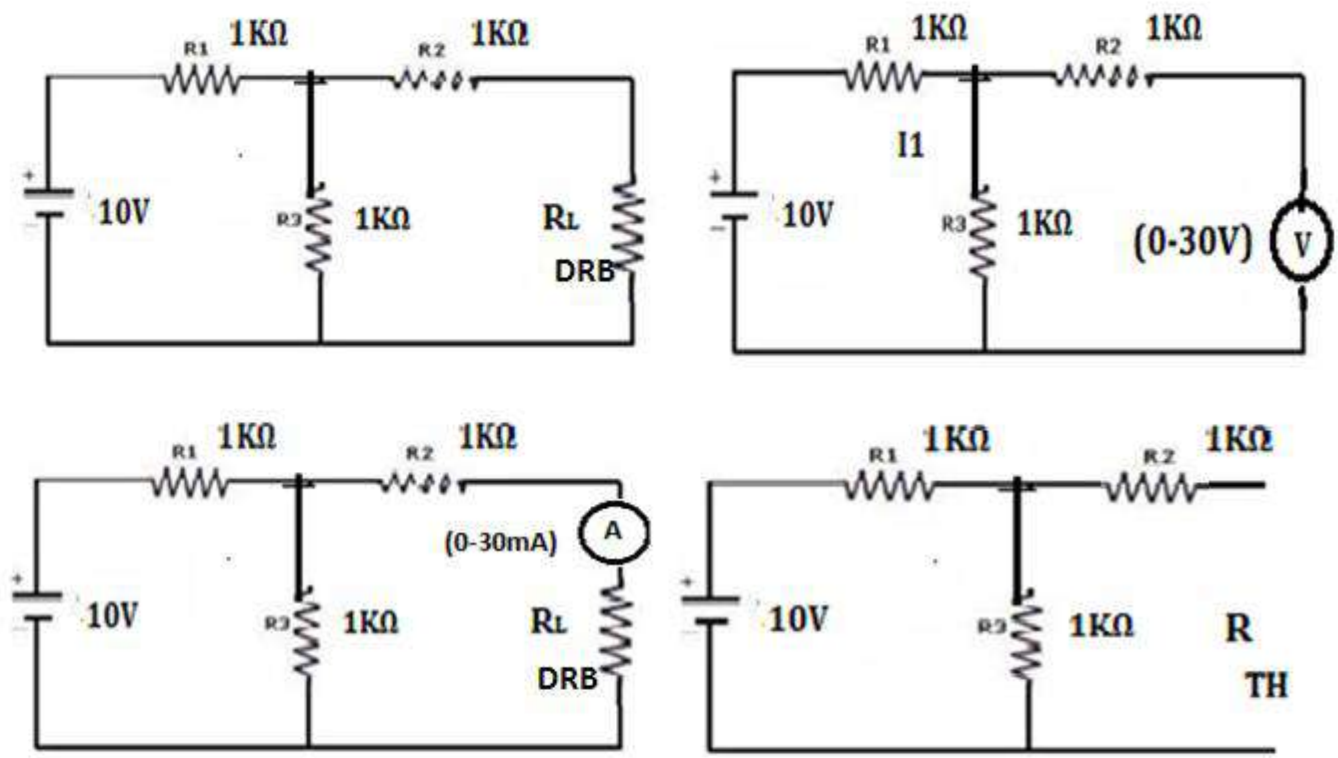
1. Check for proper connections before switching ON the supply
2. Make sure of proper color coding of resistors
3. The terminal of the resistance should be properly connected

PROCEDURE:

4. Connect the circuit as shown in figure (2) and note down the current flowing through $R_3$and let it be I.
5. Connect the circuit as shown in figure (3) and note down the ammeter Reading, and let it be $I_{1.}$
6. Connect the circuit as shown in figure (4) and note down the ammeter reading, and let it be I_2.
7. Verify for $I=I_1+I_2$.
8. Compare the practical and theoretical currents.

RESULT

CIRCUITDIAGRAM:



NOTE: USE R_L VALUE IN DRB

Maximum Power Transfer Circuit

TABULAR COLUMN:

Applied Voltage (V)	$R_L(\Omega)$	V_{TH}(v)		I_L (A)		Pmax = $I_L^2 * R_L$	
		Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

Ex.No:2B **VERIFICATION OF MAXIMUM POWER TRANSFER THEOREM**

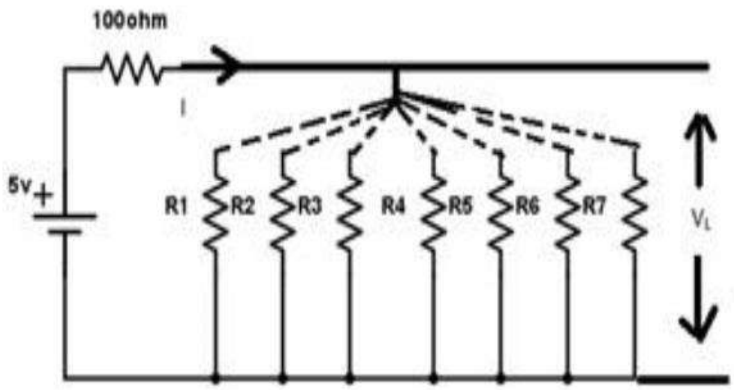
Date:

AIM:

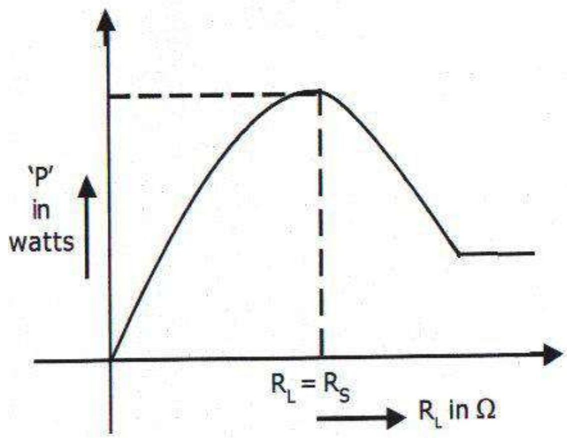
To design the load resistor which absorbs maximum power from source.

STATEMENT:

The maximum power transfer theorem states that maximum power is delivered from a source to an load resistance when the load resistance is equal to source resistance. (R_L=R_S is the condition required for maximum power transfer).



MODELGRAPH:



Output Graph of Maximum Power Transfer Theorem

THEORITICAL CALCULATION:

PRECAUTIONS:

1. Check for proper connections before switching ON the supply
2. Make sure of proper color coding of resistors
3. The terminal of the resistance should be properly connected

PROCEDURE:

1. Connect the circuit as shown in fig.
2. Vary the load resistance insteps and note down voltage across the load and current flowing through the circuit.
3. Calculate power delivered to the load by using formula P=V*I.
4. Draw the graph between resistance and power (resistance on X-axis and power on Y-axis).
5. Verify the maximum power is delivered to the load when R_L = Rs (i.e R_{th}) for DC.

RESULT

CIRCUIT DIAGRAM:

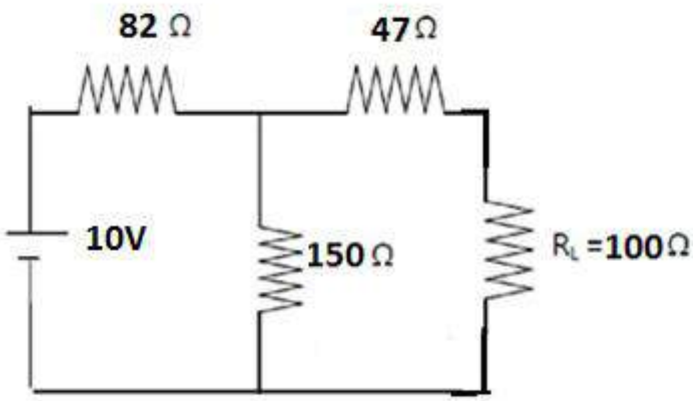
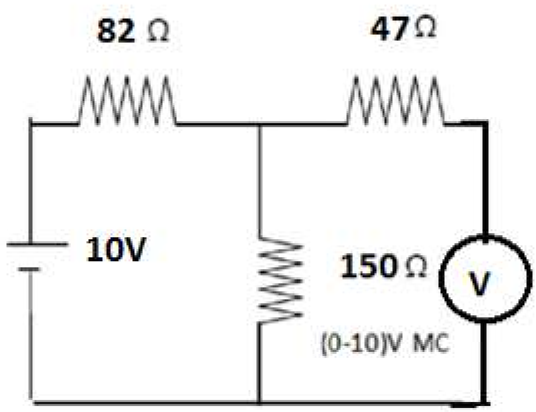


fig.1 Actual Circuit



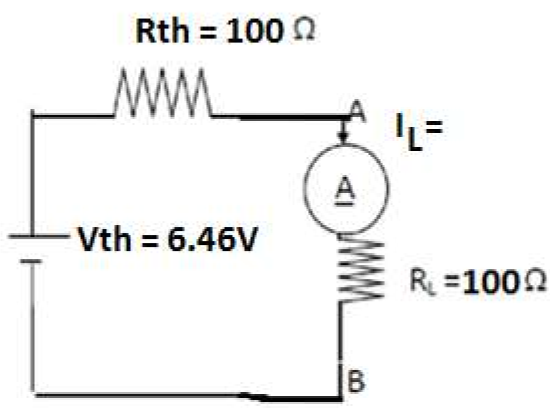
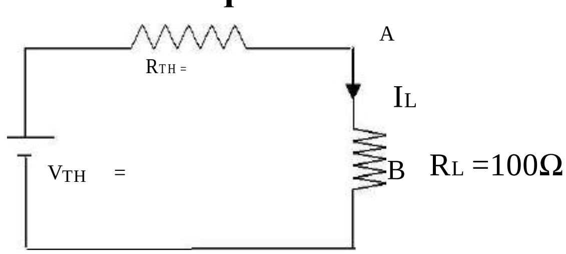


fig. 2 Measurement of V_{TH} or V_{OC} **fig.3 Measurement of I_L**

fig. 4 Thevenin's Equivalent Circuit:



Ex.No:2C VERIFICATION OF THEVENIN'S THEOREM

Date:

AIM:

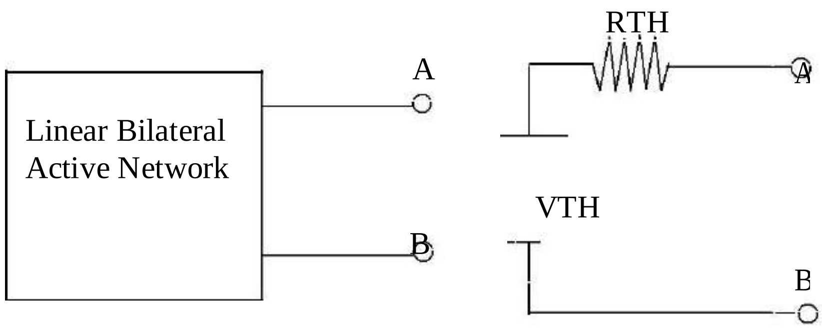
To Verify Thevenin's theorem.

APPARATUS:

S.No.	Equipment	Range	Type	Quantity
1	Ammeter			
2	Voltmeter			
3	R.P.S			
4	Bread Board			
5	Resistors			
6	Connecting Wires			As required

STATEMENT:

Any linear bilateral network with two output terminals AB can be replaced by a simple equivalent circuit with single voltage source Vth (Thevinin voltage or Open circuit voltage) in series with a single resistor Rth (Thevenin resistance) or impedance Zth (Thevenin's impedance in ac circuit).



Rth = Thevenin's Resistance (Equivalent resistance between A and B) in ohms
Vth = Thevenin's Resistance (Open circuit voltage between A and B) in volts
R_L = Load resistance connected between A and B in ohms
I_L = Load Current = Vth / (Rth + R_L) in amps

TABULAR COLUMN:

S.No	Theoretical Value		Practical Value	
	Thevenin's Voltage V_{TH} (V)	Current flowing through R_L (I_L)mA	Thevenin's Voltage V_{TH} (V)	Current flowing through R_L (I_L)mA

THEORETICAL CALCULATION:

PRECAUTIONS:

1. Check for proper connections before switching ON the supply
2. Make sure of proper color coding of resistors
3. The terminal of the resistance should be properly connected.

PROCEDURE:

1. Connect the circuit diagram as shown in fig.2.2
2. Measure open circuit voltage Voc by open circuiting terminals i.e, V_{th}
3. Connect the circuit as shown in fig2.3.
4. Measure current in R_L.
5. Draw the Thevenin's equivalent circuit as shown in fig2.4

RESULT:

CIRCUIT DIAGRAM:

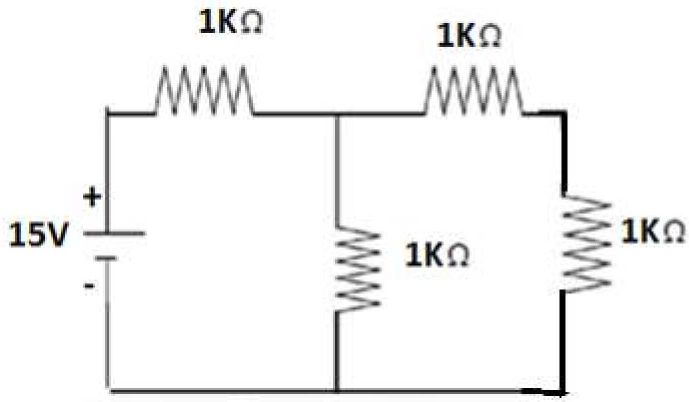


Fig –1 Actual Circuit

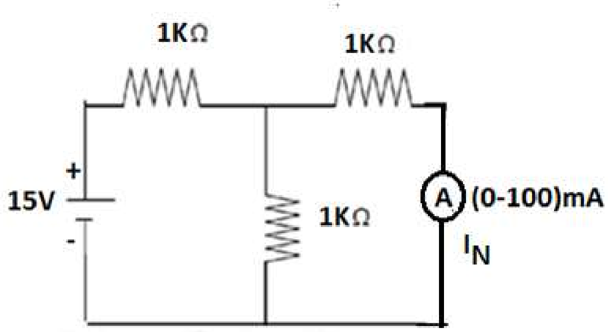


Fig –2 Norton's Current

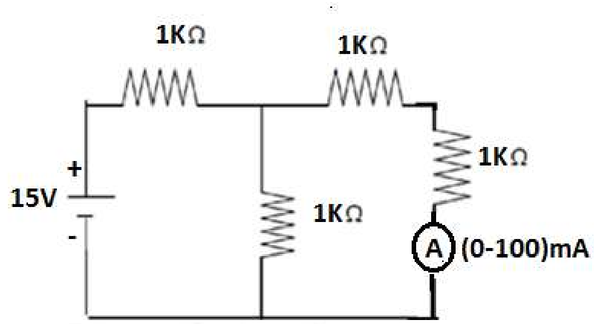


Fig –3 To find I_L

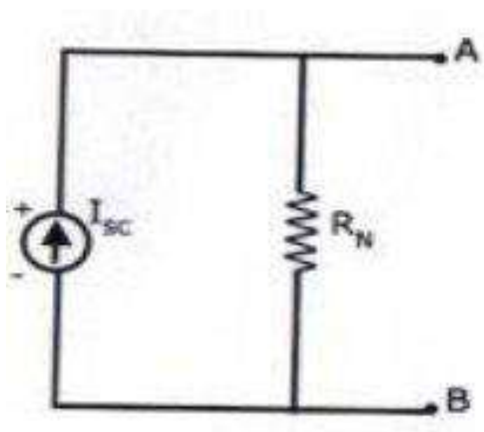


Fig – 4 Norton's Equivalent Circuit

Ex.No:2D **VERIFICATION OF NORTON'S THEOREM**

Date:

AIM:

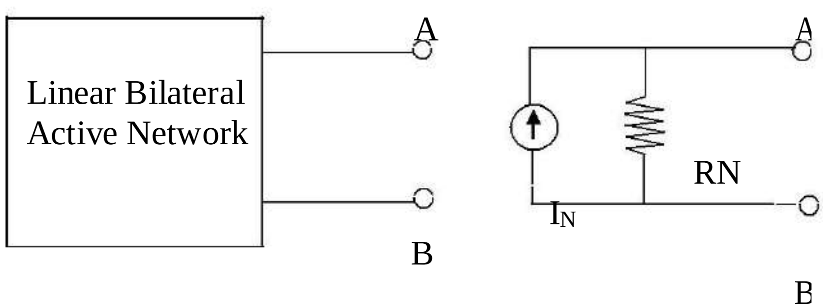
To verify Norton's theorem of given Network by experimental and simulation.

APPARATUS:

S. No.	Equipment	Range	Type	Quantity
1	Ammeter			
2	Voltmeter			
3	R.P.S			
4	Bread Board			
5	Resistors			
6	Connecting Wires			As required

STATEMENT

Any linear bilateral network with two output terminals AB can be replaced by a simple equivalent circuit with single current source IN or Isc (Norton's current or Short circuit current) in parallel with a single resistor RN(Norton resistance) or impedance ZN (Norton impedance) about the terminals AB.



R_N = Norton's Resistance (Equivalent resistance between A and B)
I_N = Norton's current (Short circuited path current through A and B)in milli amps
R_L = Load resistance connected between A and B in ohms
I_L = Load Current = $(I_N \times R_{th}) / (R_{th} + R_L)$ in milliamps

TABULATIONS:

S. No	Theoretical Value		Practical Value	
	Norton's current I_N (mA)	Load Current I_L (mA)	Norton's current I_N (mA)	Load Current I_L(mA)

THEORITICAL CALCULATION:

PRECAUTIONS:

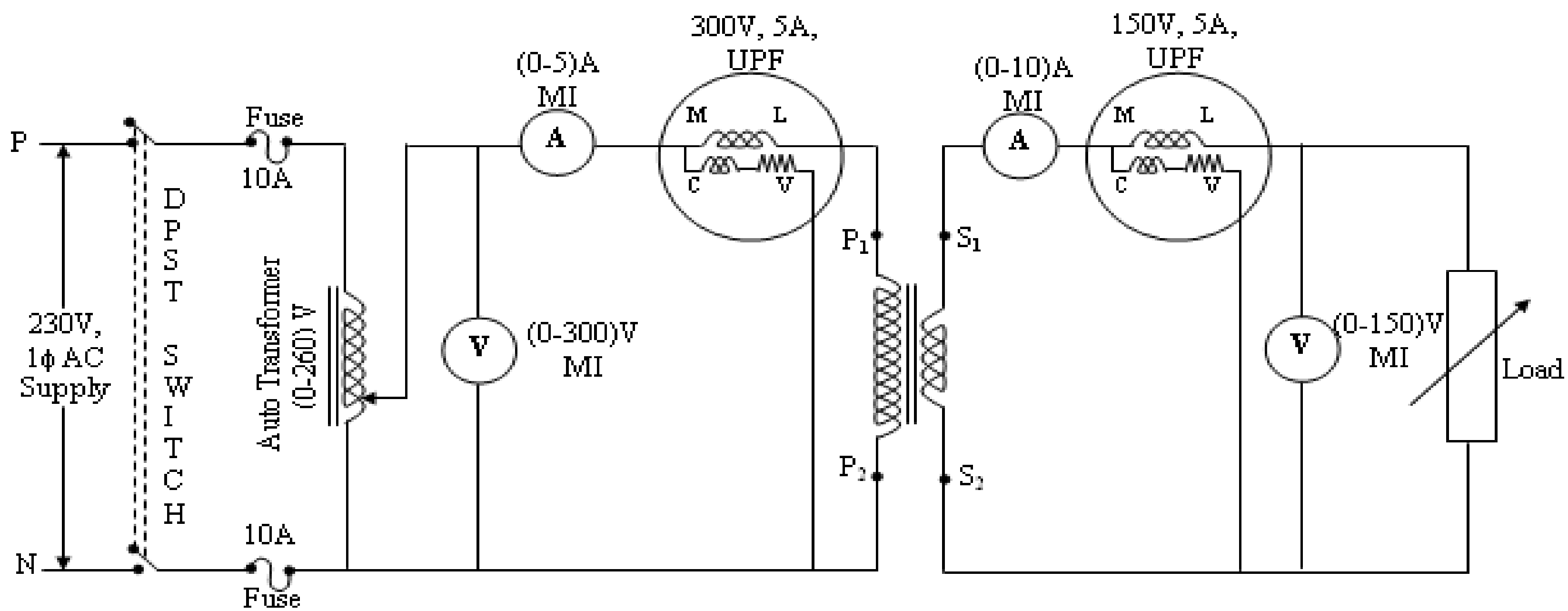
1. Check for proper connections before switching ON the supply
2. Make sure of proper color coding of resistors
3. The terminal of the resistance should be properly connected

EXPERIMENTAL PROCEDURE:

1. Connect the circuit diagram as shown infig.2.
2. Measure the current I_{SC} (or) I_N through AB by short-circuiting the resistance between A and B.
3. Connect the circuit diagram as shown infig.3.
4. Measure the load current I_L.
5. Draw Norton's equivalent circuit by connecting I_N& $R_N$in parallel as showninfig.4 and find loadcurrent.

RESULT:

CIRCUIT DIAGRAM:



FUSE RATING:

125% of rated current

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

NAME PLATE DETAILS:

	Primary	Secondary
Rated Voltage :	230V	115V
Rated Current :	5A	10 A
Rated Power :	1KVA	1KVA

Ex.No:3 LOAD TEST ON A SINGLE PHASE TRANSFORMER

Date:

AIM:

To conduct load test on single phase transformer and to find efficiency and percentage regulation.

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

FORMULAE:

Output Power = W_2 x Multiplication factor

Input Power = W_1 x Multiplication factor

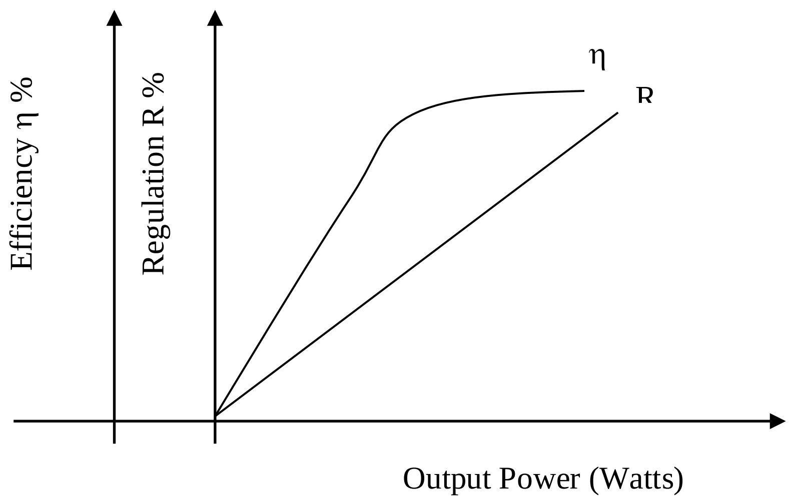
$$\text{Efficiency } \eta \% = \frac{\text{Output Power}}{\text{Input Power}} \times 100\%$$

$$\text{Regulation R } \% = \frac{V_{NL} - V_{FL} \text{ (Secondary)}}{V_{NL}} \times 100\%$$

TABULAR COLUMN:

S. No.	Load	Primary			Secondary			Input Power W_1 x MF	Output Power W_2 x MF	Efficiency η %	% Regulation
		V_1 (Volts)	I_1 (Amp)	W_1 (Watt)	V_2 (Volt)	I_2 (Amp)	W_2 (Watt)				
1.											
2.											
3.											
4.											
5.											
6.											
7.											
8											

MODEL GRAPHS:



PRECAUTIONS:

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

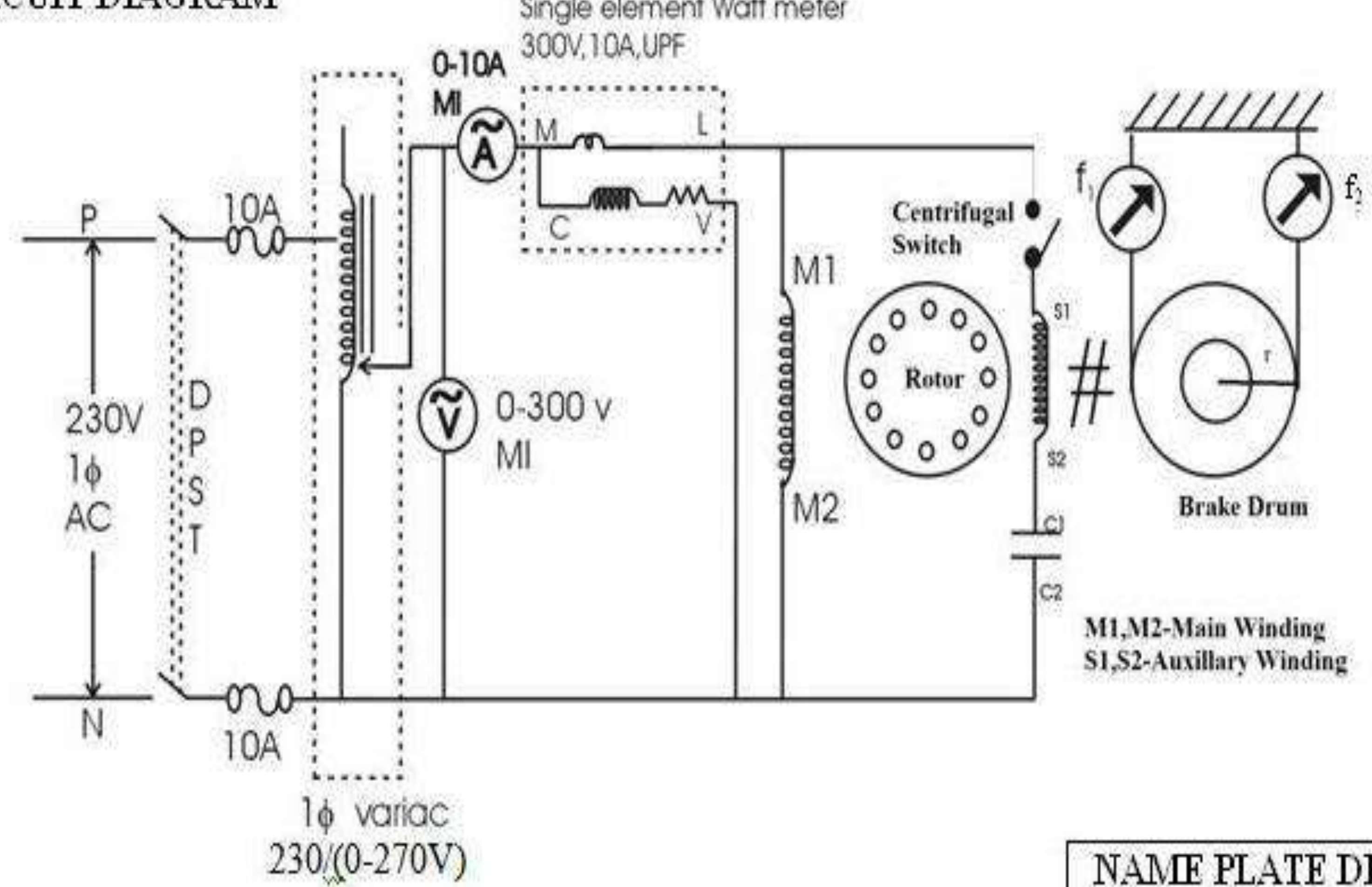
PROCEDURE:

1. Connections are made as per the circuit diagram.
2. After checking the no load condition, minimum position of auto transformer and DPST switch is closed.
3. Ammeter, Voltmeter and Wattmeter readings on both primary side and secondary side are noted.
4. The load is increased and for each load, Voltmeter, Ammeter and Wattmeter readings on both primary and secondary sides are noted.
5. Again no load condition is obtained and DPST switch is opened.

RESULT:

Thus the load test on single phase transformer is conducted.

CIRCUIT DIAGRAM



NAME PLATE DETAILS:

CAPACITY:
VOLTAGE:
CURRENT:
SPEED:

Ex.No:4 LOAD TEST ON SINGLE PHASE INDUCTION MOTOR

Date:

AIM:

To conduct the load on single-phase induction motor & to draw its performance characteristics.

APPARATUS REQUIRED:

S.No	Name of the Apparatus	Range	Type	Quantity
1	Ammeter	(0 – 10A)	MI	1
2	Voltmeter	(0 – 300)V	MI	1
3	Wattmeter	300V,10A	UPF	2
4	1 Phase auto transformer	230V/0-270V	-	1
5	Tachometer	_	-	1
6	Connecting Wires	_	_	1 Set

THEORY:

The single phase induction motor is more or less a polyphase induction motor. The only difference is that is given supply in single phase. This motor connect and motor function without any initial start the motor having some part which is called starter and rotor. These are two types of starting a 1 phase induction motor namely capacitor-start and other is split-phase. These motors are widely used in domestic purpose.

FORMULA USED:

1. Torque T=9.81x(f1~ f2) x r (N-M)
2. Output Power = 2ΠNT / 60
3. Input Power =WL (Wattmeter readings in Watts)
4. % Slip =(NS-N) / (NS) x 100
   Where, N_S = Synchronous speed = 1500 rpm.
5. Power factor = Input Power / VL IL
6. Efficiency = (Output Power / Input Power) x 100

OBSERVATION TABULATION:

Sl. No	Line Voltage V_L(Amps)	Line Current I_L(Amps)	Input Power Pi (Watts)		Speed N(rpm)	Spring Balance Reading	
			Reading	Actual		F_1 (kg)	F_2 (kg)

CALCULATION TABULATION:

S.No	Line current I_L(Amps)	p.f	Torque (N.m)	% Slip	Output Power P_0(Watts)	Input Power Pi (Watts)	% Efficiency η

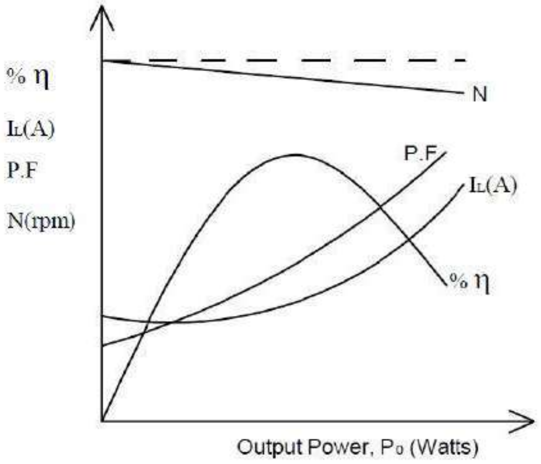
PRECAUTIONS:

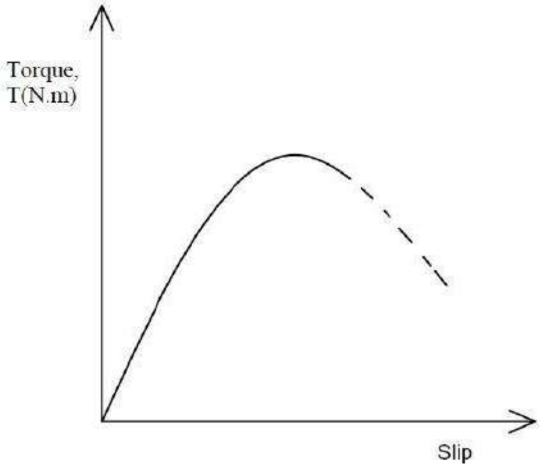
1. Fuses are checked out
2. Initially the motor should be in no load condition
3. The variac should be in minimum position

PROCEDURE:

1. Connections are given as per the circuit diagram
2. The supply is switched on
3. By adjusting the variac, set the rated voltage across the motor
4. By applying the load take various reading until rated load

MODEL GRAPHS:

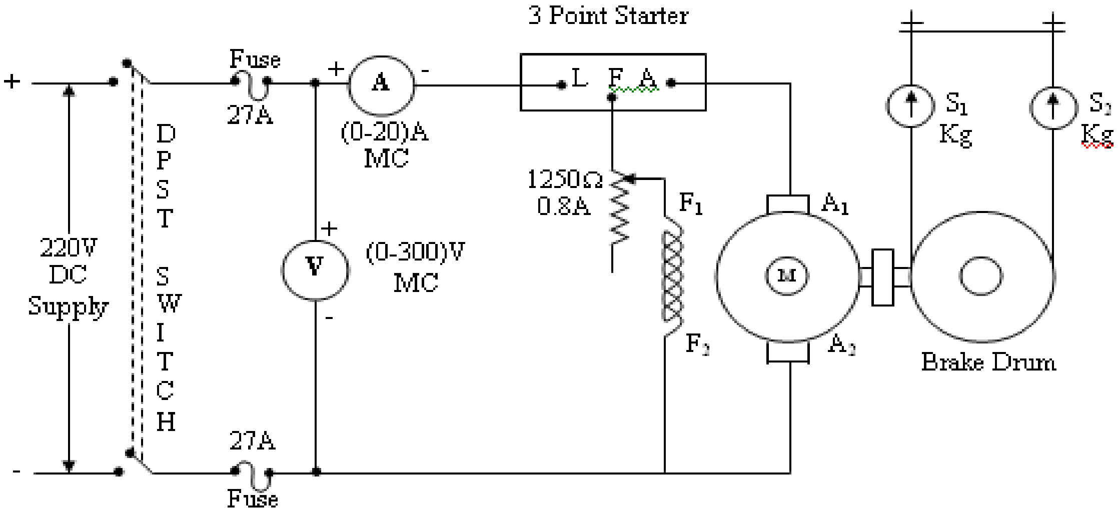




MODEL CALCULATION:

RESULT:

CIRCUIT DIAGRAM:



FUSE RATING:

125% of rated current

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

NAME PLATE DETAILS:

Rated Voltage : 220V
Rated Current : 21A
Rated Power : 3.5KW
Rated Speed : 1500 RPM

Ex.No:5 LOAD TEST ON DC SHUNT MOTOR

Date:

AIM:

To conduct load test on DC shunt motor and to find efficiency.

APPARATUS REQUIRED:

S.No.	Apparatus	Range	Type	Quantity
1	Ammeter	(0-20)A	MC	1
2	Voltmeter	(0-300)V	MC	1
3	Rheostat	1250Ω, 0.8A	Wire Wound	1
4	Tachometer	(0-1500) rpm	Digital	1
5	Connecting Wires	2.5sq.mm.	Copper	Few

FORMULAE:

$$R = \frac{\text{Circumference}}{100 \times 2\pi} \text{ m}$$

Torque T = $(S_1 \sim S_2) \times R \times 9.81$ Nm

Input Power P_i = VI Watts

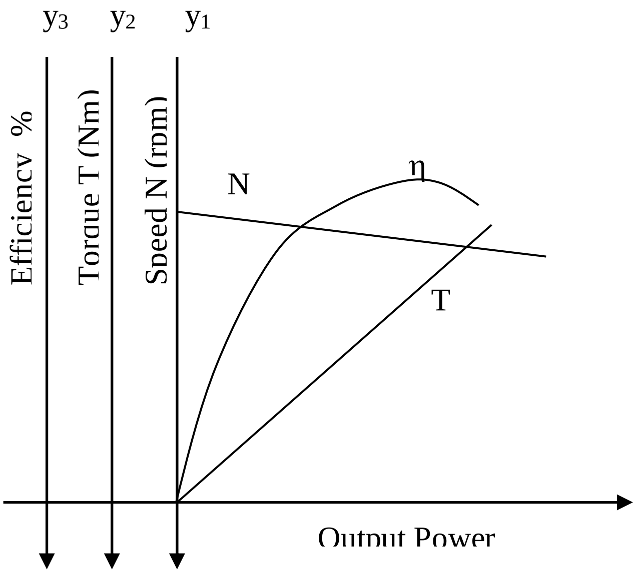
Output Power P_m = $\frac{2\pi NT}{60}$ Watts

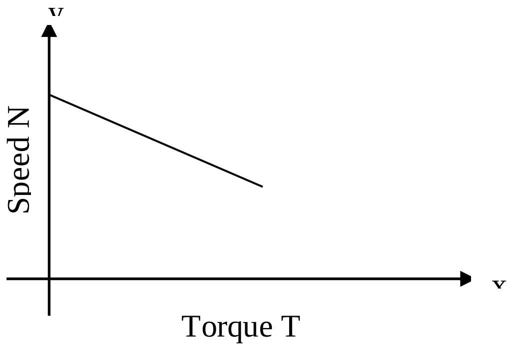
Efficiency η % = $\frac{\text{Output Power}}{\text{Input Power}} \times 100\%$

TABULAR COLUMN:

S.No.	Voltage V (Volts)	Current I (Amps)	Spring Balance Reading		$(S_1 \sim S_2)$ Kg	Speed N (rpm)	Torque T (Nm)	Output Power Pm (Watts)	Input Power P_i (Watts)	Efficiency η%
			S_1 (Kg)	S_2 (Kg)						
1.										
2.										
3.										
4.										
5.										
6.										

MODEL GRAPHS:





PRECAUTIONS:

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

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. After checking the no load condition, and minimum field rheostat position, DPST switch is closed and starter resistance is gradually removed.
3. The motor is brought to its rated speed by adjusting the field rheostat.
4. Ammeter, Voltmeter readings, speed and spring balance readings are noted under no load condition.
5. The load is then added to the motor gradually and for each load, voltmeter, ammeter, spring balance readings and speed of the motor are noted.
6. The motor is then brought to no load condition and field rheostat to minimum position, then DPST switch is opened.

RESULT:

Thus load test on DC shunt motor is conducted and its efficiency is determined.

Ex.No:6 LOAD CHARACTERISTICS OF SEPARATELY EXCITED DC SHUNT GENERATOR

Date:

AIM:

To obtain internal and external characteristics of DC separately excited DC shunt generator.

APPARATUS REQUIRED:

S.No.	Apparatus	Range	Type	Quantity
1	Ammeter	(0-2)A (0-20) A	MC MC	1 1
2	Voltmeter	(0-300)V	MC	1
3	Rheostats	1200Ω, 0.8A	Wire Wound	2
4	Loading Rheostat	5KW, 230V	-	1
5	Tachometer	(0-1500)rpm	Digital	1
6	Connecting Wires	2.5sq.mm.	Copper	Few

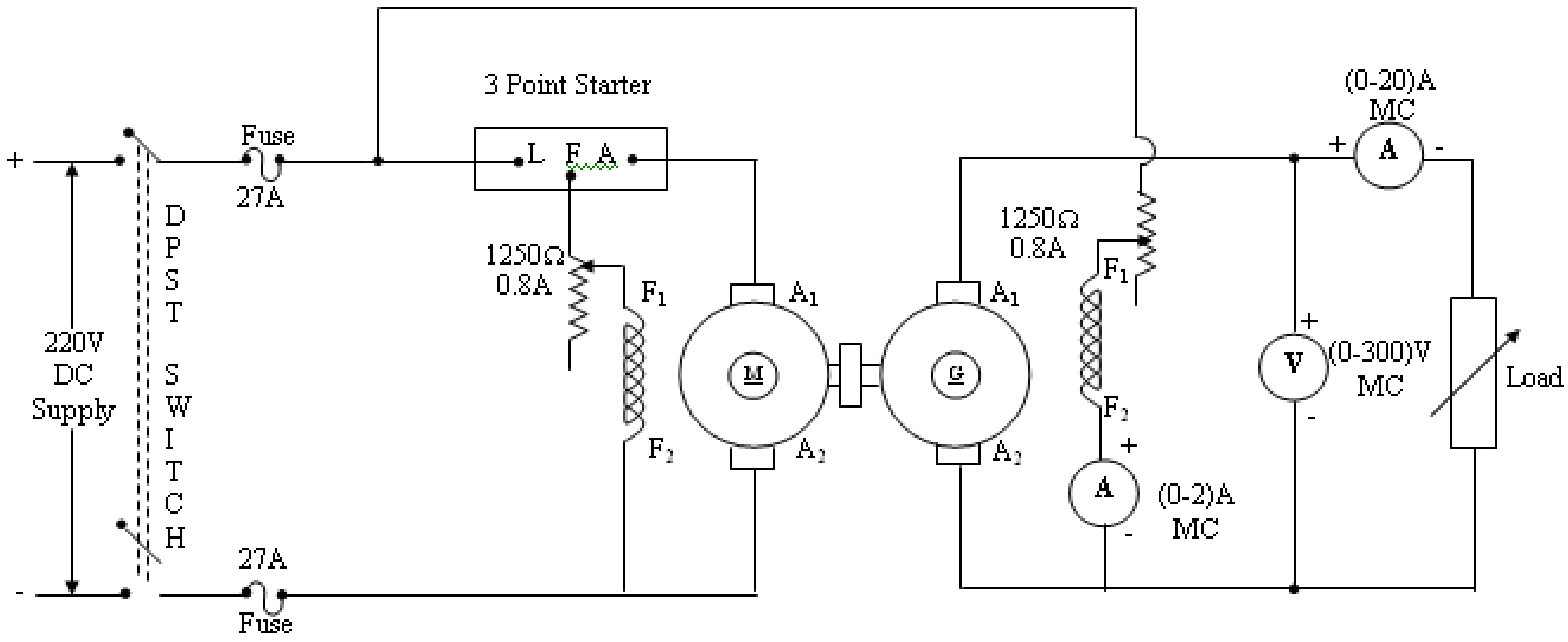
PRECAUTIONS:

1. The field rheostat of motor should be at minimum position.
2. The field rheostat of generator should be at maximum position.
3. No load should be connected to generator at the time of starting and stopping.

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. After checking minimum position of DC shunt motor field rheostat and maximum position of DC shunt generator field rheostat, DPST switch is closed and starting resistance is gradually removed.
3. Under no load condition, Ammeter and Voltmeter readings are noted, after bringing the voltage to rated voltage by adjusting the field rheostat of generator.
4. Load is varied gradually and for each load, voltmeter and ammeter readings are noted.
5. Then the generator is unloaded and the field rheostat of DC shunt generator is brought to maximum position and the field rheostat of DC shunt motor to minimum position, DPST switch is opened.

CIRCUIT DIAGRAM:



FUSE RATING:

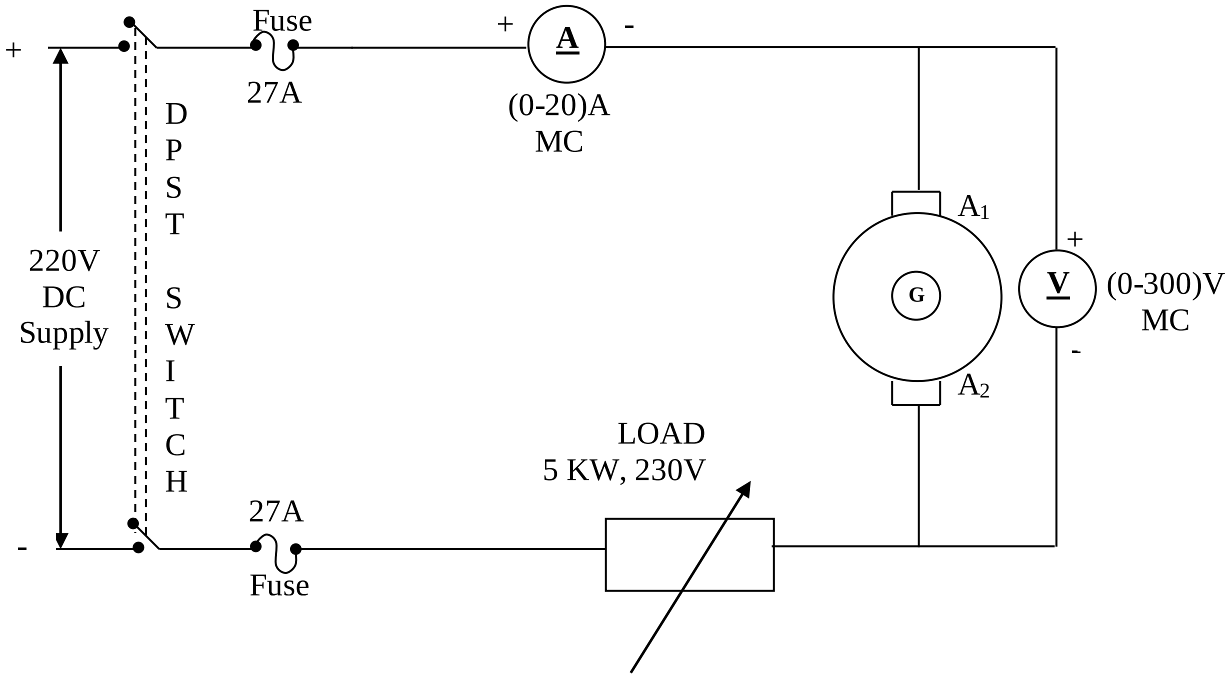
125% of rated current

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

NAME PLATE DETAILS:

	Motor	Generator
Rated Voltage :	220V	220V
Rated Current :	21A	21A
Rated Power :	3.5KW	7.5KW
Rated Speed :	1500 RPM	1500 RPM

DETERMINATION OF ARMATURE RESISTANCE:



PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Supply is given by closing the DPST switch.
3. Readings of Ammeter and Voltmeter are noted.
4. Armature resistance in Ohms is calculated as $R_a = (V \times 1.5) / I$

TABULAR COLUMN:

S.No.	Voltage V (Volts)	Current I (Amps)	Armature Resistance R_a (Ohms)

S.No.	Field Current I_f (Amps)	Load Current I_L (Amps)	Terminal Voltage (V) Volts	$I_a = I_L + I_f$ (Amps)	$E_g = V + I_a R_a$ (Volts)

FORMULAE:

E_g = $V + I_a R_a$ (Volts)

I_a = $I_L + I_f$ (Amps)

E_g : Generated emf in Volts

V : Terminal Voltage in Volts

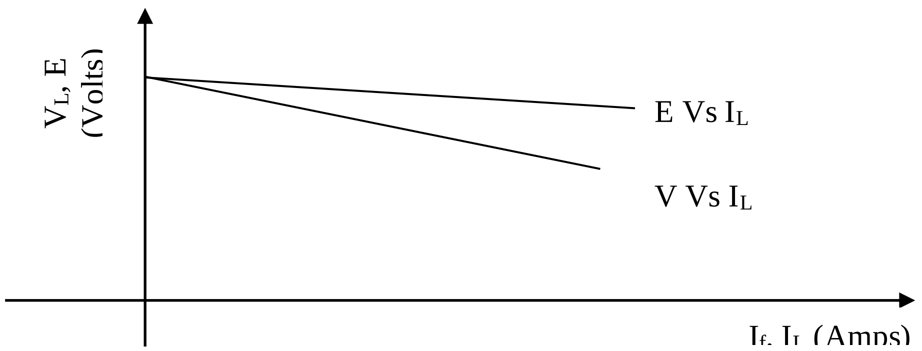
I_a : Armature Current in Amps

I_L : Line Current in Amps

I_f : Field Current in Amps

R_a : Armature Resistance in Ohms

MODEL GRAPH:

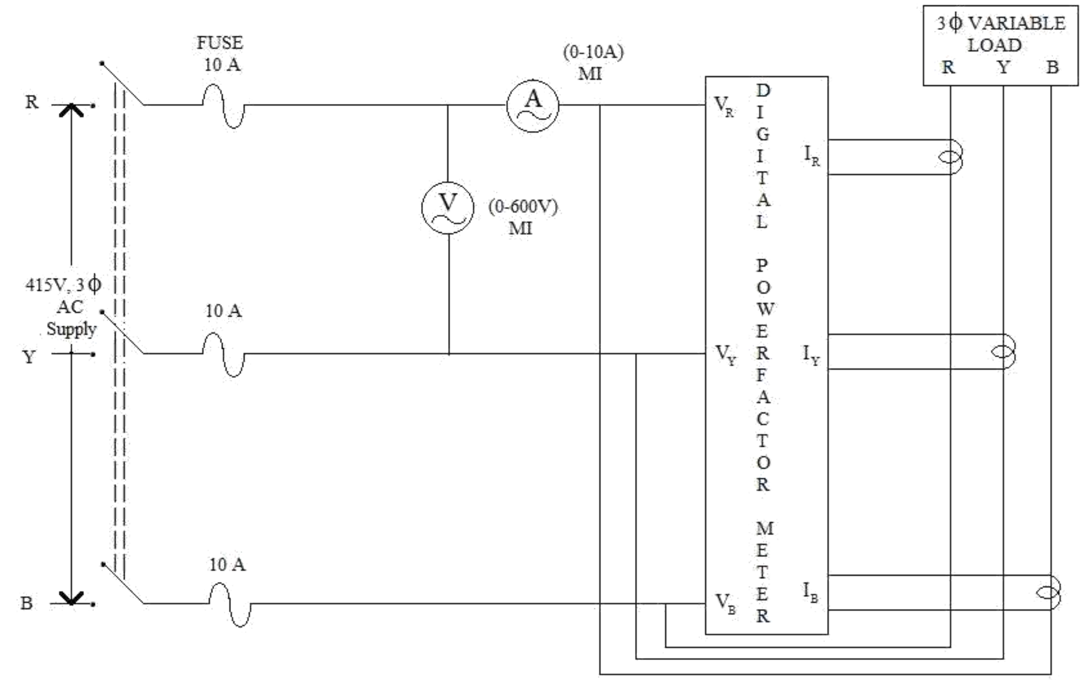


MODEL CALCULATION:

RESULT:

Thus load characteristics of separately excited DC shunt generator is obtained.

CIRCUIT DIAGRAM:



TABULATION:

LOAD	VOLTAGE V_L (V)	CURRENT I_L (A)	POWER FACTOR COS ϕ	POWER (W)

Ex.No:7 MEASUREMENT OF 3 PHASE POWER & POWER FACTOR

DATE

AIM:

To conduct a suitable experiment on a 3-phase load connected in star or delta to measure the 3-phase power and power factor using 2 wattmeter method.

APPARATUS REQUIRED:

1. Wattmeter rated 10A, 600V UPF – 2 nos.
2. Voltmeter rated 600V of type MI – 1 no.
3. Ammeter rated 10A of type MI – 1 no.
4. Three phase resistive load
5. Three phase inductive load
6. Three phase capacitive load
7. Connecting wires.

THEORY:

Power in a three phase circuit can be measured using two wattmeters. The current coil of wattmeter 1 is connected in R phase. The voltage coil of wattmeter is connected between R-phase and Y-phase. The current coil of wattmeter 2 is connected between B and Y-phase. The current coil of wattmeter 2 is connected in B phase. The sum of two wattmeter readings indicates the total power in the circuit.

FORMULA:

$$Vph = V_L/\sqrt{3}$$

$$I_L = Iph$$

$$Power = 3 * Vph * Iph \cos\phi$$

PROCEDURE:

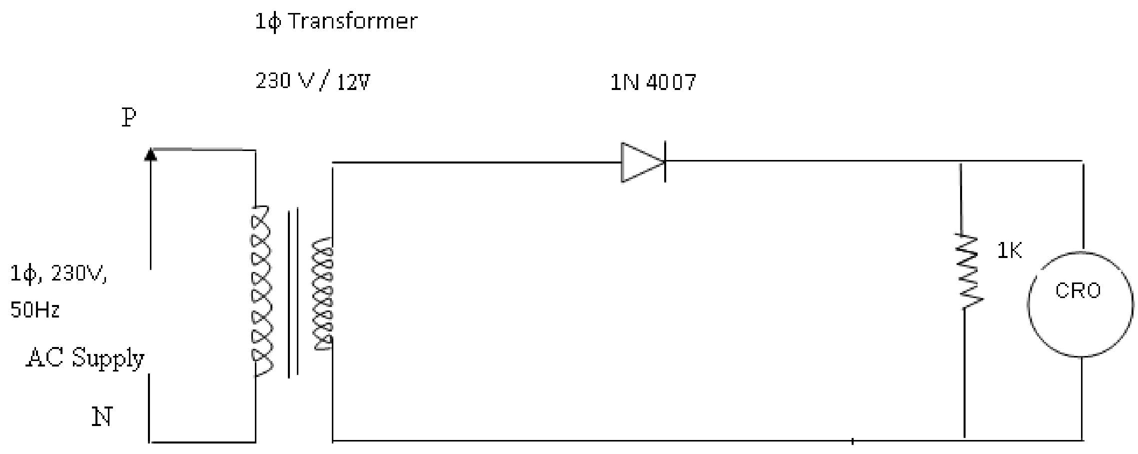
1. Connections are made as per the circuit diagram.
2. The three phase AC supply is switched ON for setting the rated voltage in the voltmeter.
3. At no load condition all the meter readings are noted down.
4. The resistive load is increased in steps and the meter readings are noted down.
5. Repeat the same procedure for inductive and capacitive loads.

MODEL CALCULATION:

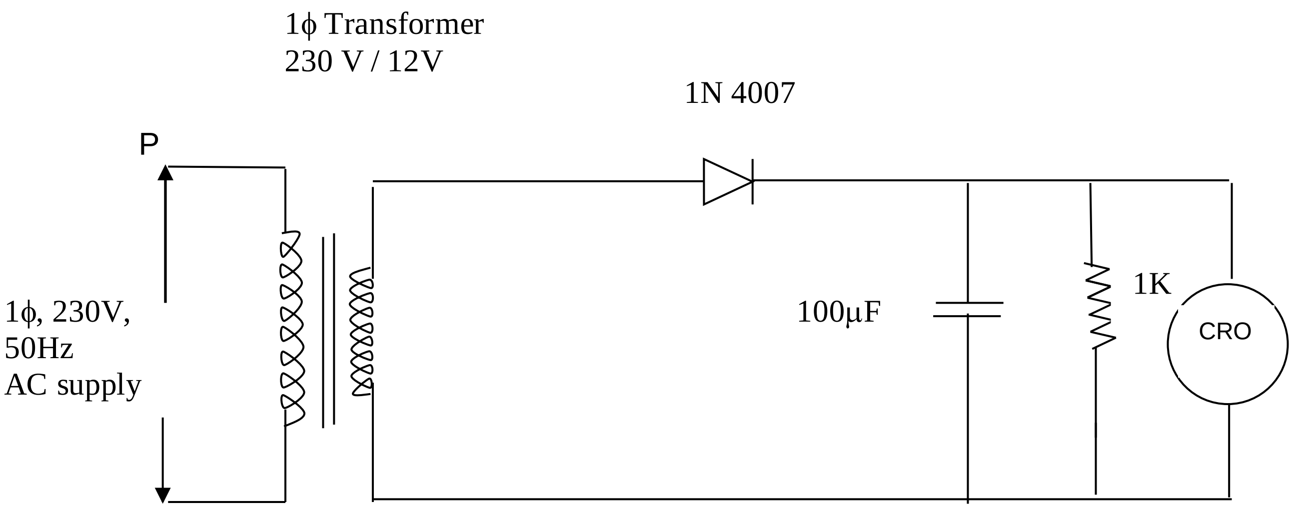
RESULT:

CIRCUIT DIAGRAM:

WITHOUT FILTER:



WITH FILTER:



Ex.No:8A SINGLE PHASE HALF-WAVE RECTIFIER WITH CAPACITIVE FILTERS

Date:

AIM:

To construct a Half wave rectifier using diode and to draw its performance characteristics.

APPARATUS REQUIRED:

S. No.	Name	Range	Type	Qty
1	Transformer	230/(12-0-12)V		1
2	Diode	IN4007		1
3	Resistor	1K Ω		1
4	Bread Board			1
5	Capacitor	100µF		1
6	CRO			1
7	Wires			As Req.

THEORY:

It converts an ac voltage into a pulsating dc voltage using one half of the applied ac voltage. The rectifying diode conducts during one half of the ac cycle only.

OPERATION:

During the positive half cycle of the input signal, the anode of the diode becomes positive with respect to cathode and hence diode D conducts. For an ideal diode, the forward voltage drop is zero. So the whole input voltage will appear across the load resistance R_L.

TABULAR COLUMN:

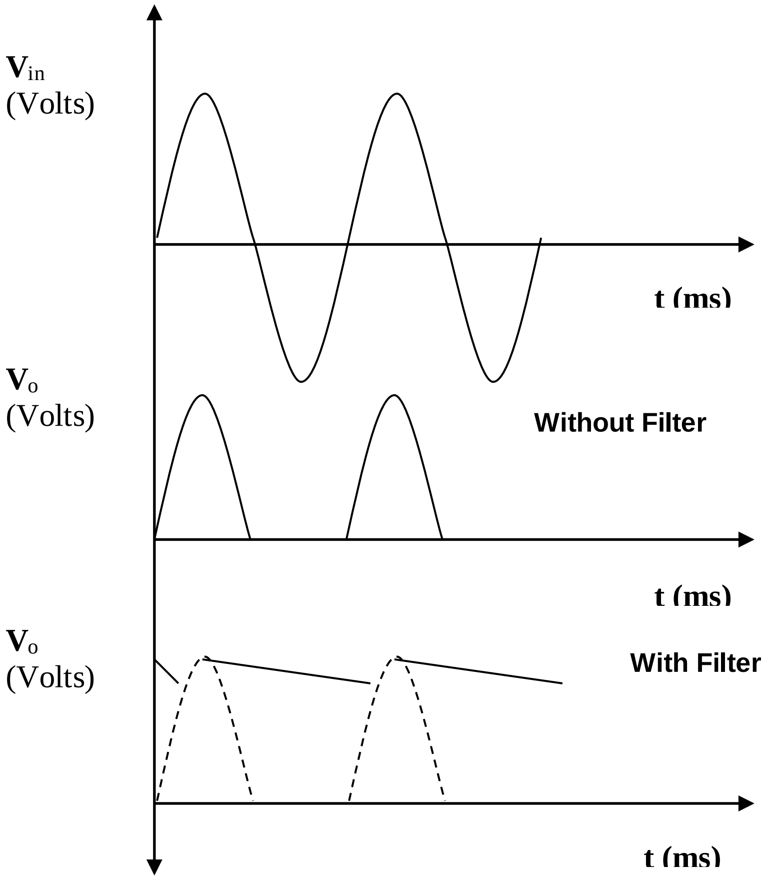
WITHOUT FILTER:

V_m	V_{rms}	V_{dc}	Ripple factor	Efficiency

WITH FILTER:

V_{rms}	V_{rpp}	V_{dc}	Ripple factor	Efficiency

MODEL GRAPH:



During negative half cycle of the input signal, the anode of the diode becomes negative with respect to the cathode and hence, diode D does not conduct. For an ideal diode, the impedance offered by the diode is infinity.So the whole input voltage appears across the diode D. Hence, the voltage drop across R_L is zero.

FORMULAE:

WITHOUT FILTER:

(i) $V_{rms} = V_m / 2$

(ii) $V_{dc} = V_m / \Pi$

(iii) Ripple Factor $= \sqrt{(V_{rms} / V_{dc})^2 - 1}$

(iv) Efficiency $= (V_{dc} / V_{rms})^2 \times 100$

WITH FILTER:

(i) $V_{rms} = \sqrt{(V_{r,rms}'^2 + V_{dc}^2)}$

(ii) $V_{r,rms} = V_{rpp} / (\sqrt{3} \times 2)$

(iii) $V_{dc} = V_m - (V_{rpp} / 2)$

(iv) Ripple Factor $= V_{r,rms} / V_{dc}$

(v) Efficiency $= (V_{dc} / V_{rms})^2 \times 100$

PROCEDURE:

WITHOUT FILTER:

1. Give the connections as per the circuit diagram.
2. Give 230v, 50HZ I/P to the step down TFR where secondary connected to the Rectifier I/P.
3. Take the rectifier output across the Load & Plot its performance graph.

WITH FILTER:

1. Give the connections as per the circuit diagram.
2. Give 230v, 50HZ I/P to the step down TFR where secondary connected to the Rectifier I/P.
3. Connect the Capacitor across the Load.
4. Take the rectifier output across the Load & Plot its performance graph.

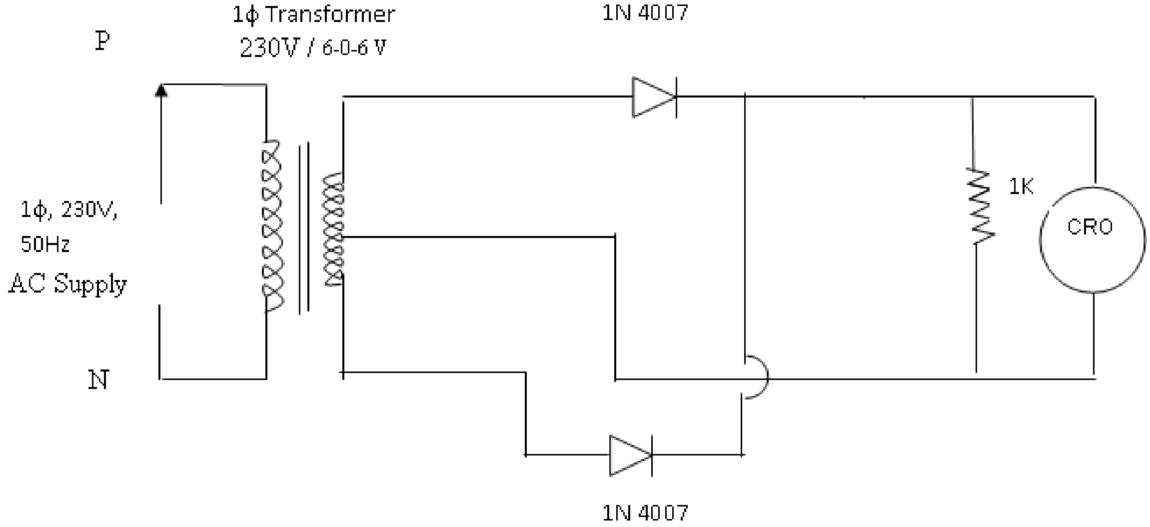
CALCULATIONS:

RESULT:

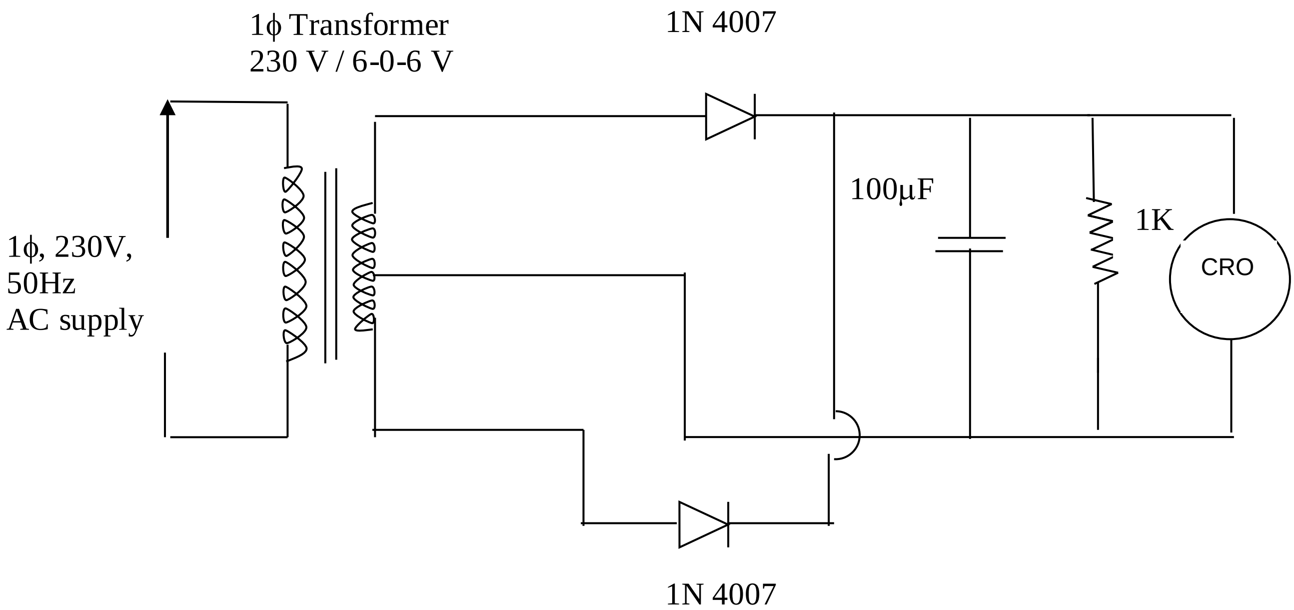
Thus the performance characteristics of 1ϕ Half wave rectifier was obtained.

CIRCUIT DIAGRAM:

WITHOUT FILTER:



WITH FILTER:



Ex.No:8B **SINGLE PHASE FULL-WAVE RECTIFIER WITH CAPACITIVE FILTERS**

Date:

AIM:

To construct a Full wave rectifier using diode and to draw its performance characteristics.

APPARATUS REQUIRED:

S.No.	Name	Range	Type	Qty
1	Transformer	230/(6-0-6)V		1
2	Diode	IN4007		2
3	Resistor	1K Ω		1
4	Bread Board			1
5	Capacitor	100µf		1
6	CRO			1
7	Wires			As Req.

THEORY:

It converts an ac voltage into a pulsating d.c voltage using both half cycle of the applied ac voltage. It uses two diodes of which one conducts during one half cycle while the other diode conducts during the other half cycle of the applied ac voltage.

OPERATION:

During positive half of the input signal, anode of diode D_1 becomes positive and at the same time the anode to the diode D_2 becomes negative. Hence, D_1 conducts and D_2 does not conduct. The load current flows through D_1 and the voltage drop across R_L will be equal to the input voltage.

TABULAR COLUMN:

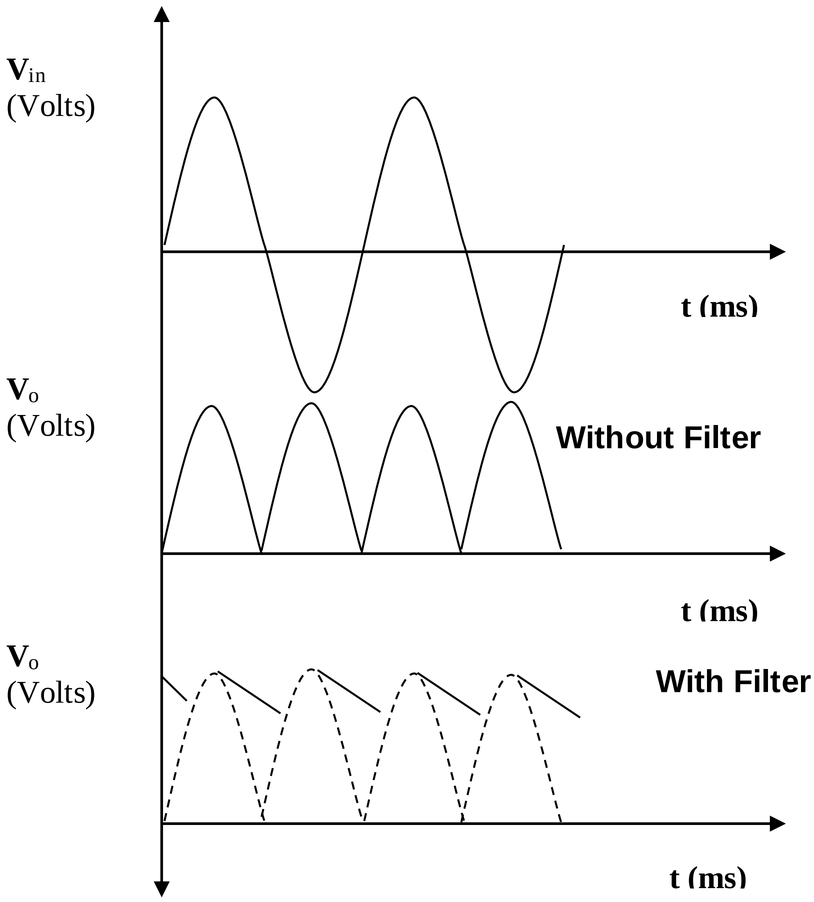
WITHOUT FILTER:

V_m	V_{rms}	V_{dc}	Ripple factor	Efficiency

WITH FILTER:

V_{rms}	V_{rpp}	V_{dc}	Ripple factor	Efficiency

MODEL GRAPH :



During the negative half cycle of the input, the anode of D_1 becomes negative and the anode of D_2 becomes positive. Hence, D1 does not conduct and D_2 conducts. The load current flows through D_2 and the voltage drop across R_L will be equal to the input voltage.

FORMULAE:

WITHOUT FILTER:

(i) $V_{rms} = V_m / \sqrt{2}$

(ii) $V_{dc} = 2V_m / \Pi$

(iii) Ripple Factor $= \sqrt{(V_{rms} / V_{dc})^2 - 1}$

(iv) Efficiency $= (V_{dc} / V_{rms})^2 \times 100$

WITH FILTER:

(i) $V_{r,rms} = V_{rpp} / (2 * \sqrt{3})$

(ii) $V_{dc} = V_m - V_{rpp}$

(iii) $V_{rms} = \sqrt{(V_{r,rms}^2 + V_{dc}^2)}$

(iv) Ripple Factor $= V_{r,rms} / V_{dc}$

(v) Efficiency $= (V_{dc} / V_{rms})^2 \times 100$

PROCEDURE:

WITHOUT FILTER:

1. Give the connections as per the circuit diagram.
2. Give 230v, 50HZ I/P to the step down TFR where secondary connected to the Rectifier I/P.
3. Take the rectifier output across the Load & Plot its performance graph.

WITH FILTER:

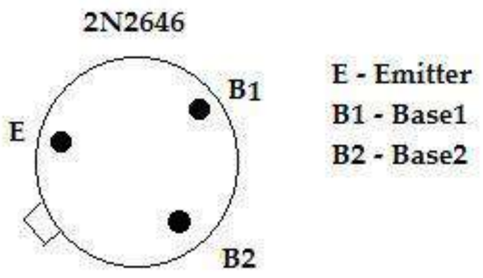
1. Give the connections as per the circuit diagram.
2. Give 230v, 50HZ I/P to the step down TFR where secondary connected to the Rectifier I/P.
3. Connect the Capacitor across the Load.
4. Take the rectifier output across the Load & Plot its performance graph.

CALCULATIONS:

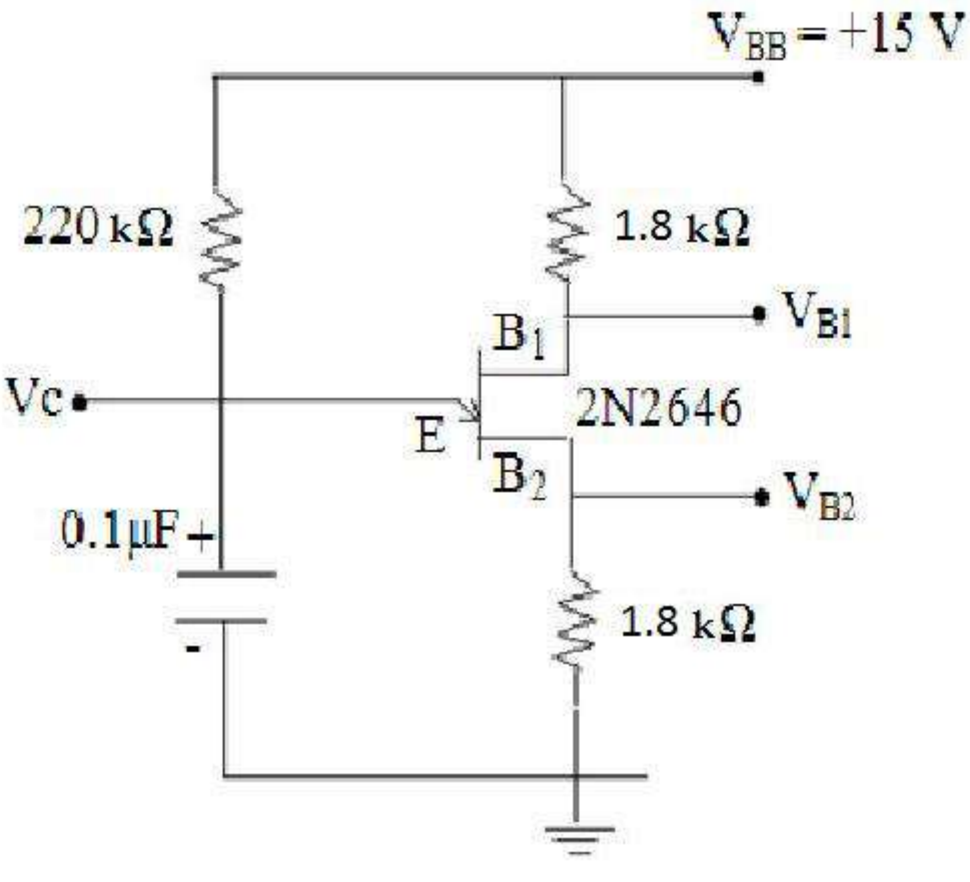
RESULT:

Thus the performance characteristics of 1ϕ Full wave rectifier were obtained.

UJT PIN DIAGRAM



CIRCUIT DIAGRAM:



Ex.No:9 **UJT RELAXATION OSCILLATOR FOR GENERATION OF SAW TOOTH WAVE**

Date:

AIM:

To construct the UJT oscillator and obtain the characteristics.

APPARATUS REQUIRED:

S.NO	NAME OF THE EQUIPMENT	TYPE	RANGE	QUANTITY
1	UJT	2N2646		1
2	Resistor		15 kΩ 220 kΩ, 33Ω	One from each
3	Capacitor		0.1 μF	1
4	CRO			1
5	Bread Board			1
6	Connecting wires			As Required

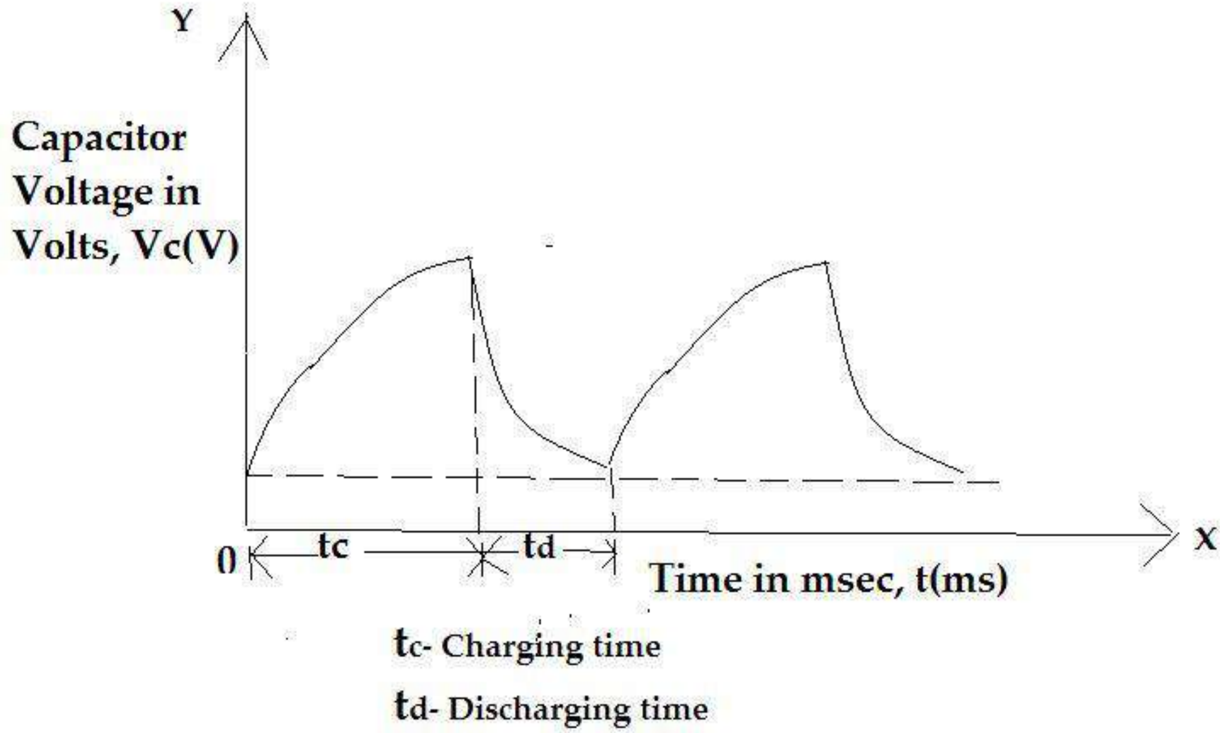
THEORY:

The Relaxation UJT oscillator consists of UJT and a capacitor which is charged through a RE as the supply voltage VBB is switched ON. The voltage across the capacitor increases exponentially and when the capacitor voltage reach the peak point voltage Vp, the UJT starts conducting and the capacitor voltage is discharged rapidly through EB1 and R1. After the peak point voltage of UJT is reached, it provides negative resistance to the discharge path which is useful in the working of the relaxation oscillator. As the capacitor voltage reaches zero, the device then cuts off and capacitor CE starts to charge again. This cycle is repeated continuously generating a saw tooth waveform across the capacitor. The inclusion of external resistors R2 and R1 in series with B2 and B1 provides spike waveforms

TABULATION:

S.No.	Charging Time, t_c(ms)	DisCharging Time, t_d(ms)	Amplitude,V_c(V)

MODEL GRAPH:



When the UJT fires, the sudden charge of current through B1 causes drop across R1, which provides positive going spikes. Also, at the time of firing, fall of VEB1 causes I2 to increase rapidly which generates negative going spikes across R2. By changing the values of capacitance CE or resistance RE, the frequency of the output waveform can be changed as desired, Since these values control the time constant RECE of the capacitor changing circuit. The frequency of oscillation can be obtained by assuming that the capacitor is initially uncharged.

$F = 1/T = 2.3\ R_E\ C_E \log 10\ [1/(1-\eta)]$

Where, η is intrinsic stand-off ratio

FORMULA USED:

Charging time of capacitance,

$$T = RC \ln [(E - E_0)/E - E_C]$$

E = Supply voltage

E_0 = Initial capacitor voltage

E_C = Capacitance voltage

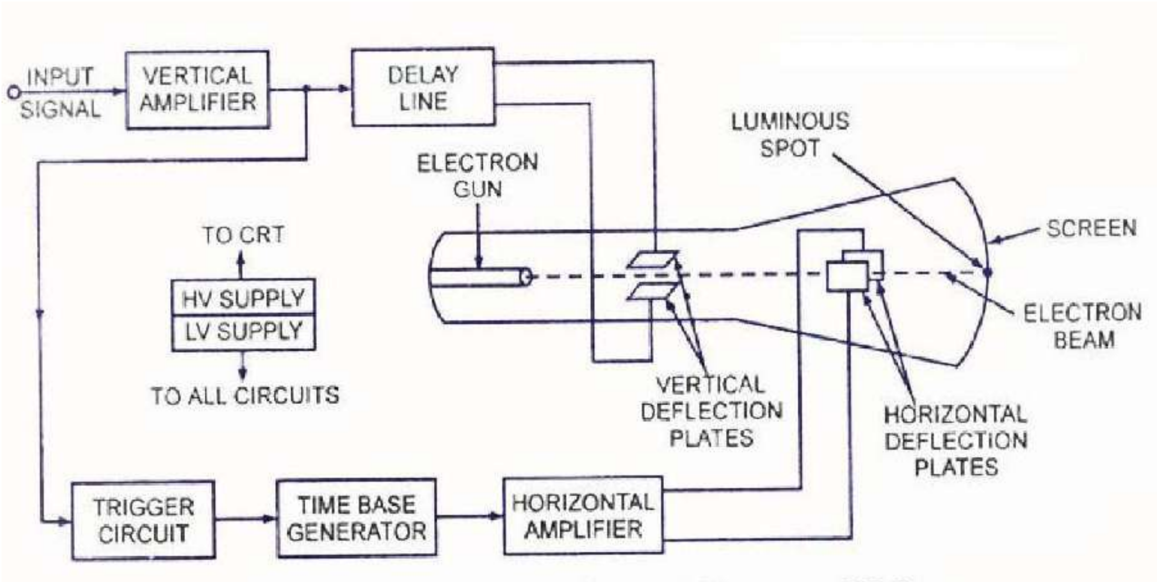
PROCEDURE:

1. Connections are given as per the circuit diagram.
2. Positive biasing voltage is given to the Emitter and Base-2 terminal.
3. The charging and discharging time of capacitor is observed from the output waveform of CRO.

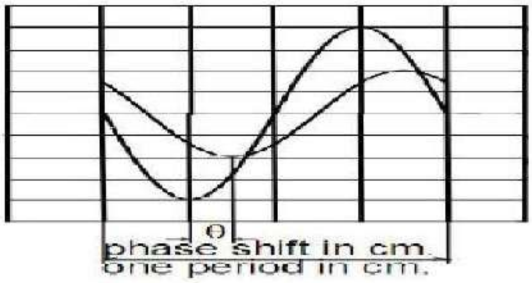
RESULT:

Thus the UJT relaxation oscillator circuit was constructed and the output waveforms were noted. The corresponding graphs are drawn.

BLOCK DIAGRAM OF GENERAL PURPOSE CRO



Block Diagram of a General Purpose CRO



OBSERVATION TABLE

Sl. No	Type of Wave	Time Period (T)	Amplitude	Theoretical Frequency	Practical Frequency

Ex.No:10 STUDY OF CRO AND MEASUREMENT OF SINUSOIDAL VOLTAGE, FREQUENCY AND POWER FACTOR

Date:

AIM:

The aim of the experiment is to understand the operation of cathode ray oscilloscope (CRO) and to become familiar with its usage, also to perform an experiment using function generator to measure amplitude, time period, frequency & power factor of the time varying signals using a calibrated cathode ray oscilloscope.

APPARATUS REQUIRED:

S. No	Name of the Components / Equipment	Qty
1.	CRO	1
2.	Function generator	1
3.	Probes	2

THEORY:

The cathode ray oscilloscope (CRO) provides a visual presentation of any waveform applied to the input terminal. The oscilloscope consists of the following major subsystems.

- Cathode ray tube (CRT)
- Vertical amplifier
- Horizontal amplifier
- Sweep Generator
- Trigger circuit
- Associated power supply

It can be employed to measure quantities such as peak voltage, frequency, phase difference, pulse width, delay time, rise time, and fall time.

CATHODE RAY TUBE:

The CRT is the heart of the CRO providing visual display of an input signal waveform. A CRT contains four basic parts:

- An electron gun to provide a stream of electrons.
- Focusing and accelerating elements to produce a well define beam of electrons.
- Horizontal and vertical deflecting plates to control the path of the electron beam.
- An evacuated glass envelope with a phosphorescent which glows visibly when struck by electron beam.

A Cathode containing an oxide coating is heated indirectly by a filament resulting in the release of electrons from the cathode surface. The control grid which has a negative potential, controls the electron flow from the cathode and thus control the number of electron directed to the screen. Once the electron passes the control grid, they are focused into a tight beam and accelerated to a higher velocity by focusing and accelerating anodes. The high velocity and well defined electron beam then passed through two sets of deflection plates.

The First set of plates is oriented to deflect the electron beam vertically. The angle of the vertical deflection is determined by the voltage polarity applied to the deflection plates. The electron beam is also being deflected horizontally by a voltage applied to the horizontal deflection plates. The tube sensitivity to deflecting voltages can be expressed in two ways that are deflection factor and deflection sensitivity.

The deflected beam is then further accelerated by very high voltages applied to the tube with the beam finally striking a phosphorescent material on the inside face of the tube. The phosphor glows when struck by the energetic electrons.

CONTROL GRID:

Regulates the number of electrons that reach the anode and hence the brightness of the spot on the screen.

FOCUSING ANODE:

Ensures that electrons leaving the cathode in slightly different directions are focused down to a narrow beam and all arrive at the same spot on the screen.

ELECTRON GUN:

Cathode, control grid, focusing anode and accelerating anode.

DEFLECTING PLATES:

Electric fields between the first pair of plates deflect the electrons horizontally and an electric field between the second pair deflects them vertically. If no deflecting fields are present, the electrons travel in a straight line from the hole in the accelerating anode to the center of the screen , where they produce a bright spot. In general purpose oscilloscope, amplifier circuits are needed to increase the input signal to the voltage level required to operate the tube because the signals measured using CRO are typically small. There are amplifier sections for both vertical and horizontal deflection of the beam.

VERTICAL AMPLIFIER:

Amplify the signal at its input prior to the signal being applied to the vertical deflection plates.

HORIZONTAL AMPLIFIER:

Amplify the signal at its input prior to the signal being applied to the horizontal deflection plates.

SWEEP GENERATOR:

Develop a voltage at the horizontal deflection plate that increases linearly with time.

OPERATION:

The four main parts of the oscilloscope CRT are designed to create and direct an electron beam to a screen to form an image. The oscilloscope links to a circuit that directly connects to the vertical deflection plates while the horizontal plates have linearly increasing charge to form a plot of the circuit voltage over time. In an operating cycle, the heater gives electrons in the cathode enough energy to escape. The electrons are attracted to the accelerating anode and pulled through a control grid that regulates the number of electrons in the beam, a focusing anode that controls the width of the beam, and the accelerating anode itself. The vertical and horizontal deflection plates create electric field that bend the beam of electrons. The electrons finally hit the fluorescent screen which absorbs the energy from the electron beam nad emits it in the form of light to display an image at the end of the glass tube.

PRECAUTIONS:

1. Do not leave a ‘bright spot’ on the screen for any length of time.
2. Do not apply signals that exceed the scopes voltage rating.
3. Do not try make accurate measurements on signals whose frequency is outside the scope’s frequency specifications.
4. Be aware that the scope’s input circuitry can cause loading effects on the circuitry under test-use correct probe for the work.

PROCEDURE:

1. Measurement of Voltage Using CRO: A voltage can be measured by noting the Y deflection produced by the voltage; using this deflection in conjunction with the Y-gain setting, the voltage can be calculated as follows : V = (no. of boxes in cm.) x (selected Volts/cm scale)

2 .Measurement of Current and Resistance Using a CRO: Using the general method, a correctly calibrated CRO can be used in conjunction with a known value of resistance R to determine the current I flowing through the resistor.

3 Measurement of Frequency Using a CRO: A simple method of determining the frequency of a signal is to estimate its periodic time from the trace on the screen of a CRT. However this method has limited accuracy, and should only be used where other methods are not available. To calculate the frequency of the observed signal, one has to measure the period, i.e. the time taken for 1 complete cycle, using the calibrated sweep scale. The period could be calculated by T = (no. of squares in cm) x (selected Time/cm scale) Once the period T is known, the frequency is given by f (Hz) = 1/T (sec).

4. Measurement of Phase: The calibrated time scales can be used to calculate the phase shift between two sinusoidal signals of the same frequency. If a dual trace or beam CRO is available to display the two signals simultaneously (one of the signals is used for synchronization), both of the signals will appear in proper time perspective and the amount of time difference between the waveforms can be measured. This, in turn can be utilized to calculate the phase angle θ, between the two signals.

Referring to the fig. the phase shift can be calculated by the formula;

$$\theta° = \frac{phase\ shift\ in\ cm}{one\ period\ in\ cm}$$

MEASUREMENT OF POWER FACTOR:

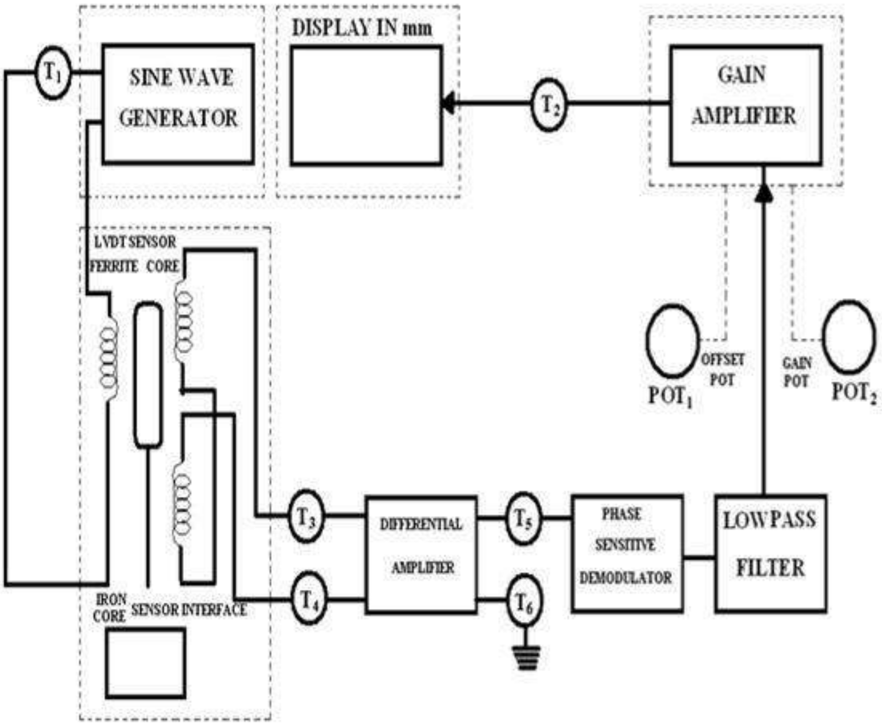
The power factor is calculated by the formula

$$Pf = VI\ COS\phi$$

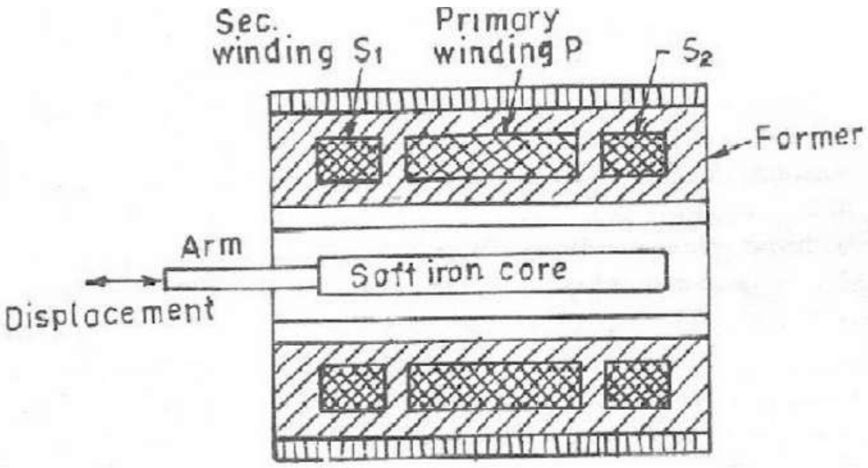
RESULT:

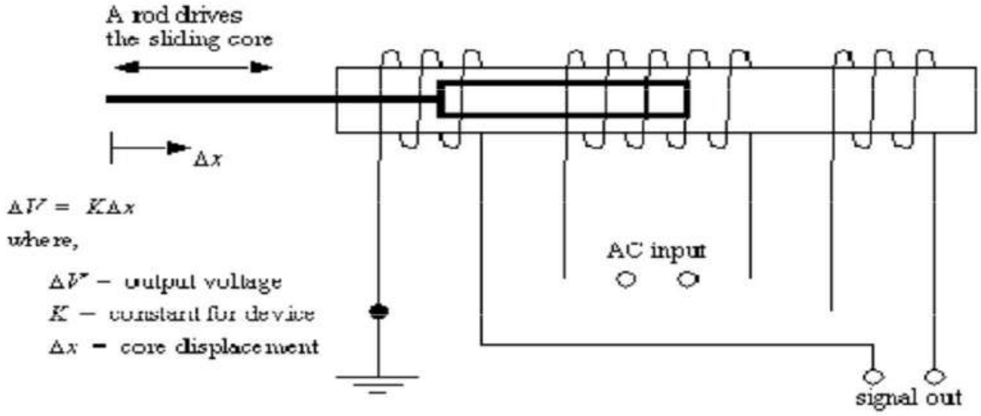
CIRCUIT DIAGRAM:

Study Of Displacement Transducer - LVDT



GENERAL DIAGRAM





Ex.No:11 **CHARACTRISTICS OF LVDT**

DATE

AIM:

To study the displacement transducer using LVDT and to obtain its characteristics

APPARATUS REQUIRED:

Sl.No	Name of the Apparatus	Qty
1	LVDT Trainer kit	1
2	Connecting Wires	1
3	Digital Multimeter	1
4	Screw gauge	1

FORMULA USED:

%ERROR = [(Displayed Displacement – Actual Displacement)/ Actual Displacement] x100

PRECAUTIONS:

1. While taking reading on scale parallel error has to be avoided.
2. Smooth gradual movement of the core to be ensured.

PROCEDURE:

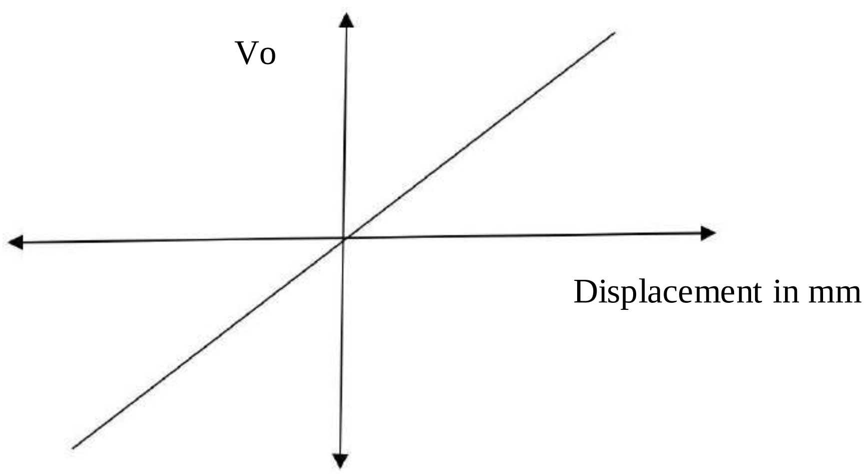
1. Switch on the power supply to the LVDT module.
2. Connect the CRO at T1 to check the input sine wave signal. Adjust the frequency to kHz.
3. Place the LVDT at the null position (10mm) and adjust the offset to display zero on the DVM(actual displacement).calibrated in displacement of the core. Gradually move the core of the LVDT in the positive direction (20mm) and Note the reading on the display (mm).It should be around 10mm, if it not adjust the gain to display 10mm.
4. Repeat step 4 in the opposite direction.

5. Tabulate the readings of actual displacement and displayed on the DVM. The LVDT core may be moved through a distance of 20mm.

TABULATION:

ACTUAL DISPLACEMENT D_a(mm)	OUTPUT VOLTAGE Vo *volts*	DISPLAYED DISPLACEMENT D_d (mm)	% ERROR
1			
2			
3			
4			

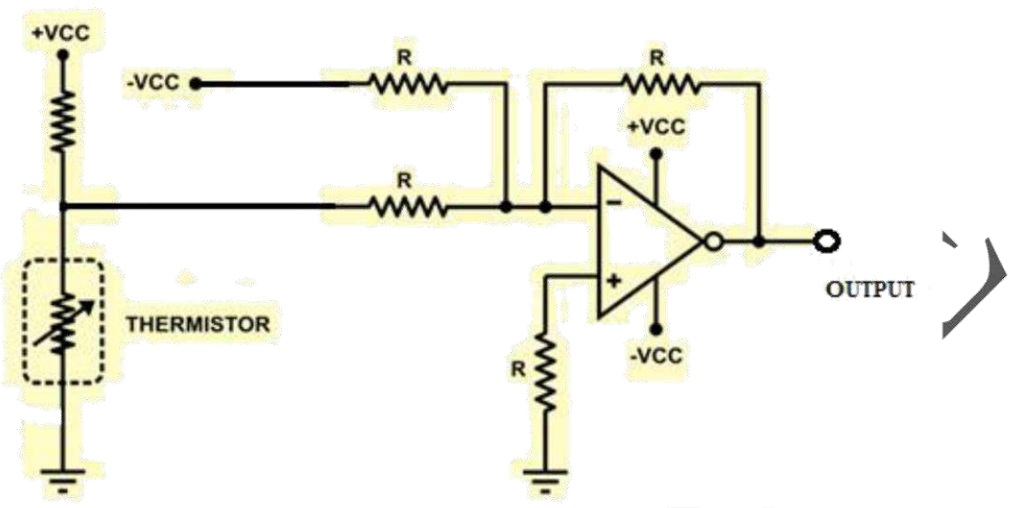
MODEL GRAPH:



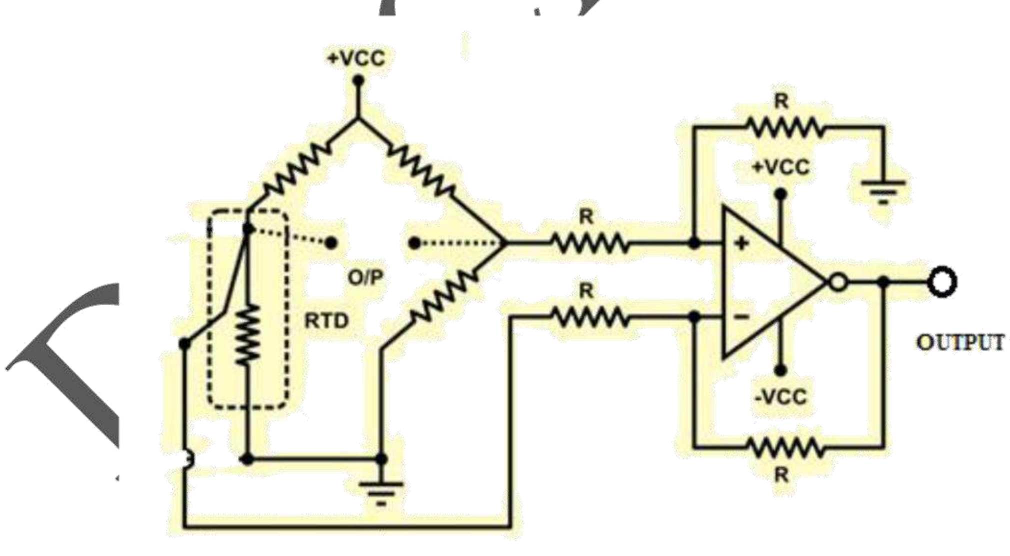
RESULT:

Thus the displacement and characteristics of transducer are studied using LVDT

TEMPERATURE MEASUREMENT USING THERMISTOR:



TEMPERATURE MEASUREMENT USING RTD:



Ex.No:12 **TEMPERATURE TRANSDUCER**

DATE

AIM:

To measure temperature using RTD & Thermistor

APPARATUS REQUIRED:

1. Trainer kit
2. Thermistor
3. RTD
4. Electric Kettle
5. Thermometer
6. Patch cords

THEORY:

Temperature Sensors measure the amount of heat energy or even coldness that is generated by an object or system, allowing us to "sense" or detect any physical change to that temperature producing either an analogue or digital output.

The **Thermistor** is another type of temperature sensor, whose name is a combination of the wordsTHERM-ally sensitive res-ISTOR. A thermistor is a special type of resistor which changes its physical resistance when exposed to changes in temperature. Thermistors are generally made from ceramic materials such as oxides of nickel, manganese or cobalt coated in glass which makes them easily damaged. Their main advantage over snap-action types is their speed of response to any changes in temperature, accuracy and repeatability.

Another type of electrical resistance temperature sensor is the **Resistance Temperature Detector**or **RTD**. RTD"s are precision temperature sensors made from high-purity conducting metals such as platinum, copper or nickel wound into a coil and whose electrical resistance changes as a function of temperature, similar to that of the thermistor.

TABULATION:

TEMPERATURE MEASUREMENT USING THERMISTOR:

S. NO	Temperature in degree (Measured by THERMOMETER)	Temperature in degree (Measured by THERMISTOR)	Error
01	Room temperature ( )		
02			
03			
04			
05			

TEMPERATURE MEASUREMENT USING RTD:

S. NO	Temperature in degree	Temperature in degree	Error
	(Measured by THERMOMETER)	(Measured by RTD)	
01	Room temperature ( )		
02			
03			
04			
05			

PROCEDURE:

TEMPERATURE MEASUREMENT USING THERMISTOR

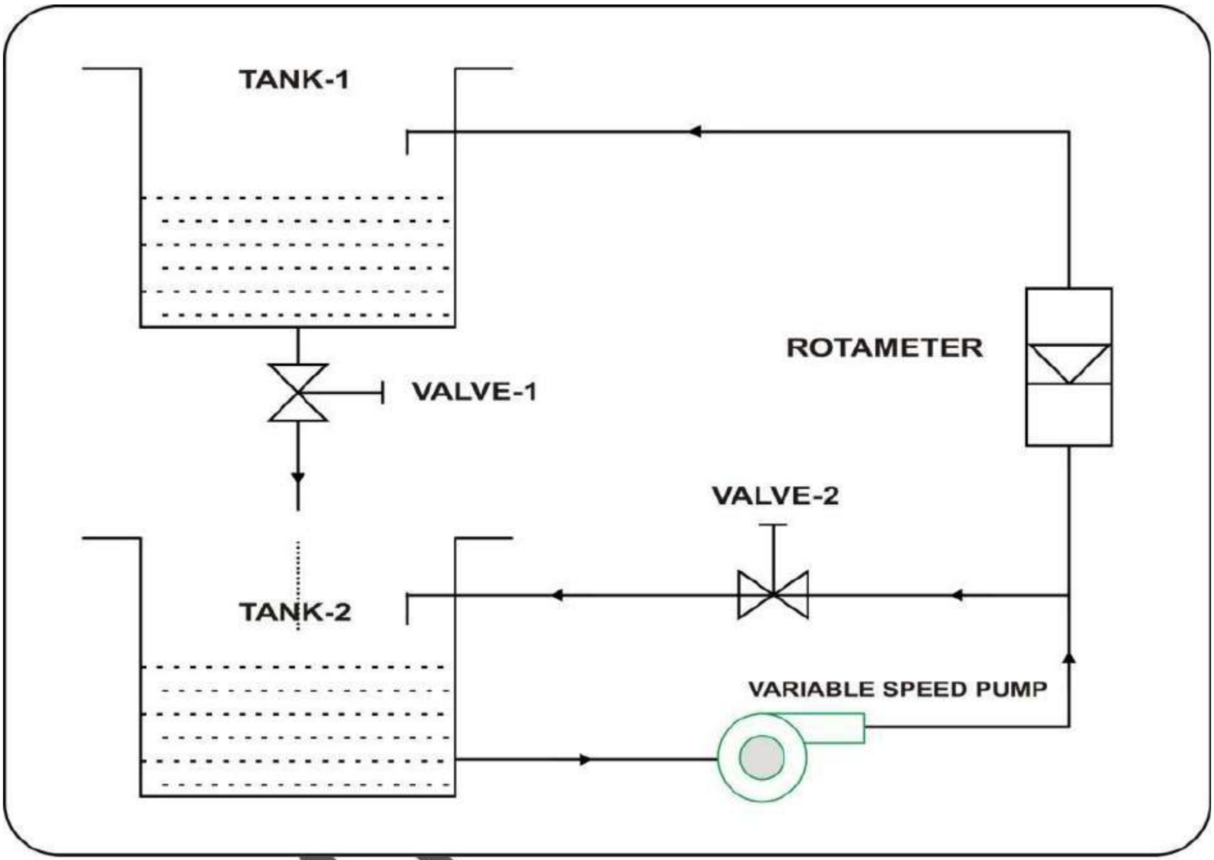
- Connect thermistor probe one end to P1 terminal of trainer
- Connect thermistor probe other end to P2 terminal of trainer
- Connect thermistor P4 terminal to P5 terminal in trainer
- Connect thermistor P6 terminal to P7 terminal (Display input) in trainer
- Insert THERMISTOR probe in water kettle & ensure thermistor probe fully immersed in water
- Insert GLASS Thermo meter probe in water kettle & ensure probe fully immersed in water
- Note down initial (ROOM) temperature value in display ,now switch ON water heater kettle
- Note down & tabulate the Trainer display reading & Thermometer reading
- Switch OFF the trainer .

TEMPERATURE MEASUREMENT USING RTD

- Connect RTD Probe –WHITE-1 color wire to P 09 terminal of trainer
- Connect RTD Probe –WHITE-2 color wire to P10 terminal of trainer
- Connect RTD Probe –Red color wire to P11 terminal of trainer
- Connect thermistor P12 terminal to P13 terminal (Display input) in trainer
- Insert RTD probe in water kettle & ensure RTD probe fully immersed in water
- Insert GLASS Thermo meter probe in water kettle & ensure probe fully immersed in water
- Note down initial (ROOM) temperature value in display ,now switch ON water heater kettle
- Note down & tabulate the Trainer display reading & Thermometer reading
- Switch OFF the trainer

RESULT:

CIRCUIT DIAGRAM:



Ex.No:13 **CALIBRATION OF ROTAMETER**

DATE

AIM:

To measure the Water Flow Rate in LPM by using Rota meter

APPARATUS REQUIRED:

1. Flow measurement trainer
2. Scale
3. Rota meter
4. Stop Clock

THEORY:

The rotameter's operation is based on the variable area principle: fluid flow raises a float in a tapered tube, increasing the area for passage of the fluid. The greater the flow, the higher the float is raised. The height of the float is directly proportional to the flowrate. With liquids, the float is raised by a combination of the buoyancy of the liquid and the velocity head of the fluid. With gases, buoyancy is negligible, and the float responds to the velocity head alone. The float moves up or down in the tube in proportion to the fluid flowrate and the annular area between the float and the tube wall. The float reaches a stable position in the tube when the upward force exerted by the flowing fluid equals the downward gravitational force exerted by the weight of the float. A change in flowrate upsets this balance of forces. The float then moves up or down, changing the annular area until it again reaches a position where the forces are in equilibrium. To satisfy the force equation, the rotameter float assumes a distinct position for every constant flowrate. However, it is important to note that because the float position is gravity dependent, rotameters must be vertically oriented and mounted.

TABULATION:

Rotameter Error Constant = 0.3333 (CONSTANT VALUE)

Level of Water in litre	Time taken to fill	Rotameter Reading	Actual Reading of Rotameter = (Rotameter Reading x error constant)	Calculated LPM = T /60

PROCEDURE:

1. Drain all the water in Tank -1 using S1 switch
2. Fill the water in Tank -2
3. Switch ON Power ON/OFF Switch (S1)
4. Switch ON Pump speed adjustment regulator & Adjust slowly
5. Now the water is flow from Tank-2 to Tank-1 through Rota meter
6. Rota meter indicate the Flow rate in LPM
7. To Vary the Flow Rate adjust any one of the Below
    1. Rotameter Knob
    2. S2-Valve
    3. Pump speed adjustment regulator
8. By adjusting any one of the above ,the Flow Rate of water will be varied & corresponding Rotameter Reading in LPM (Litre per Minutes) will vary. Observe the reading.

RESULT: