L10 – Series Magnetic Circuits – QUIZ 02 – Solutions

01 Calculate the magneto motive force required to produce a flux of 0.015 Wb across an air gap of 2mm long having an effective area of 200 sq.cm

Solution

$$Sg = \frac{(2\ x\ 10^{-3})}{(4\pi\ x\ 10^{-7})(1)(200\ x\ 10^{-4})} = 79577.47\ AT/Wb$$

$$MMF = \Phi \times Sg = 0.015 \times 79577.47 = 1193.66\ AT$$

02 A coil of 1000 turns is wound on a ring having relative permeability of 1, mean circumference of 100cm and a uniform cross-sectional area of 200mm2. If the current flowing through the coil is 2A. Find magnetic field strength

Solution

$$H = \frac{NI}{l} = \frac{1000\ x\ 2}{100\ x\ 10^{-2}} = 2000\ AT/m$$

03 For the Question 2. Calculate the Flux Density

Solution

$$S = \frac{(100\ x\ 10^{-2})}{((4\pi\ x\ 10^{-7})(1)(200\ x\ 10^{-6})} = 3978873577\ \frac{AT}{Wb}$$

$$\Phi = \frac{NI}{S} = \frac{1000\ x\ 2}{3978873577} = 0.5026\mu Wb$$

$$B = \frac{\emptyset}{A} = \frac{0.5026\mu}{200\ x\ 10^{-6}} = 2.513mWb$$

04 An iron ring has a cross-section of 3 cm2 and a mean circumference of 25 cm. An air-gap of 0.4 mm has been cut across the section of the ring. The ring is wound with a coil of 200 turns through which a current of 2 A is passed. If the total magnetic flux is 0.24 mWb, find the relative permeability of iron, assuming no magnetic leakage.

Solution

$$B = \frac{\emptyset}{A} = \frac{0.24}{3\ x\ 10^{-4}} = 0.8\ Wb/m^2$$

$$MMF_{iron} = H \times l = \frac{B}{\mu 0\ \mu r}\ l = \frac{0.8\ x\ 0.25}{4\pi\ x\ 10^{-7}\ \mu r} = \frac{1.59\ x\ 10^{-5}}{\mu r}$$

$$MMF_{gap} = \frac{0.8}{4\pi\ x\ 10^{-7}}\ x\ 0.4x\ 10^{-3} = 255$$

MMF $_{Total}$ = 200 x = 400 = $\frac{1.59\ x\ 10^{-5}}{\mu r} + 255$ Solving we get μ_r = 1096

05 A ring has a diameter of 21 cm and a cross-sectional area of 10 cm2. The ring is made up of semicircular sections of cast iron and cast steel, with each joint having a reluctance equal to an air-gap of 0.2 mm. Find the ampere-turns required to produce a flux of 80 mWb. The relative permeability of cast steel and cast iron are 800 and 166 respectively. Neglect fringing and leakage effects.

Solution

Diameter = 21cms, So Circumference = length of core = 65.97cm
Airgap = 0.4cm
Length of iron & Steel = (65.97 cm – 0.4mm) / 2 = 32.9cm

$S_g = \frac{0.2\ x\ 10^{-3}}{(4\pi\ x\ 10^{-7})(10\ x\ 10^{-4})} = 159154.94\ AT/Wb$

$S_{iron} = \frac{32.9\ x\ 10^{-2}}{(4\pi\ x\ 10^{-7})(166)(10\ x\ 10^{-4})} = 1580366\ AT/Wb$

$S_{steel} = \frac{32.9\ x\ 10^{-2}}{(4\pi\ x\ 10^{-7})(800)(10\ x\ 10^{-4})} = 327262\ AT/Wb$

S_{total} = 2225937 AT/Wb

MMF = 80m x 2225937 = 178075AT