(M1-2)Magnetic Field of a Long Wire

Aim of experiment

Determination of the magnetic field distribution as a function of radial distance of an electric current carrying long straight wire and the magnetic permeability of air.

Apparatus

One Meter Long Copper Wire –A.C Power Supply – Tesla Meter– Ammeter.

Theory of experiment

Electric currents produce magnetic fields. For a current element, *Ids,* the produced magnetic field, *dB* at a radial distance *r,* according to the *Biot-Savart law* is given by

$$dB=\mu_o Ids/r^2$$

For a long straight wire of length *L*, carrying a current of *I (A),* the integration of *Biot-Savart* law produces a magnetic field *B(T)* at a radial distance *r(m)* given by

$$\boldsymbol{B}=\mu_o I/2\pi r$$

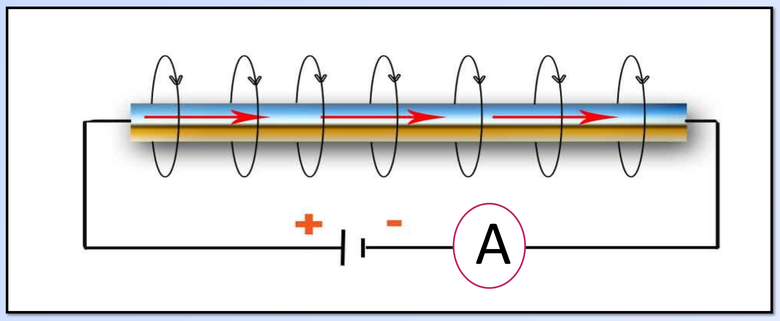

Figure 1. Magnetic field distribution of a long wire carrying current

When a magnetic probe of the tesla meter is placed near from a wire carrying current and perpendicular to its plane, one can measure *B* as a function of the radial distance, *r.* If one draws the relation between B and *1/r*, a straight line of slope $\mu_o I/2\pi$ from which μ_o can be calculated.

Procedure

1. Arrange the circuit as shown in *figure 1.*
2. Pass a measured current (say *1 A*) through the wire and record *B* at different distances r radially from the wire.
3. Repeat step 2 two more times at least.
4. Tabulate the obtained data on a table.
5. Draw a graph between *1/r* on x-axis and B_{av} on y-axis.
6. Determine μ_o.
7. Comment on the graph.

Results

I= *A*

r (m)	*1/r (m^{-1})*	$B_1(T)$	$B_2(T)$	$B_3(T)$	$B_{av}(T)$

$\mu_o=$ *Tm/A*