Unit 02. Magnetic Circuits & Electromagnetism

01 A laminated soft iron ring of relative permeability 1000 has a mean circumference of 800 mm and a cross-sectional area 500 mm2. A radial air-gap of 1 mm width is cut in the ring which is wound with 1000 turns. Calculate the current required to produce an air-gap flux of 0.5 mWb

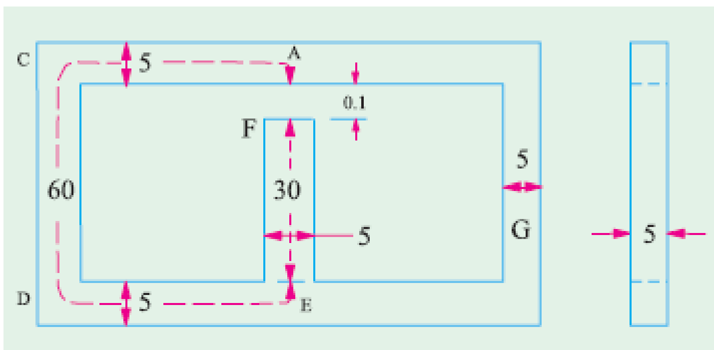
Answer : 1.432A

02 A mild steel ring of 30 cm mean circumference has a cross-sectional area of 6 cm^2 and has a winding of 500 turns on it. The ring is cut through at a point so as to provide an air-gap of 1 mm in the magnetic circuit. It is found that a current of 4 A in the winding, produces a flux density of 1 T in the air-gap. Find (i) the relative permeability of the mild steel and (ii) inductance of the winding.

Answer : μ_r = 197.5 & L =0.075 H

03 Cast steel d.c. electromagnet shown in Fig. below has a coil of 1000 turns on its central limb. Determine the current that the coil should carry to produce a flux of 2.5 mWb in the air-gap. Neglect leakage. Dimensions are given in cm. The magnetization curve for cast steel is as under:

Flux density (Wb/m^2)	0.2	0.5	0.7	1.0	1.2
Mag Field Strength H (AT/m)	300	540	650	900	1150



Answer : I = 1.39A

04 A magnetic circuit with a uniform cross-sectional area of 6 cm2 consists of a steel ring with a mean magnetic length of 80 cm and an air gap of 2 mm. The magnetizing winding has 540 ampere-turns. Estimate the magnetic flux produced in the gap. The relevant points on the magnetization curve of cast steel are:

Flux density (Wb/m^2)	0.12	0.14	0.16	0.18	0.20
Mag Field Strength H (AT/m)	200	230	260	290	320

Answer: Φ = 0.1128 m Wb

05 A coil of resistance 100 Ω is placed in a magnetic field of 1 mWb. The coil has 100 turns and a galvanometer of 400 Ω resistance is connected in series with it. Find the average e.m.f. and the current if the coil is moved in 1/10th second from the given field to a field of 0.2 mWb.

Answer: E = 0.8V & I = 1.6mA

06 An iron rod, 2 cm in diameter and 20 cm long is bent into a closed ring and is wound with 3000 turns of wire. It is found that when a current of 0.5 A is passed through this coil, the flux density in the coil is 0.5 Wb/m2. Assuming that all the flux is linked with every turn of the coil, what is (a) the B/H ratio for the iron (b) the inductance of the coil? What voltage would be developed across the coil if the current through the coil is interrupted and the flux in the iron falls to 10 % of its former value in 0.001 second?

Answer: (a) $B/H = 6.67 \times 10-5$ H/m (b) $L = 0.94$H (c) $e_L = 424$V

07 Two coils, A of 12,500 turns and B of 16,000 turns, lie in parallel planes so that 60 % of flux produced in A links coil B. It is found that a current of 5A in A produces a flux of 0.6mWb while the same current in B produces 0.8 mWb. Determine (i) mutual inductance and (ii) coupling coefficient.

Answer: $M = 1.15$H & $k = 0.586$

08 A primary coil having an inductance of 100 µH is connected in series with a secondary coil of 240 µH and the total inductance of the combination is measured as 146 µH. Determine the coefficient of coupling.

Answer: $M = 97$µH