ELEC 344
2nd Tutorial

Review Magnetic Circuits
& Examples

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Ex 1.1)

Fig E1.1 represents the magnetic circuit of a primitive relay. The coil has 500 turns and the mean core path is 360mm. When the air gap lengths are 1.5mm each, a flux density of 0.8 T is required to actuate the relay. The core is cast steel.

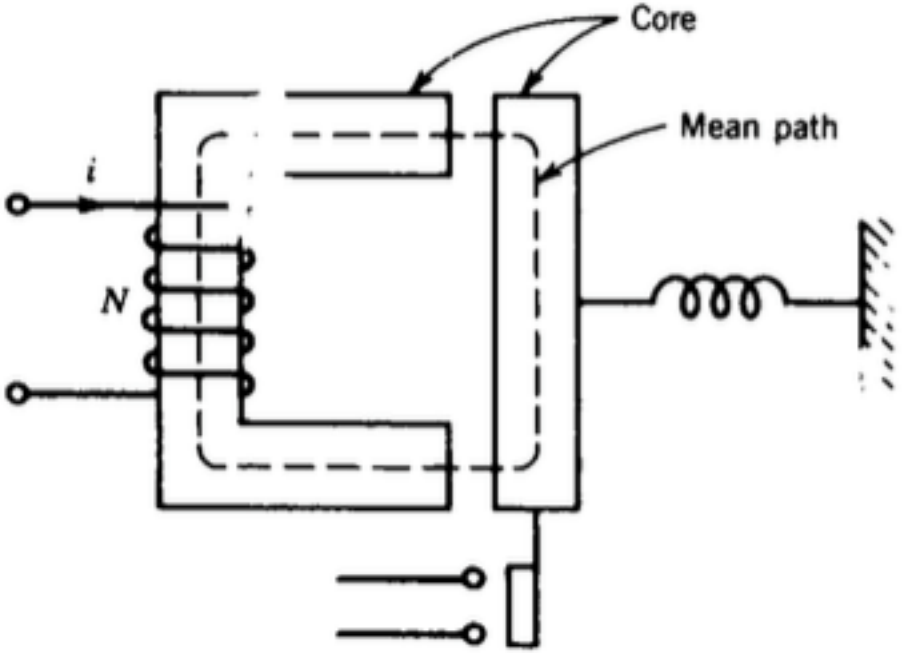

FIGURE E1.1 $N = 500$ turns, $l_c = 36$ cm.

Ex 1.1) Continued

(a) Find the current in the coil.

(b) Compute the values of permeability and relative permeability of the core.

(c) If the air gap is zero, find the current in the coil for the same flux density (0.8 T) in the core.

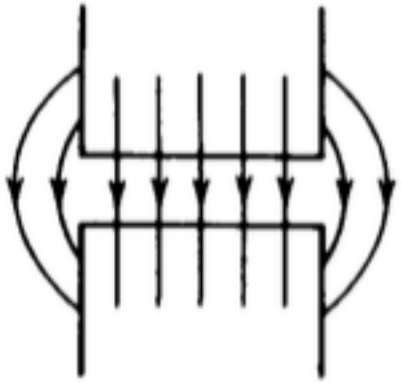

FIGURE 1.10 Fringing flux.

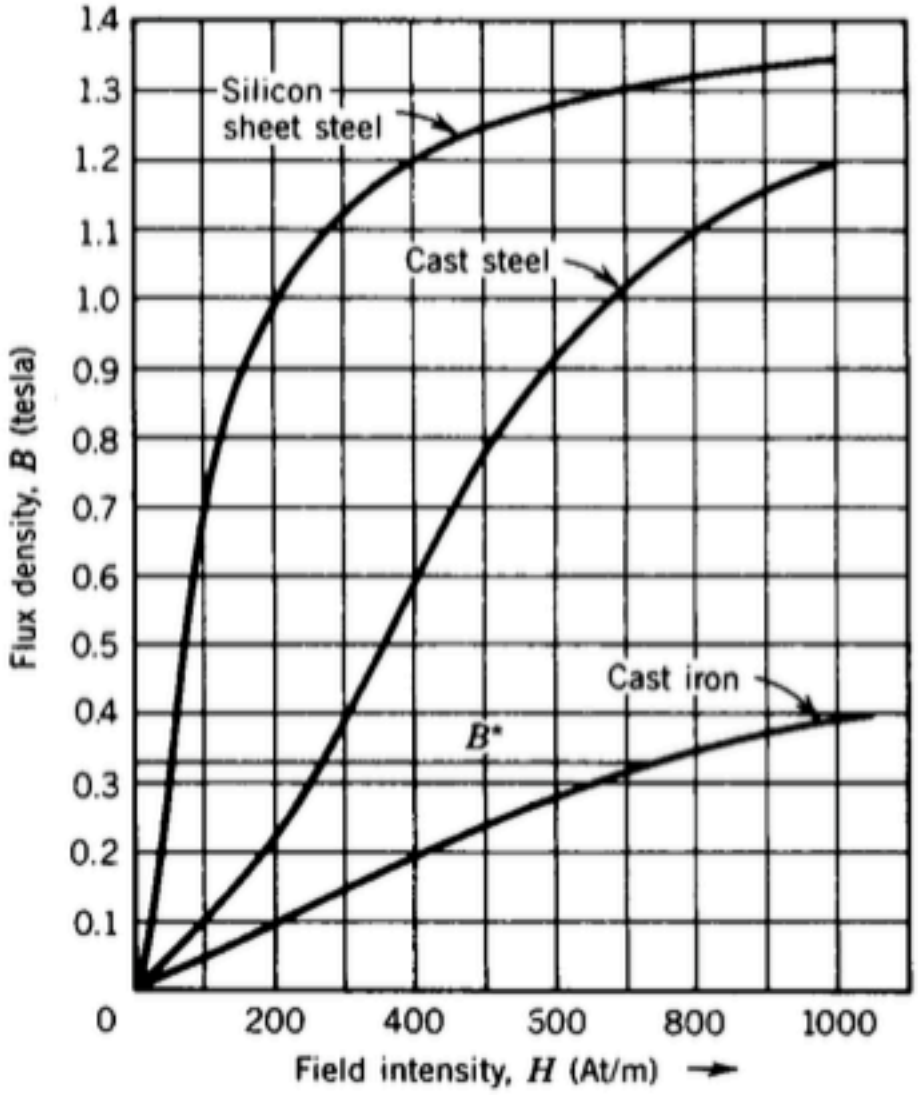

FIGURE 1.7 Magnetization curves.

Ex 1.1) Solution

Assumption: For small air gap, the fringing effect can be neglected.

(a) Find the current in the coil.

- For the core,

  $B_c = 0.8$ T, $H_c = 450$ At/m (from the magnetization curve in the Figure 1.7.

  mmf $F_c = H_c l_c = 450 * 0.36 = 162$ At

- For the air gap,

  mmf $F_g = H_g 2l_g = B_g 2l_g / \mu_0 = 0.8 * 2 * 1.5 * 10^{-3} / 4\pi 10^{-7} = 1910$ At

- Total mmf required:

  $F = F_c + F_g = 162 + 1910 = 2072$ At

- Current required:

  $i = F / N = 2072 / 500 = 4.144$ A

Ex 1.1) Solution

Assumption: For small air gap, the fringing effect can be neglected.

(b) Compute the values of permeability and relative permeability of the core.

- Permeability of core,

  $\mu_c = B_c / H_c = 0.8 / 450 = 1.78 * 10^{-3}$

- Relative permeability of core,

  $\mu_r = \mu_c / \mu_0 = 1.78 * 10^{-3} / 4\pi 10^{-7} = 1416$

Ex 1.1) Solution

Assumption: For small air gap, the fringing effect can be neglected.

c) If the air gap is zero, find the current in the coil for the same flux density (0.8 T) in the core.

- For the core,

  $F = H_c \, l_c = 450 * 0.36 = 162$ At

- Current required,

  $i = F / N = 162 / 500 = 0.324$ A