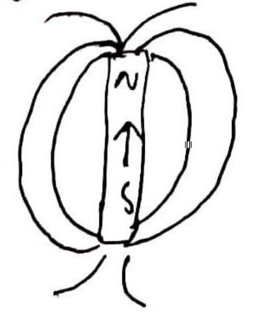
19/09/2019

Magnetism

1. Permanent Magnets :
   - Retain magnetism even if magnetic force removed.

2. Electromagnet
   - magnetism only if c̄ flow through coils.

- Magnetic Induction: The process by which magentising material becomes a magnet when place near a field.
- Magnetic field : The space surrounding a magnet where an magnetic effect can be detected.



→ Lines of force : * N → S outside
  * S → N inside.
  * Closed path.

- Magnetic flux :(ϕ ⇒ Wb) → ϕ , unit = Wb
  Total lines on an magnetic field
- Magnetic flux Density : flux passing through unit area at ⊥ to plane
  B $\xrightarrow{\text{unit}}$ Wb/m^2

$$\boxed{B = \frac{\phi}{A}}$$

- Permeability (μ): ~~Abb~~ Ability of material to pass the mag. field flux is called permiability or absolute permeabity.

permeability of Space, $\boxed{\mu_0 = 4\pi \times 10^{-7}\ H/m}$

relative permiability, $\boxed{\mu_r = \frac{\mu}{\mu_0}}$

$\mu_{r(space)} = 1$

- Magnetic field Intensity or (Magnetising force) (H) ~~$\frac{\phi}{A}$~~

at a pnt ~~is the~~ in the magnetic field is the force experienced by a unit north pole placed @ a pnt.

$$\boxed{\mu_0 = \frac{B}{H} \text{ or } \mu_r = \frac{B}{\mu_0 H}}$$

- Magnetic motive force (MMF) r_0 mmf

Magnetic pressure required to produce magnetic flux in a magnetic circuit.

~~MF =~~ $\boxed{\text{Motive force} = NI \quad \text{unit} \rightarrow \text{Ampere-turns}}$, N-no. of turns.

- Relectance (S): opposition offered to magnetic lines of force in a magnetic circuit

Analogous to Resistance

* depends on material

$$\boxed{S = \frac{l}{\mu A}}$$, unit ATurns/Wb

$$\boxed{S = \frac{mmf}{flux} = \frac{NI}{\phi}}$$

- Permeance : Permeance = $\frac{1}{S}$

Mag. Circuits	Electric Circuit
$\phi = \frac{mmf}{S}$	$I = \frac{emf}{R}$
$S = \frac{1}{\mu}\left(\frac{l}{A}\right)$	$R = \rho\frac{l}{A}$
$S = \frac{1}{P}$	$R = \frac{1}{G}$

23/09/2019

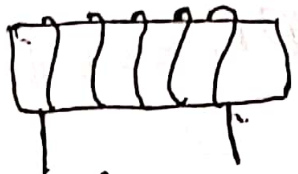
Magnetic Circuits

Clossed path followed by magnetic lines of force.

Simple magnetic crt

→ 1 magnetic material

→ Solenoid



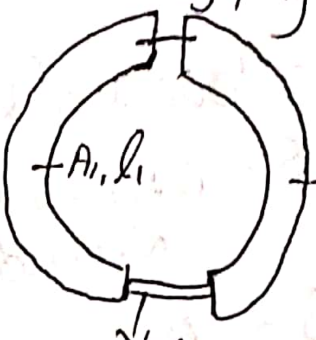
$$\left\{ \begin{aligned} & \left(S = \frac{l}{\mu A}\right) \\ & \oint H.dl = \mu_0 NI \\ & Hl = NI \\ & H = \frac{NI}{l} \end{aligned} \right\}$$

Composite magnetic crt

→ Closed loops through various magn. material

→ Reluctance.

→



$$S_1 = \frac{l_1}{\mu_1 A_1}, \quad S_2 = \frac{l_2}{\mu_2 A_2}$$

$$S_3 = \frac{l_3}{\mu_3 A_3}, \quad S_4 = \frac{l_g}{\mu_0 A_g}$$

$$S_{total} = S_1 + S_2 + S_3 + S_4$$

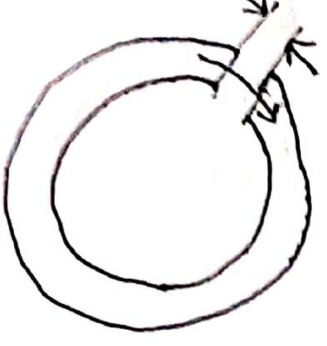
? An iron ring having A of 400 mm^2 & mean circumference of 500 mm carries a coil of 250 turns wound uniformly around it. Calculate

a) Reluctance of the ring

b) Current required to produce a flux of 1000 mW in the ring.

$\mu_{r_{fe}} = 400.$

(neglect leakage & fringing.) → Area Same.



ans) $S = \frac{NI}{\phi}$

Series magnetic crct.

$S_1 + S_g = S$

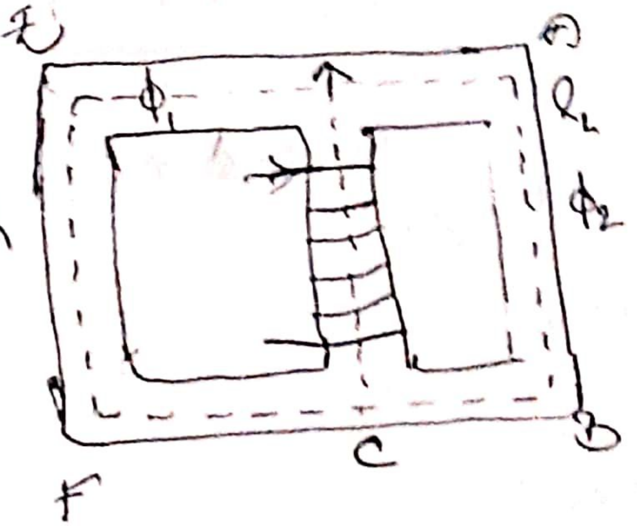
$$\frac{15\times10^{-2}}{12\times10^{-4}\times800\times4\pi\times10^{-7}} + \frac{1\times10^{-3}}{12\times10^{-4}\times4\pi\times10^{-7}} = S$$

$S = 787485.39$ AT/Wb

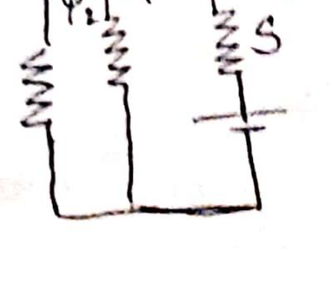
7.8×10^{5} AT/Wb

mmf $= S\times\phi =$

11/10/2019 Parallel magnetic Circuit



$\phi = \phi_1 + \phi_2$



Total mmf = mmf required to produce ϕ + mmf required to produce ϕ_1 or ϕ_2

$= \phi . S + \phi_1 S_1$ or $\phi S + \phi_2 S_2$

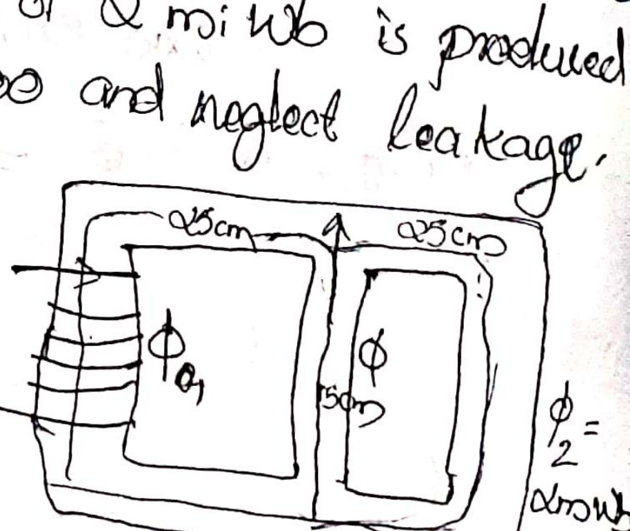
$S = \frac{l_c}{\mu A_c}$; l_c - central limb.

A_c - area of central limb

$S_1 = \frac{l_1}{\mu A_1}$, $S_2 = \frac{l_2}{\mu A_2}$

? A cast steel magnetic structure, made from a bar section 8cm×2cm is shown in the fig. Determine the current that 500 turns magnetising coil on the left limb should carry so that a flux of 2 mWb is produced in the right limb. $\mu_r = 600$ and neglect leakage.

→ $A_c = 16\,cm^2 = 16 \times 10^{-4}\,m^2$



$S = \frac{mmf}{\phi} = \frac{NI}{\phi}$ $\quad \frac{l_1}{\mu A_1}$

$S = \frac{15 \times 10^{-2}}{600 \times 4\pi \times 10^{-7} \times 16 \times 10^{-4}} = 1.24 \times 10^5$

$\phi_1 = \phi + \phi_2$

Total mmf $= \phi_1 S_1 + \phi_2 S_2$

$S_1 = \frac{15 \times 10^{-2}}{600 \times 4\pi \times 10^{-7} \times 8 \times \cancel{\ldots} \times 10^{-4}}$