KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

Electric Engineering Department

EE 306 Electric Energy Engineering - Experiment#3

MAGNETIC CIRCUITS

Objective:

1. To determine the B-H characteristics of an iron core
2. To find the relative permeability (μ_r)
3. To calculate the reluctance "R"

Apparatus:

1 Rectangular laminated core
1 coil
1 voltmeter
1 ammeter
1 variable AC supply

Theory:

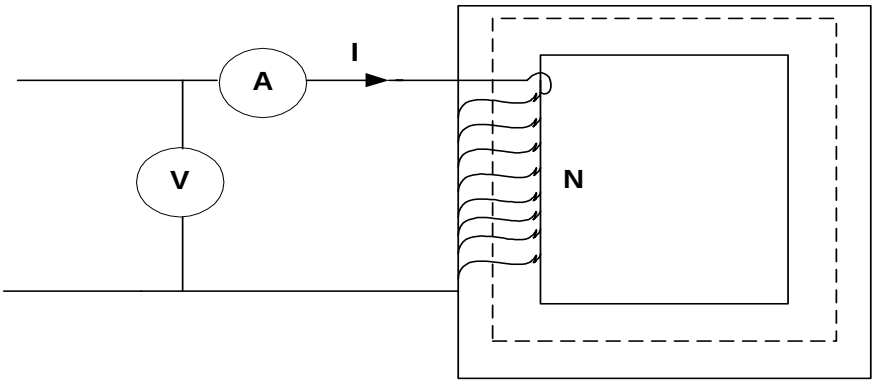

Fig. 1 : A simple rectangular core

If a current of 1 A, flows from a supply of E volts through a coil of N turns, as shown in fig 1, the magnetic field intensity can be written as

$$H = NL / L_C \qquad (1)$$

From faraday's law of electromagnetic induction, the rms values of the induced voltage across the coil (E) is

$$E = \omega N \Phi \qquad (2)$$
$$= \omega N A B$$

$$B = \mu H \qquad (3)$$

From (1), (2) and (3) it is clear that E-I characteristic of the core is equivalent to the B-H characteristic. Further, it can be shown that

$$E = \frac{\omega N^2 A \mu I}{L_c} \qquad (4)$$

Where, the permeability can be written as:

$$\mu = \mu_r \mu_o; \qquad \mu_o = 4 \pi \times 10^{-7} \qquad (H/n)$$

The reluctance of the core can be expressed as:

$$R = NI / \Phi$$
$$= L_c / (\mu A) \qquad (5)$$

Procedure

1. Find the typical dimensions of the core. The instructor may help you to get the accurate numbers.
2. Connect the circuit as in fig 1
3. On a separate sheet of paper make a table as shown below:

Table 1

E	I	K= E / I	μ_r	R

4. Set the input voltage of 10V. Record the current and enter them in table 1.
5. Repeat step 4 up to 150 volts in steps of 10 volts.

Report

1. Plot E Vs I on a graph paper.
2. Find K, and R for each reading and complete the table. Here,

$$K = E / I$$

$$\mu_r = \frac{KLc}{2 \pi f N^2 A \mu_o}$$

3. Plot μ and R as functions of I
4. Derive equations (4) and (5)

Core Dimensions:

L_c = 40 cms
N = 400 turns
A = 9 Sq. cms

