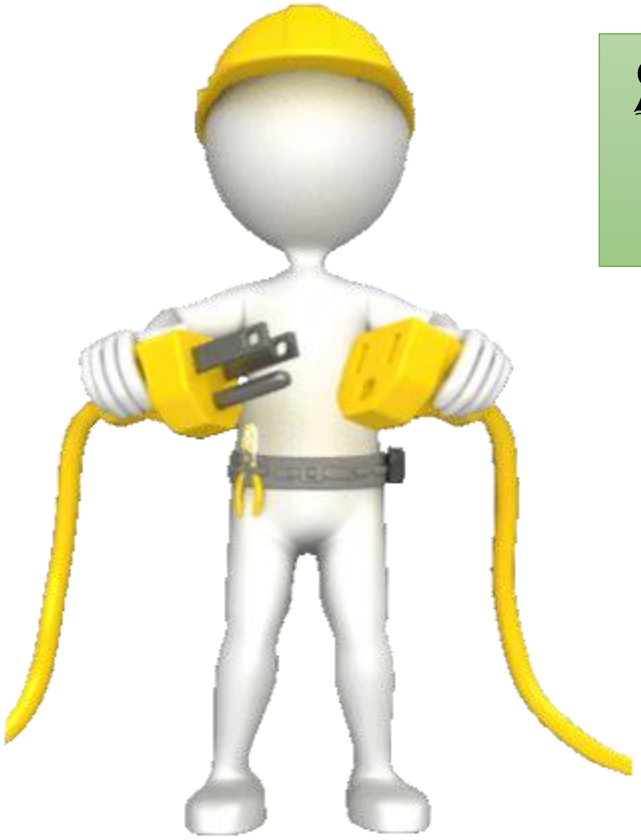
GANPAT UNIVERSITY

U. V. PATEL COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL ENGINEERING



SUBJECT: 2ES103 BASIC ELECTRICAL ENGINEERING (BEE)

BASIC ELECTRICAL ENGINEERING LABORATORY

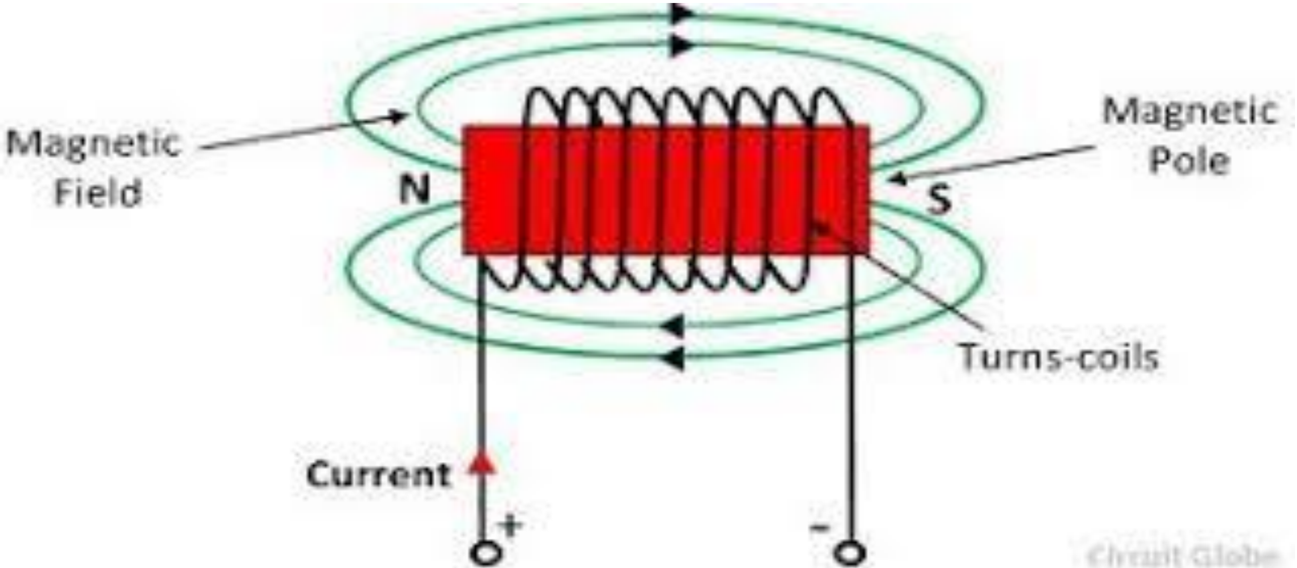
Experiment 2

AIM: To obtain the magnetization characteristics of a given magnetic material.

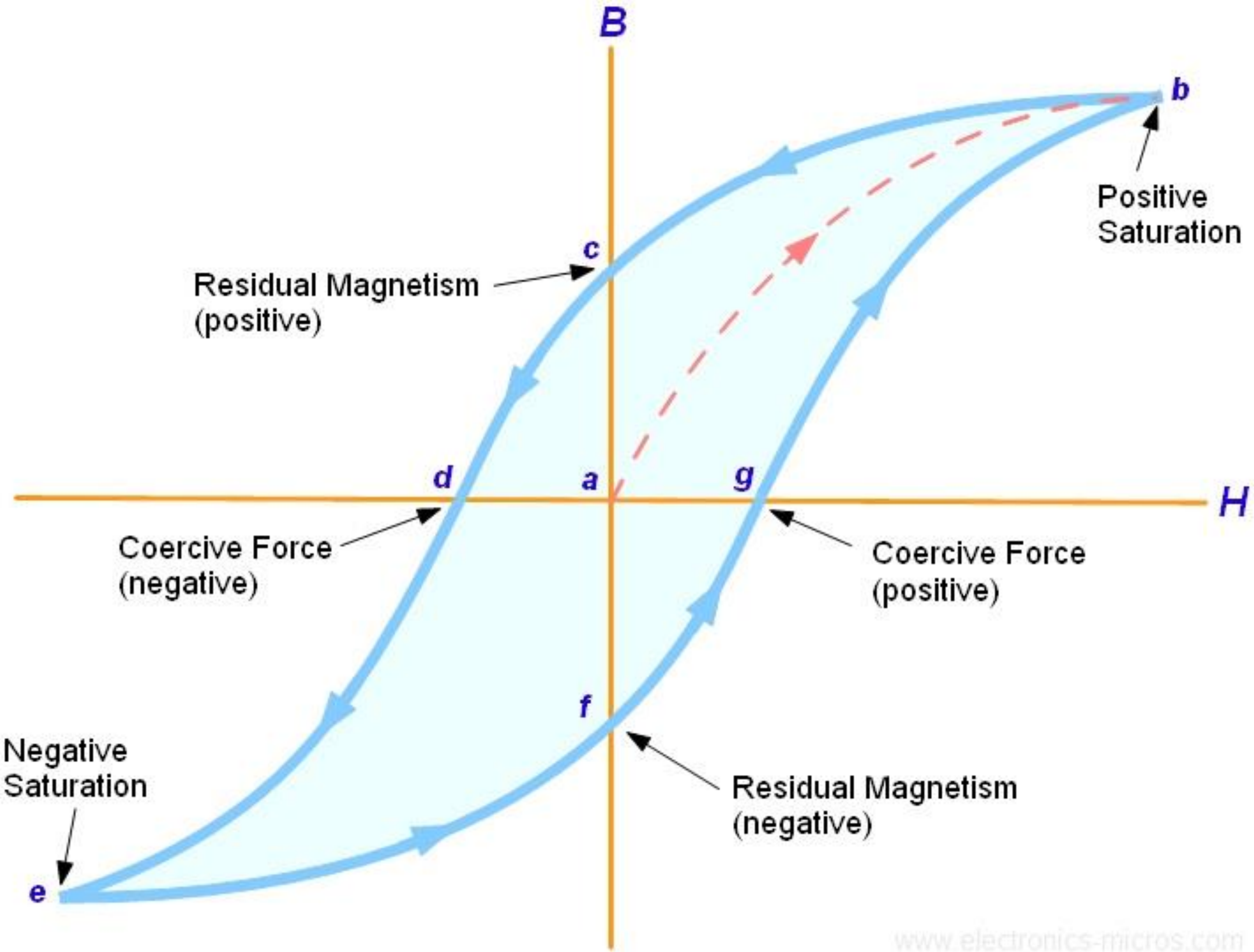
B-H CURVE

- A B-H curve plots changes in a magnetic circuit's flux density to magnetic field strength, as the magnetic field strength is gradually increased or decreased.
- The resulting shape indicates how the flux density increases or decreases due to the gradual alignment of the magnetic domains (atoms, that behave like tiny magnets) within the magnetic circuit material.

- **<u>Magnetic field strength (H):</u>** the magneto motive force per unit length of a magnetic circuit. H = mmf/l = Ni/L, **<u>H α i</u>**
- magneto motive force (mmf) is provided by a current-carrying coil, wound around that magnetic circuit.
- Magneto motive force is the product of the current flowing through the coil and the number of turns, expressed in amperes (although often spoken as "ampere turns"). Mmf = NI
- The magneto motive force gives rise to the magnetic flux within the magnetic circuit, the intensity of which is termed flux density (**<u>symbol B),</u>** expressed in teslas. B = Flux/cross section area Ø (phi) /sq m.



- The complete B-H curve is usually described as a hysteresis loop. The area contained within a hysteresis loop indicates the energy required to perform the 'magnetize - demagnetize' process.



SOME TERMS RELATED TO B-H CURVE

1) MAGNETIC SATURATION

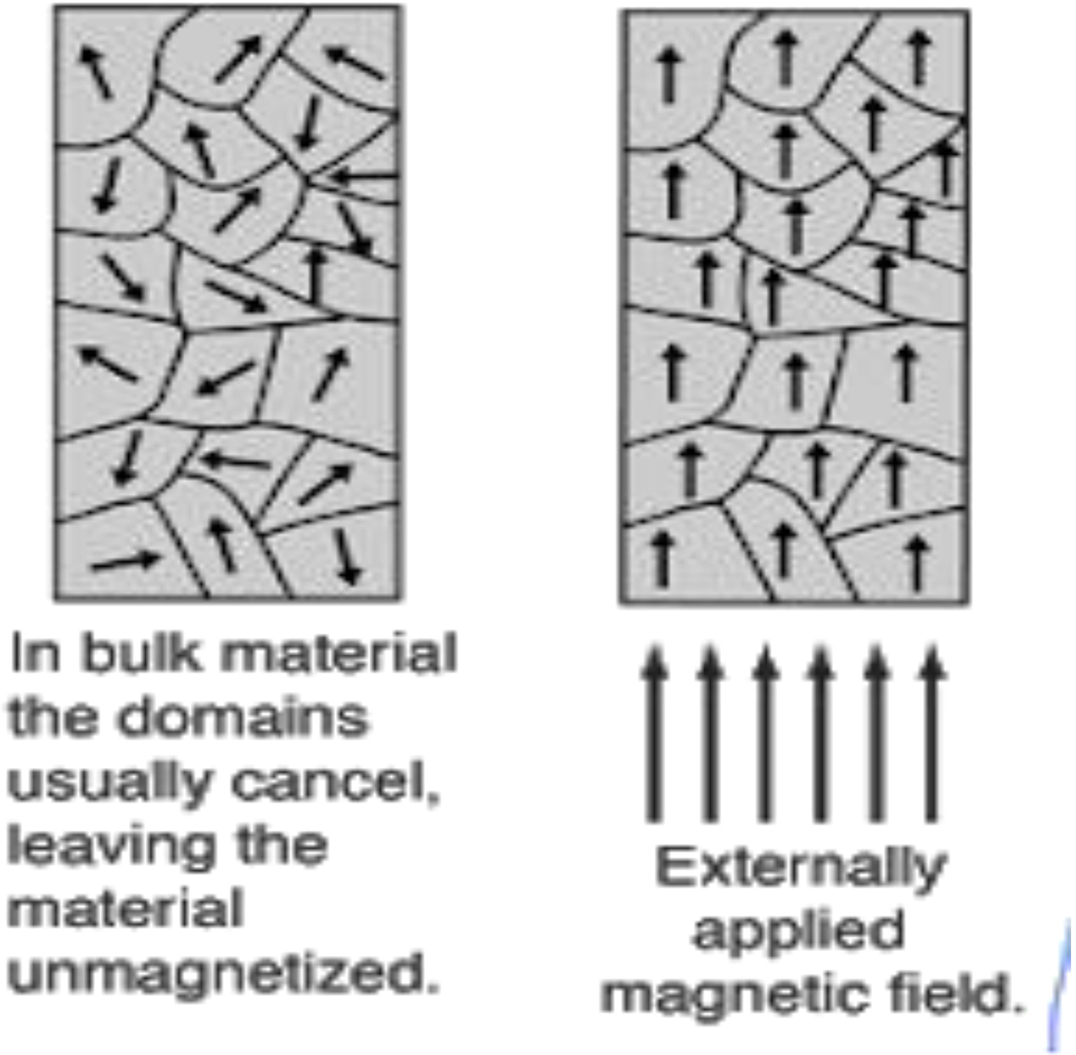
2) RETENTIVITY

3) COERSIVE FORCE

4) MAGNETIC HYSTERESIS

MAGNETIC SATURATION

- when a magnetization current flows through a coil the domains in the coil get aligned.
- When all the domains have aligned, the B-H curve reaches a plateau and the magnetic circuit is said to be saturated.
- At this point, any further increase in magnetic field strength has no further effect on the flux density.
- This is known as magnetic saturation point.



Saturation occurs because the random haphazard arrangement of the molecule structure within the core material changes as the tiny molecular magnets within the material become "lined-up".

- You may notice that the flux density increases in proportion to the field strength until it reaches a certain value were it can not increase any more becoming almost level and constant as the field strength continues to increase.

- This is because there is a limit to the amount of flux density that can be generated by the core as all the domains in the iron are perfectly aligned. Any further increase will have no effect on the value of M, and the point on the graph where the flux density reaches its limit is called Magnetic Saturation, also known as Saturation of the Core.

RETENTIVITY

- The ability to retain some magnetism in the core after magnetization has stopped is called Retentivity or Remanence while the amount of flux density still present in the core is called Residual Magnetism.
- The reason for this that some of the tiny molecular magnets do not return to a completely random pattern and still point in the direction of the original magnetizing field giving them a sort of "memory".
- One way to reduce this residual flux density to zero is by reversing the direction of the current flowing through the coil, thereby making the value of H, the magnetic field strength negative.

COERSIVE FORCES

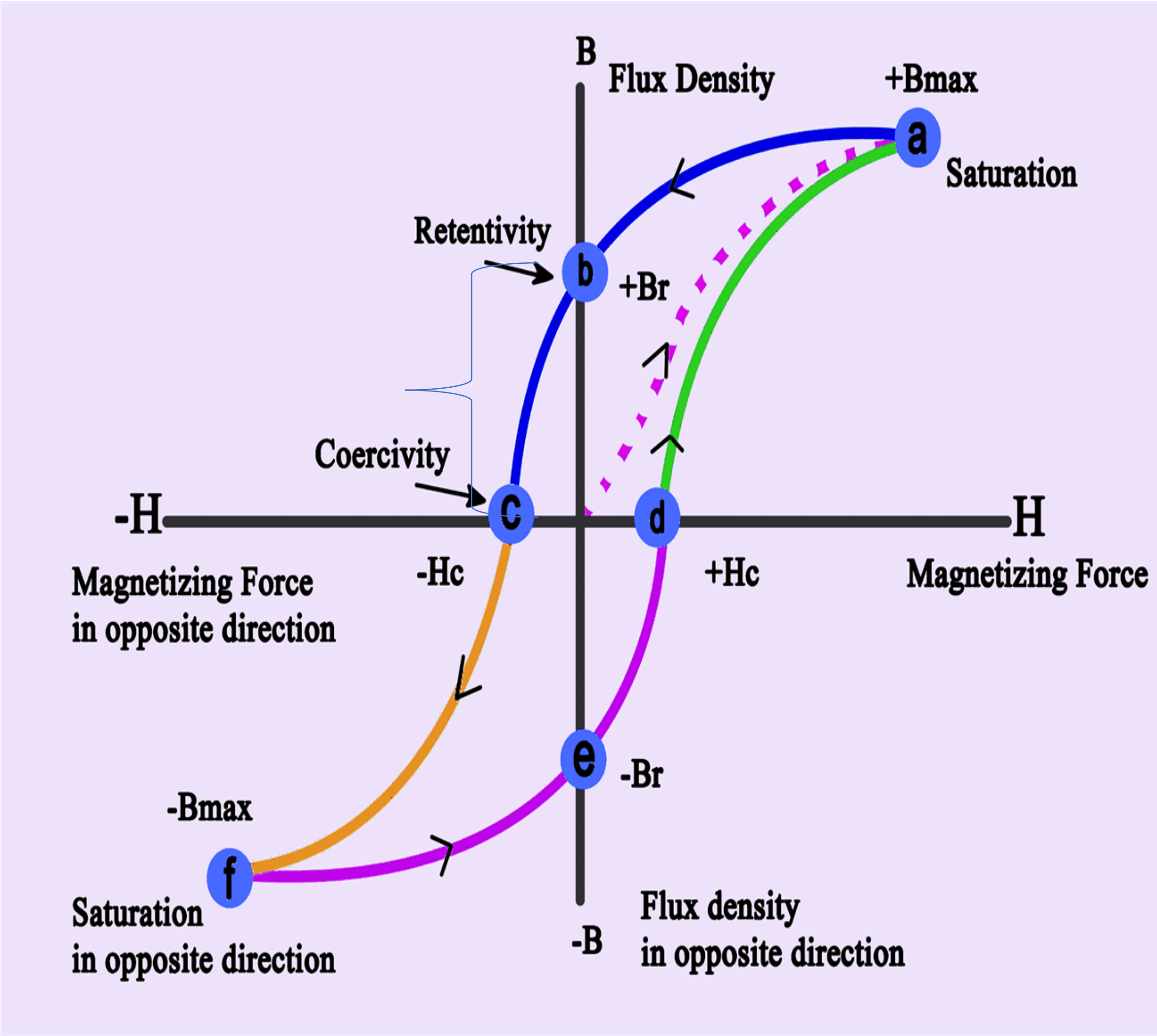
- To reduce the flux density we need to reverse the current flowing through the coil, the magnetizing force which must be applied to null the residual flux density is called coersive forces.
- It reverses the magnetic field rearranging the molecular magnets until the core becomes unmagnetized.
- For materials having low Retentivity (i.e. soft ferromagnetic materials) coercive forces are also low and for materials having high Retentivity (hard ferromagnetic materials) coercive forces are large.

MAGNETIC HYSTERESIS

- The lag or delay of a magnetism due to the magnetization properties of a material by which it firstly becomes magnetized and then de-magnetised is known as magnetic hysteresis.

HOW HYSTERESIS LOOP WORKS ?

- The Magnetic Hysteresis loop shows the behavior of a ferromagnetic core graphically as the relationship between B and H is non-linear.
- Starting with an unmagnetised core both B and H will be at zero, point 0 on the magnetization curve.



1) **<u>0 – a:</u>** If the magnetization current, i is increased in a positive direction to some value the magnetic field strength H increases linearly with i and the flux density B will also increase.

2) **<u>a – b:</u>** if the magnetizing current in the coil is reduced to zero the magnetic field around the core reduces to zero but the magnetic flux does not reach zero due to the residual magnetism present within the core.

- To reduce the flux density at point b to zero we need to reverse the current flowing through the coil.

- An increase in the reverse current causes the core to be magnetised in the opposite direction and increasing this magnetisation current will cause the core to reach saturation but in the opposite direction, point d on the cure which is symmetrical to point b.

- If the magnetizing current is reduced again to zero the residual magnetism present in the core will be equal to the previous value but in reverse at point e.
- Again reversing the magnetizing current flowing through the coil this time into a positive direction will cause the magnetic flux to reach zero, point f on the curve and as before increasing the magnetization current further in a positive direction will cause the core to reach saturation at point a.
- Then the B-H curve follows the path of a-b-c-d-e-f-a as the magnetizing current flowing through the coil alternates between a positive and negative value such as the cycle of an AC voltage.
- This path is called a Magnetic Hysteresis Loop.

Let's start the experiment....

APPARATUS:

(1) MULTIMETER

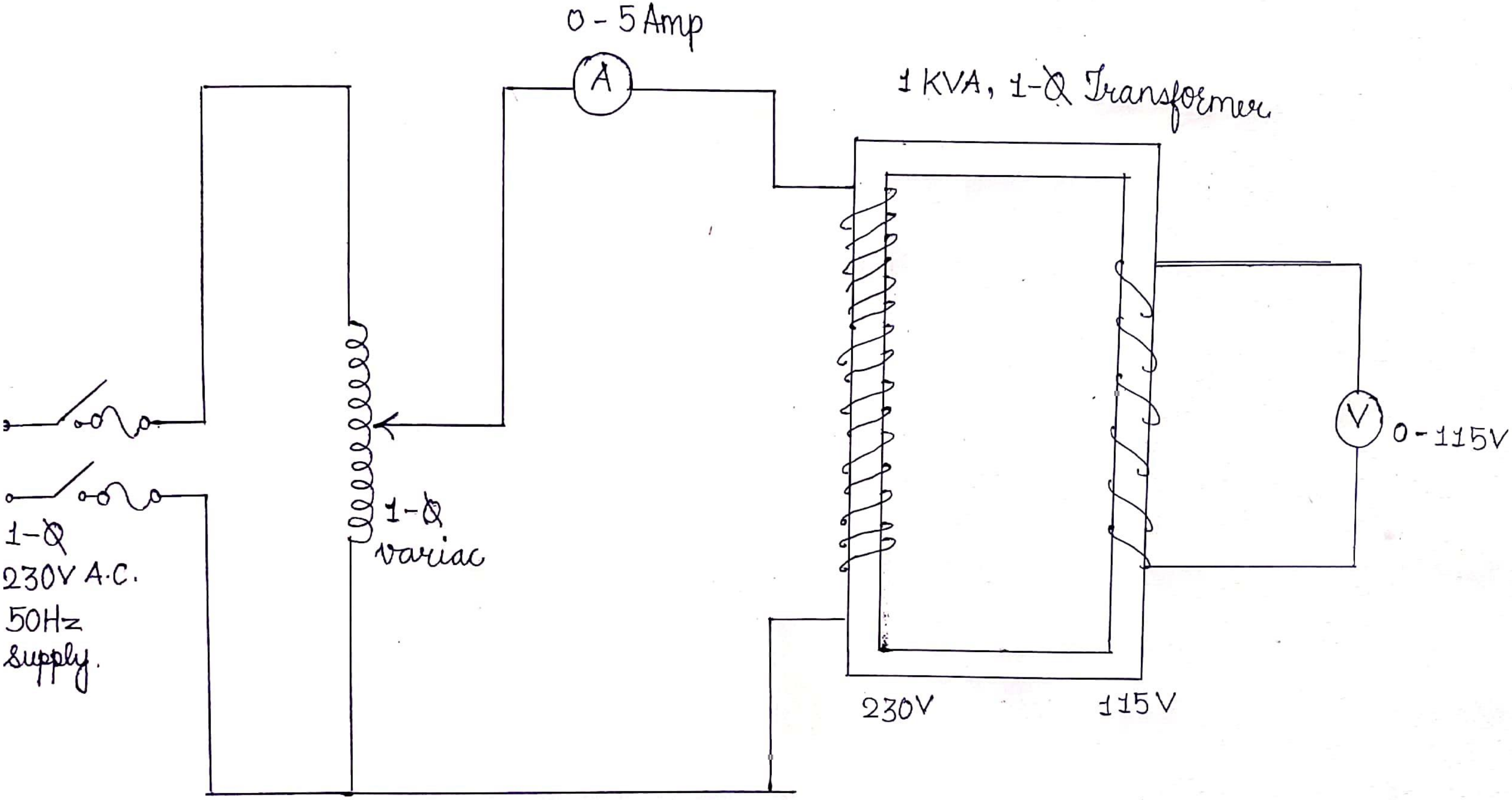
(2) CLAMP METER

(3) Single phase transformer (230V/115V)

(4) Single phase variac

(5) Connecting Wires

CIRCUIT DIAGRAM



PROCEDURE

1. Connect the circuit as shown in the figure.
2. Supply the required voltage.
3. Gradually increase the input voltage with the help of a variac.
4. For the variations of voltage measure the primary current and secondary A.C voltage.

Let’s understand with the video…

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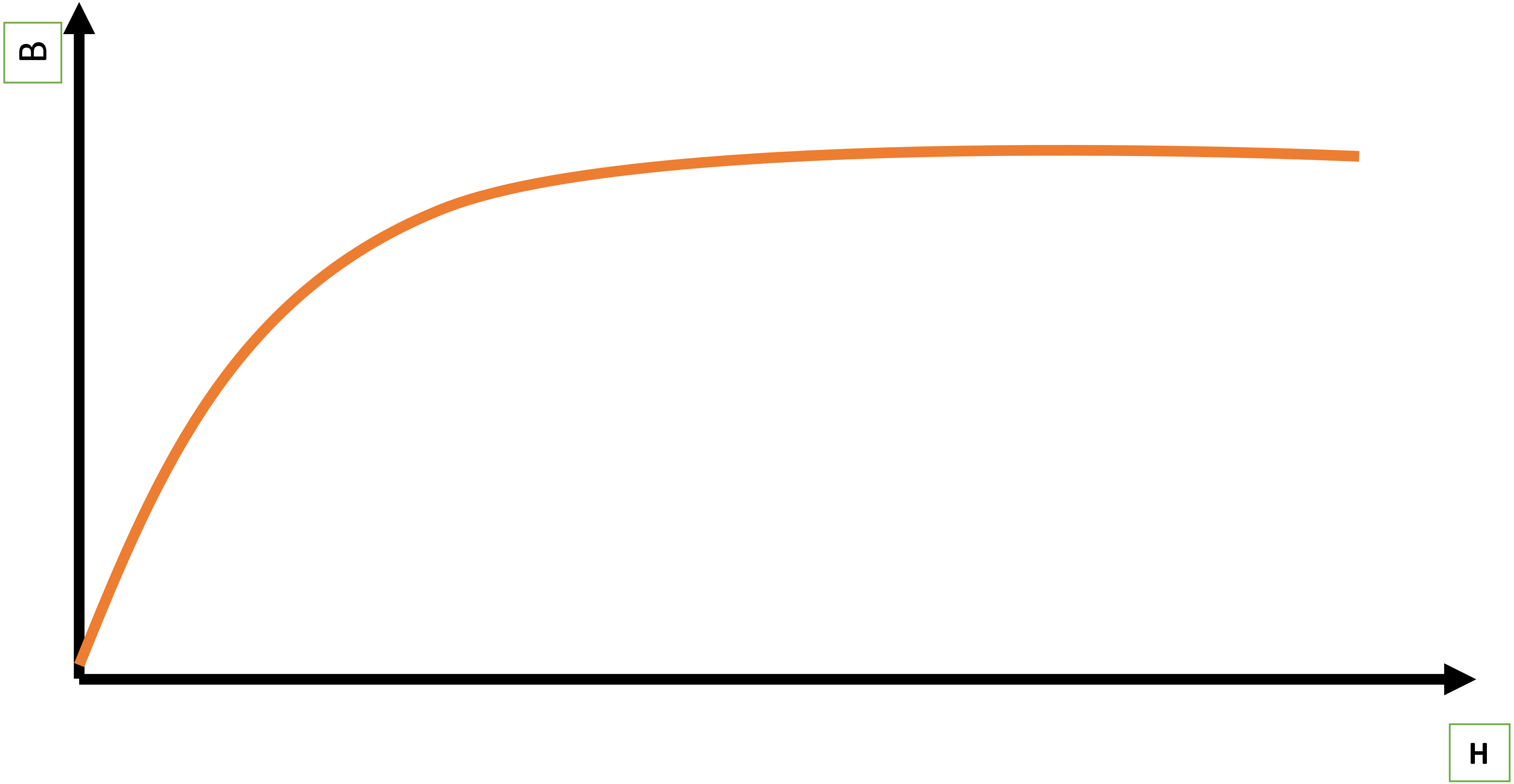
OBSERVATION TABLE

Sr. No.	Current I α H	Voltage V α B
1	0.10	86.5
2	0.2	98.7
3	0.25	102.9
4	0.3	105.6
5	0.35	108
6	0.4	110.9
7	.45	113
8	.5	115
9	0.55	117.7
10	0.6	119
11		
12		
13		
14		
15		

GRAPH:

- Plot the BH curve between V and I



CONCLUSION: