Expt. No 10. **<u>Hysteresis loss</u>**

Aim:

1) Obtain the hysteresis loss of a given magnetic material which is the core of a given transformer through the hysteresis curve method. The voltage of the i/p is taken across a resister is fed to the X axis of CRO and the voltage o/p of cap is fed to the Y axis of CRO, which has a phase diff of 90^0 with i/p.

Apparatus:

CRO, step down transformers (2 no.s), capacitor (10μF), variable resistance box voltmeter, ammeter.

Principle:

Electrical & magnetic oscillations of a magnetic material (i.e B-H curve) can be displayed on the screen of a CRO. To accomplish this, a solenoids primary is fed by an alternating current. The primary carries the specimen core in it & wound round by a secondary of large number of turns. The magnetizing field 'H' is proportional to the current through the primary. And a drop of voltage across a low series resistance is displayed across xx plates of CRO , while the induced e.m.f in the secondary is integrated by RC combination to give an equivalent magnetic induction 'B' & it is displayed across the yy plates of CRO. Thus we obtain B-H curve on CRO by displaying 'H' on X-axis & 'B' on Y-axis.

The energy loss due to hysteresis is calculated from the curve displayed on the CRO screen.

The current flowing through primary is subjected to varying magnetic fields (because of ac field) & hence 'H' is given by

$$H = \frac{4\pi n I_{rms}\sqrt{2}}{10} \quad \text{Oersted.}$$

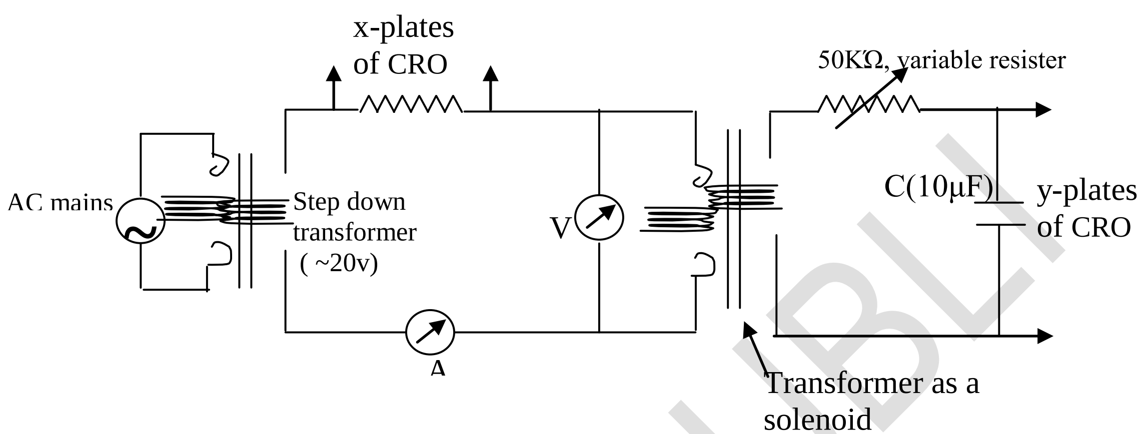
Where I_{rms} = current in amps. & n = number of turns in primary / cm.

Procedure:

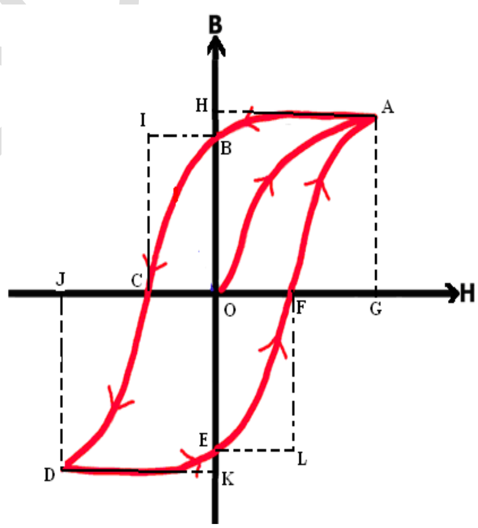
1) The connections are made as shown in the circuit diagram.
2) The x & y gains of CRO, 50KΩ variable resister & the current in the primaries are adjusted to yield the proper shape of the hysteresis loop.
3) The x-plate rheostat is adjusted to make the tips horizontal.
4) The I & V values are noted for a particular shape of the loop.
5) The loop is traced on the graph paper.
6) Area of a loop & area of a rectangle is measured & hysteresis loss / unit cycle /unit volume (W) is measured using the formula,

$$\mathbf{W} = \frac{I \times V \times looparea}{f \times \pi \times rec\tan glearea}$$

Circuit Diagram:



Nature of Graph:



Given: Frequency of AC (*f*) = 50 Hz

Tabulation:

Obs .No	I in mA	V in volts	Area of loop in cm^2	Area of a rectangle in cm^2(I quadrant only)
1				

Calculation of the area of loop PQRSTU

Area of loop in 1st Quadrant

=Area of Rectangle OGAH -[Area of Triangle FGA+Area of Triangle AHB]

=[OG x GA] – [(1/2 x FG x AG) + (1/2 x HB x HA)

-

= ___________________ **sq.cm.**

Area of loop in 2nd Quadrant

=Area of Rectangle OBIC - [Area of Triangle BIC]

= OC x CI – [1/2 x BI x CI]

= ___________________ **sq.cm.**

Area of loop in 3rd Quadrant

= Area of Rectangle OKDJ-[Area of Triangle CJD+ Area of Triangle DKE]

= [JD x DK] – [(1/2 x JC x JD) +(1/2 x DK x KE)]

= ___________________ **sq.cm.**

Area of loop in 4th Quadrant:

Area of Rectangle OFLE -[Area of Triangle ELF]

= OFx OE – [1/2 x EL x FL]

= ___________________ **sq.cm.**

Area of loop OBCDKFA = [Area of loop in 1st Quadrant+ Area of loop in 2nd Quadrant+ Area of loop in 3rd Quadrant+ Area of loop in 4thQuadrant]

= __________________ sq.cm.

Hysteresis loss /unit vol/unit cycle is (W) = $\frac{I \times V \times \text{Area of loop OBCDKFA}}{f \times \pi \times \text{Area of Rectangle OGAH}}$

= __________________ sq.cm.

Result: Hysteresis loss /unit vol/unit cycle is (W) =_____________ Joules/cycle

Viva Questions:

1. What is Ferro magnet?
2. What is hysteresis?
3. What are the differences between hard and soft magnets?
4. What is coercivity?
5. *What are the applications of hard and soft magnets?*