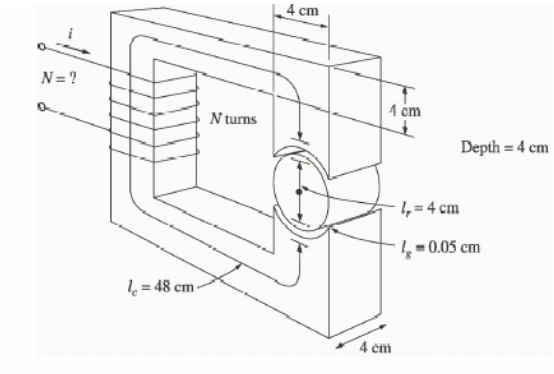
ELG3311: Tutorial for Chapter 1

P1-17



(a) From Figure 1-10c&d, a reasonable maximum flux density would be about 1.2 T.
(b) At flux density of 1.2 T, the total flux in the core would be

$$\phi = BA = (1.2)(0.04\text{mm})(0.04\text{m}) = 0.00192\text{Wb}$$

(c) The total reluctance of the core is

$$R_T = R_{\text{stator}} + R_{\text{airgap1}} + R_{\text{rotor}} + R_{\text{airgap2}}$$

At flux density of 1.2 T, the relative permeability μ_r is 3800. We find the total reluctance by adding the reluctance of each part

$$R_{\text{stator}} = \frac{l_{\text{stator}}}{\mu_{\text{stator}} A_{\text{stator}}} = \frac{0.48\text{m}}{(3800)(4\pi \times 10^{-7}\,\text{H/m})(0.04\text{m})(0.04\text{m})} = 62.8\,\text{kA.t/Wb}$$

$$R_{\text{rotor}} = \frac{l_{\text{rotor}}}{\mu_{\text{stator}} A_{\text{rotor}}} = \frac{0.4\text{m}}{(3800)(4\pi \times 10^{-7}\,\text{H/m})(0.04\text{m})(0.04\text{m})} = 5.2\,\text{kA.t/Wb}$$

$$R_{\text{airgap1}} = R_{\text{airgap2}} = \frac{l_{\text{airgap}}}{\mu_{\text{airgap}} A_{\text{airgap}}} = \frac{0.00005\text{m}}{(1)(4\pi \times 10^{-7}\,\text{H/m})(0.0018\text{m}^2)} = 221\,\text{kA.t/Wb}$$

$$R_T = 62.8 + 221 + 5.2 + 221 = 510\,\text{kA.t/Wb}$$

The required MMF is

$$\Im_T = \phi R_T = (0.00192\ \text{Wb})(510\,\text{kA.t/Wb}) = 979\ \text{A.t}$$

$$\Im_T = Ni\ (\text{since the current is 1 A so } N \text{ is around 1000})$$

P1-18

(a)

$$S = VI^* = (208\angle -30^o \text{ V})(5\angle 15^o \text{ V}) = 1040\angle -45^o \text{ VA}$$

(b) The load is capacitive

(c) The power factor = PF = cos (-45^o) = 0.707

(d) This load supplies reactive power to the source. The reactive power of the load is

$$Q = VI\sin\theta = (208)(5)\sin(-45^o) = -735 \text{ VAR}$$