magnetic flux density (B):

The magnetic flux per unit area through a loop of small area is called the magnetic flux density, B. at the location of the loop.

It is a vector quantity. Its unit is tesla or weber/m^2.

The magnetic flux through any closed surface is the surface integral of the normal component of $\vec{B}$, that is

$$\phi = \int_s B_n da = \int_s \vec{B} \cdot d\vec{a}.$$

magnetic field strength H & magneto-motive force $\mathcal{F}$:

In a homogeneous medium, $\vec{B}$ is related to the current $\vec{I}$ through

$$\vec{B} \propto \frac{\mu \vec{I}}{r} \quad \text{——— (1)}$$

r = distance from the wire
μ = constant depends upon the medium.

μ is called the permeability and may be written as

$$\mu = \mu_v \mu_r$$

μ_v = absolute permeability
$= 4\pi \times 10^{-7}$ H/m

μ_r = relative permeability
$= 1$ (in vacuum)
$\cong 1$ (in air).

$\therefore \mu = \mu_v$

The proportionality factor is found to be $\frac{1}{2\pi}$, so the relation becomes

$$\vec{B} = \frac{\mu \vec{I}}{2\pi r} = \mu \vec{H}$$

where, $\boxed{\vec{H} = \frac{\vec{I}}{2\pi r} \quad A/m}$

The line integral is

$$\mathcal{F} = \int_a^b \vec{H} \cdot d\vec{s}$$

is defined as the magnetomotive force between the points a and b.

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For the circular path,

$$\mathcal{F} = \oint \vec{H} \cdot d\vec{s} = I$$

This equation known as Ampere's work law or Ampere's circuital law.

$$\mathcal{F} = nI$$

where n = number of turns.

$$\therefore H \simeq \frac{I}{2\pi R} = \frac{\mathcal{F}}{2\pi R} = \frac{nI}{2\pi R} = \frac{nI}{l} \text{ ampere turns/m}$$

where $l = 2\pi R$ = length of the coil.

Ampere's work law in Differential form:

$$\vec{\nabla} \times \vec{H} = \vec{J}$$

Maxwell's equations:

The electromagnetic equation are known as Maxwell's equations.

Differential form:	Integral form
i) $\vec{\nabla} \times \vec{H} = \dot{\vec{D}} + \vec{J}$	i) $\oint \vec{H} \cdot d\vec{s} = \int (\dot{\vec{D}} + \vec{J}) \cdot d\vec{a}$
ii) $\vec{\nabla} \times \vec{E} = -\dot{\vec{B}}$	ii) $\oint \vec{E} \cdot d\vec{s} = -\int \dot{\vec{B}}\, d\vec{a}$
iii) $\vec{\nabla} \cdot \vec{D} = \rho$	iii) $\oint \vec{D} \cdot d\vec{a} = \int \rho\, dv$
iv) $\vec{\nabla} \cdot \vec{B} = 0$	iv) $\oint \vec{B} \cdot d\vec{a} = 0$

⊕ magnetic field:

The area around a magnet within which magnetic force is exerted, is called a magnetic field.

It is produced by moving electric charge.

⊕ Difference Electric & magnetic field:

Electric	magnetic
i) created around electric charge.	i) created around moving electric charge & magnets
ii) Its unit is N/m or V/m	ii) Its unit is Gauss or Tesla.
iii) Its pole is monopole or dipole.	iii) Its pole is dipole

⊕ Faraday's induction law: $\vec{E} = \vec{c}\vec{B}$

Statement:

The induced electromotive force is any closed circuit is equal to the negative of the time rate of change of the magnetic flux enclosed by the circuit.

$$\therefore EMF = -\frac{d\phi}{dt}$$

$$\therefore V = -\frac{d\phi}{dt}$$

* magnetomotive force is called magnetic voltage.

The first two maxwell eqⁿ. can be stated

1) The magnetic voltage around a closed path is equal to the electric current through the path.

$V = I$

$V = I$

11) The electric voltage " " " " " " " " magnetic current through the path.

$I = V$

Stokes theorem :

$$\oint_C \vec{A} \cdot d\vec{s} = \int_S \vec{\nabla} \times \vec{A} \cdot d\vec{a}$$

$d\vec{s} = \hat{t}\, ds$ and $d\vec{a} = \hat{n}\, da$.

magnetic flux:

magnetic flux is a measurement of the total magnetic field which passes through a given area.

$$\phi = A \cdot B \cos\theta$$

A = Area
B = magnetic flux density

magnetic field strength (H):

It is a vector quantity, having the same direction as the magnative flux density.

It is denoted by $\vec{H}$.

$$\vec{H} = \frac{\vec{B}}{M}$$