



LABORATORY MANUAL

FUNDAMENTAL OF ELECTRICAL & ELECTRONICS ENGINEERING (03607152)

1st SEMESTER



CERTIFICATE

This is to certify that

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Enrolment number _____ *studying in* 1st

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**FUNDAMENTAL OF ELECTRICAL & ELECTRONICS
ENGINEERING**

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EXPERIMENT: 1

AIM: Determine the permeability of magnetic material by plotting its B-H curve.

THEORY:

Consider a magnetic material being subjected to a cycle of magnetization. The graph intensity of magnetization (M) vs. magnetizing field (H) gives a closed curve called M-H loop. Consider the portion AB of the curve given below. The intensity of magnetization M does not become zero when the magnetizing field H is reduced to zero. Thus, the intensity of magnetization M at every stage lag behind the applied field H. This property is called magnetic hysteresis. The M-H loop is called hysteresis loop. The shape and area of the loop are different for different materials.

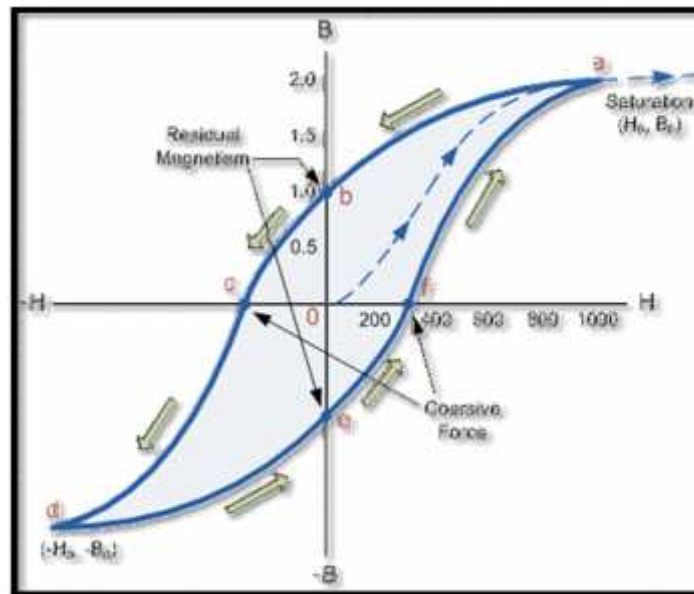


Fig1.1 B-H curve

- Magnetic flux is produced when current is passed through coil wound on a soft iron piece. The flux increases with the increase in the current due to increase in magnetizing force $H = AT/L$. So the flux density also increases. A graph is plotted with flux density B on Y-axis and magnetizing force H on X-axis.
- First the magnetizing force is increased slowly and corresponding flux density is plotted and curve OA is as shown in figure is obtained. Initially increases in Afterwards increases in flux density and is presented by B_m .
- When H is decreased, B is decreased. But decreases in flux density is less. We follow the curve AB. This is because flux lags behind the current due to the hysteresis effect. When magnetizing force H becomes zero, we get certain flux density OB. This is called the residual flux.
- When magnetizing force H is reversed (by reversing the current) then at C, the flux density becomes zero. OC is called coercive force. The coercive force is the magnetizing force to reduce the residual flux density to zero value. Now when H is increased. We obtain curve CD.



- Curve DE is obtained when the magnetizing force is decreased. OE is the residual flux density. Now the magnetizing force is increased in the original direction and we obtain curve FA. OE is again coercive force.
- Thus the magnetic flux lags behind the magnetizing current. It is called the hysteresis effect. The loop obtained as above is called hysteresis loop. Area of the loop represents the energy loss and is called hysteresis loss

Let, l = mean length of iron bar in m,

A = area of cross section of bar in m^2 ,

N = No. of turns around on the bar,

$$= B \cdot A.$$

Emf of self-induction is induced in the coil when current through the coil is changed.

$$e = N \frac{dB}{dt} \text{ (Neglecting Negative Sign)}$$

$$e = N A \frac{dB}{dt}.$$

Now $H = NI/L$, Thus $I = HL/N$.

Power is required to keep the magnetizing current flowing against this induced emf.

$$P = e I \text{ Watt.}$$

$$= N A \frac{dB}{dt} * \frac{HL}{N}$$

$$= ALH \frac{dB}{dt}.$$

And energy consumed during small time dt is,

$$= ALH \frac{dB}{dt} * dt$$

$$= ALH dB \text{ joule.}$$

Total work required for one complete cycle.

$$W = \oint H dB \text{ joules.}$$

Where \oint indicates integration for the whole cycle.

In figure, $H dB$ represents small shade area. So $\oint H dB$ represents the area of the complete loop.

EXPERIMENT: 2

AIM: Measure voltage, current and power on single phase circuit (with resistive load).

APPARATUS:

Sr. No.	EQUIPMENT	SPECIFICATION	QUANTITY
1	Lamp Load	5 Amp	1 No.
2	Volt meter	0-250 Volt	2 No.
3	Ammeter	0-10 Amp	1 No.
4	single phase Variac	10 Amp, 250 Volt	1 No.
5	Wattmeter	2.5 KW, Dynamometer	1 No.

THEORY:

The pure resistors contain only ohmic values and it should not have any inductive effect or value. In circuit a.c. voltage is applied to pure resistor having resistance of R ohm. Due to flow of current I through resistor R, there is a voltage drop of $V_R = IR$ volt which is equal to supply voltage V.

$$V_R = IR$$

$$I = I_M \sin t$$

So the power consumed in resistive circuit also depends upon this angle ϕ . but in resistive circuit power factor angle is zero.

$$P = VI$$

CIRCUIT DIAGRAM:

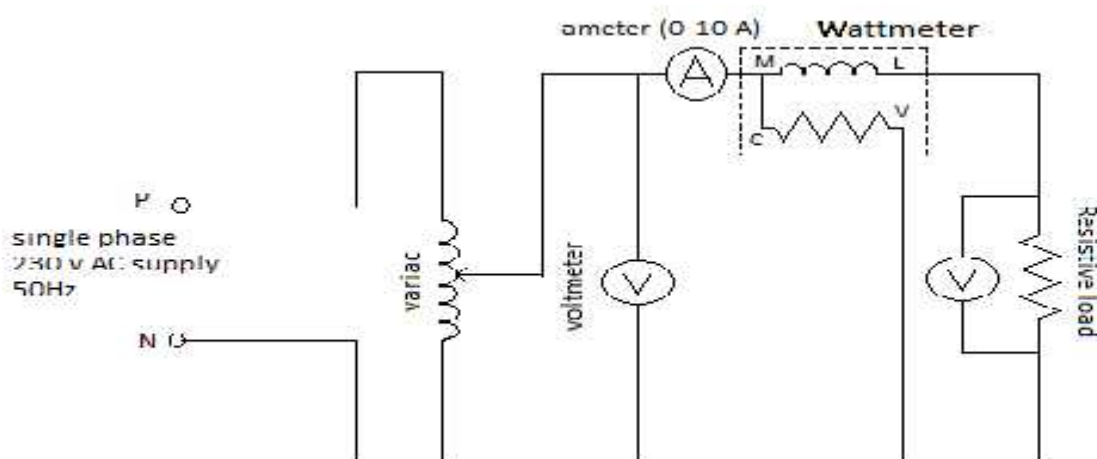


FIG 1.1 (Pure Resistive Circuit)

PROCEDURE:

1. Make connections as shown in the diagram.



2. Keep the switches of the lamps off.
3. Switch on the supply, switch on certain lamps and take the readings of ammeter,
4. Supply voltage, voltage drop across resistor.
5. Vary the current by changing the no of lamps & take readings.
6. Switch off the supply & disconnect the circuit.

OBERVATION TABLE:

Sr. No.	Supply Voltage V_S volts	Current I Amp.	Voltage drop across resistor V_R	Power (watt)
1	230V	0.307A	230V	70.54W
2	230V	0.23A	230V	52.90W
3	230V	0.153A	230V	35.27W

COMPUTATION TABLE:

Sr. No.	$R=V_R/I$	$P=V_R I \cos \phi$
1	749.2	70.61W
2	1000	52.91W
3	1503.26	35.19W

CONCLUSION:



EXPERIMENT: 3

AIM: Measure voltage, current, & power in RL series circuit.

APPARATUS:

Sr. No.	EQUIPMENT	SPECIFICATION	QUANTITY
1	Lamp Load	5 Amp	1 No.
2	Chock coil	10A, 250 V variable	1 No.
3	Volt meter	0-250 Volt	3 No.
4	Ammeter	0-10 Amp	1 No.
5	single phase Variac	10 Amp, 0-250 Volt	1 No.
6	Wattmeter	2.5 kw, Dynamometer	1 No.

THEORY:

In R-L series circuit, as shown in fig 4.1 that resistance of R ohm and inductor of L Henry are connected in series across V volt ac supply. Let current of I ampere be drawn from the mains. So voltage is dropped across resister and inductor. Voltage drop across the resister is $V_R = IR$ and inductor is $V_L = IX_L$ and it leads the vector by 90° . Vector sum of OA and AB is equal to OB which shows applied voltage V. The current is same phase with voltage in case of resister, where as in case of inductor current lags by ϕ .

$$\begin{aligned}(OB)^2 &= (OA)^2 + (AB)^2 \\(V)^2 &= (V_R)^2 + (V_L)^2 \\V &= [(IR)^2 + (IX_L)^2]^{1/2} \\V/I &= [(R)^2 + (X_L)^2]^{1/2} \\Z &= [(R)^2 + (X_L)^2]^{1/2}\end{aligned}$$

Z is called impedance.

So the power consumed in R-L series circuit also depends upon this lagging angle ϕ .

$$P = VI \cos \phi$$

Fig 2.2 is shows the vector diagram of RL series circuit.

CIRCUIT DIAGRAM:

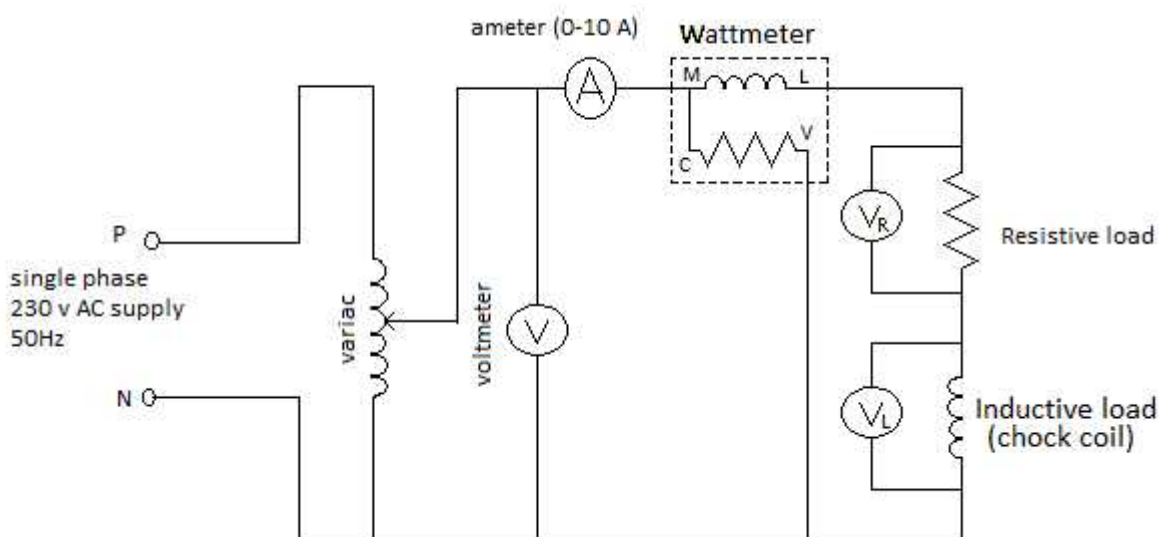


FIG 2.1 (R-L Series Circuit)

PROCEDURE:

- 1) Connect the circuit diagram as shown in circuit diagram.
- 2) Keep the switches of the lamps off.
- 3) Switch on the supply, switch on certain lamps and take the readings of ammeter, Supply voltage, voltage drop across resistor & inductor.
- 4) Vary the current by changing the no of lamps & take readings.
- 5) Switch off the supply & disconnect the circuit.
- 6) Draw vector diagrams & make necessary calculations.

OBSERVATION TABLE:

Sr. No.	Supply Voltage V_s volts	Current I Amp	Voltage drop across resistor V_R	Voltage drop across inductor V_L	Power (watt)
1	230V	0.285A	228.36V	27.25V	65.2W
2	230V	0.375A	225V	47.74V	84.36W
3	230V	0.534A	213.70V	85.02V	114.18W
4	230V	0.687A	171.71V	153.01V	117.94W

COMPUTATION TABLE:

Sr. No.	$R=(V_R/I)$	$X_L=V_L/I$	$Z=[R^2+X_L^2]^{1/2}$	$L = X_L/2\pi f$	$\cos\phi=R/Z$	$P = V_s I \cos\phi$
1	801.26	95.61	807.28	0.304H	0.99	64.89W
2	599.97				0.98	
3	400.18Ω	Ω			0.93	
4	249.94				0.746	

PHASER DIAGRAM:

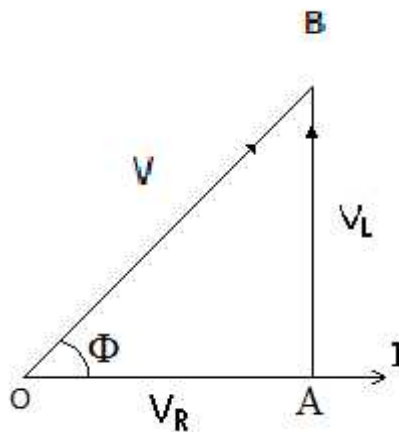


FIG 2.2 (VECTOR DIAGRAM)

CONCLUSION:

EXPERIMENT: 4

AIM: Measure transformation ratio K of single-phase transformer.

Apparatus Required:

Sl	Equipment	Rating	Type	Qua
1.	Volt meter	0-300V	M	2
2.	1-Ø Transformer	3 KVA, 115/230V	1:2 Ratio	1
3.	1-Ø Auto	230V, 0-270V/15A		1

Theory:

The transformation ratio is defined as the ratio of the secondary voltage to primary voltage. It is denoted by the letter K.

Transformation Ratio of Transformer

This constant is called **transformation ratio of transformer**, if $T_2 > T_1$, $K > 1$, then the transformer is step up transformer. If $T_2 < T_1$, $K < 1$, then the transformer is step down transformer.

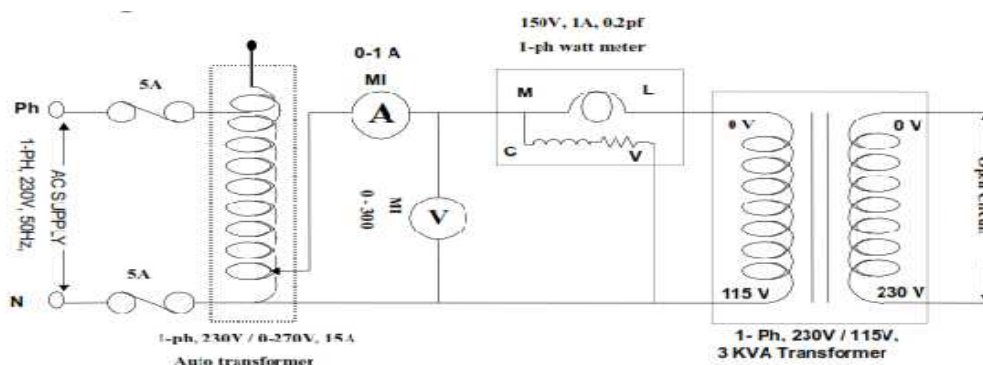
Voltage Ratio of Transformer

This above stated ratio is also known as **voltage ratio of transformer** if it is expressed as ratio of the primary and secondary voltages of transformer.

Turns Ratio of Transformer

As the voltage in primary and secondary of transformer is directly proportional to the number of turns in the respective winding, the transformation ratio of transformer is sometime expressed in ratio of turns and referred as **turns ratio of transformer**.

Circuit Diagram:





Procedure:

- 1) Connections are given as per circuit diagram
- 2) Switch on the power supply
- 3) With the help of Auto-Transformer, Apply voltage to HV side in steps (230V)
- 4) At each step note down Voltmeter, Ammeter and Wattmeter readings
- 5) After reaching maximum voltage of 230V on HV side, the supply is switched off

Tabular Column

Sl No	Primary voltage(V1)	Secondary voltage(V2)	Ratio V2/V1
1	110V	220V	2
2	110V	73.33V	0.66
3	110V	183.32V	1.66

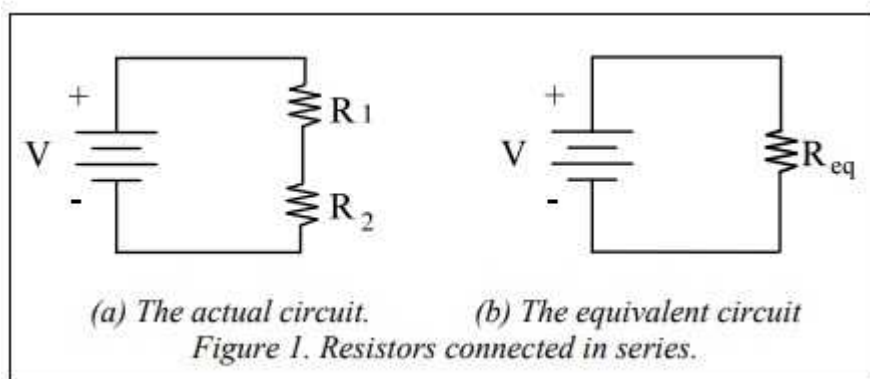
EXPERIMENT: 5

AIM: Connect resistors in series and parallel combination on bread board and measure its value using Digital multimeter.

Objective: In this experiment you will set up three circuits: one with resistors in series, one with resistors in parallel, and one with some of each.

Equipment: Breadboard, Power supply, Resistors, Multi-meter.

Theory: In the first part of this experiment we will study the properties of resistors, which are connected “in series”. Figure 1 show two resistors connected in series (a) and the equivalent circuit with the two resistors replaced by an equivalent single resistor (b), when resistors are connected in series, each one “sees” the same current. Recall the water analogy: We showed that the equivalent resistance for resistors in series is $R_{eq} = R_1 + R_2$.

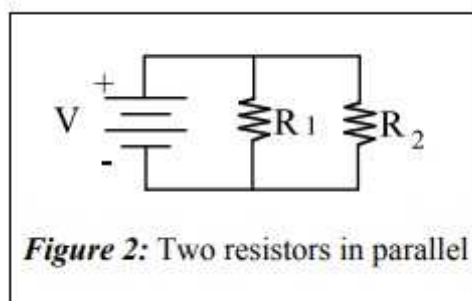


Of course, this equation can be extend to any number of resistors in series, so that for N resistors the equivalent resistance is given by

$$R_{eq} = R_i \text{ (for } i=1,2,3,\dots,N\text{)}$$

or

$$R_{eq} = R_1 + R_2 + R_3 + \dots + R_N.$$



We say these resistors are connected in parallel. In series they were connected one after the other, but in parallel, as the name suggests, they are 'side by side' in the circuit. When resistors are in parallel, the current flowing from the battery will come to a junction where it has a “choice” as to which branch to take. Therefore, they “see” different amounts of current, we calculate



$$1 / R_{eq} = 1 / R_1 + 1 / R_2$$

It's important to remember that after you do this calculation, you will have gotten $1/R_{eq}$.

CONCLUSION:-

