Answer to Question #82732, Physics / Electromagnetism

A mild steel ring having a cross sectional area of $500\ mm^2$and a mean circumference of $400\ mm$ has a coil of 200 turns wound uniformly around it. Calculate

a. The reluctance of the ring.

Solution.

The reluctance:

$$R = \frac{L}{A\mu\mu_0}$$

where

$$L = 400\ mm = 0.4\ m$$

$$A = 500\ mm^2 = 5 \cdot 10^{-4}\ m^2$$

$$\mu_0 = 4\pi \cdot 10^{-7}\ N/A^2$$

$$\mu = 1500\ for\ mild\ steel$$

Answer:

$$R = \frac{0.4}{5 \cdot 10^{-4} \cdot 4\pi \cdot 10^{-7} \cdot 1500} = 42.44\ H^{-1}$$

b. The current required to produce a flux of $800\ \mu Wb$ in the ring.

Solution.

The current:

$$I = \frac{\Phi}{A\mu_0 n}$$

where

$$\Phi = 800\ \mu\text{Wb} = 8 \cdot 10^{-4}\ \text{Wb}$$

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$$n = 200\ turns$$

Answer:

$$I = \frac{8 \cdot 10^{-4}}{5 \cdot 10^{-4} \cdot 4\pi \cdot 10^{-7} \cdot 200} = 6.366 \cdot 10^{3}\ A$$