L12-BET-04Dec2021-Teams6-7

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Concept of Relative Permeability

$$\mu_r = \frac{\mu}{\mu_0}$$

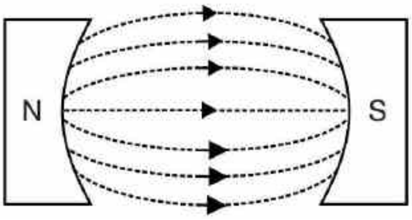
where

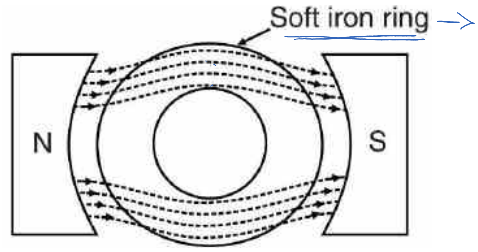
- μ_r is the relative permeability
- μ is the permeability of a substance (absolute)
- μ_0 is the permeability of a vacuum (absolute)

$\mu_0 = 4\pi \times 10^{-7}$ H/m → Air / Free space / Vacuum

$\mu_r \approx 8000$ → (soft iron → pure iron)

$\boxed{\mu_r \approx 50000}$ → (core material → 22% iron, 78% Nickle) (An alloy known as permalloy)





Due to high relative permeability of magnetic materials (e.g. iron, steel, and other magnetic alloys) they are widely used fo r the cores of all electromagnetic equipment.

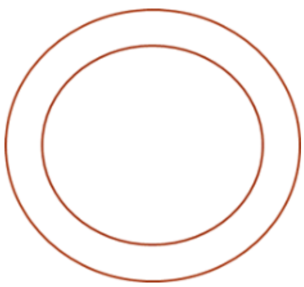
Illustration 1 - Magnetic Circuits

A ring made of ferromagnetic material has 500 mm^2 as cross-sectional area (A) and 400 mm as mean circumference (l). A coil of 600 turns (N) is wound uniformly around it. Calculate:

a) The reluctance of the ring

b) The current required to produce a flux density of 1.6 T in the ring

Take μ_r of the ferromagnetic material as 800 (μ_r) for flux density of 1.6 T (B)



(a)

$$S = \frac{l}{A\,\mu_0\,\mu_r} = \frac{400 \times 10^{-3}}{500 \times 10^{-3} \times 10^{-3} \times 4\pi \times 10^{-7} \times 800}$$

$$= 795774.72\ AT/Wb$$

(b)

$$\emptyset = \frac{mmf}{Reluctance} = \frac{NI}{S}\ or\ B.A = \frac{NI}{S}\ or\ I = \frac{B\ A\ S}{N}$$

$$I = \frac{1.6 \times 500 \times 10^{-3} \times 10^{-3} \times 795774.72}{600} = 1.061\ A$$