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.
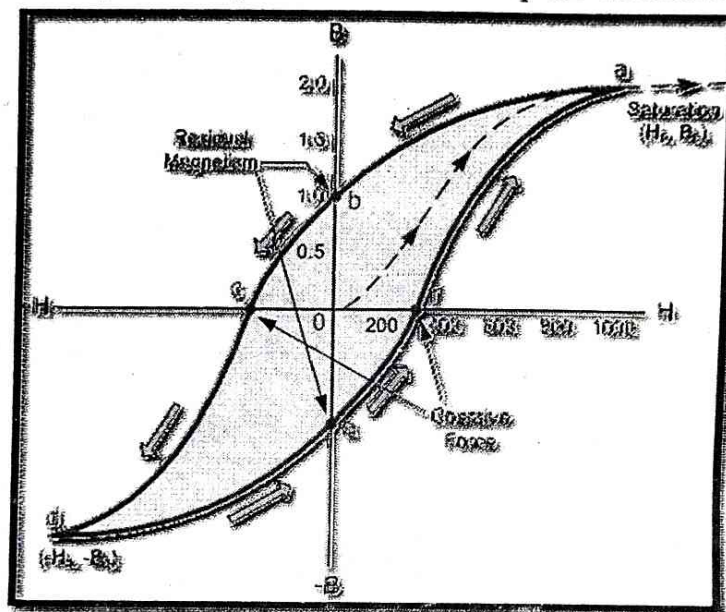

Fig1.1 B-H curve

- 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 Afterward increases in flux density and is presented by Bm.

- 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 m2,

   N= No. of turns around on the bar,

$$\Phi = B*A.$$

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

   e= N dΦ/dt. (Neglecting Negative Sign)

   e= N A 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 l Watt.

   = N A dB/dt * HL/N

   = ALH dB/dt.

And energy consumed during small time dt is,

   = ALH dB/dt * dt

   = ALH dB joule.

Total work required for one complete cycle.

$$W = AL\Phi H\ dB\ joules.$$

Where Φ indicates integration for the whole cycle.

In figure, H dB represents small shade area. So Φ H dB represents the area of the complete loop.