Magnetic Permeability (μ):

It is the degree to which the magnetic lines of force can penetrate in a substance placed in a magnetizing field.

It is also defined as the ratio of magnetic induction to the magnetizing field. It is denoted by μ and given by:

$$\mu = \frac{B}{H}$$

In free space $\mu = \mu_0 = 4\pi \times 10^{-7} wbA^{-1}m^{-1}$

Magnetic permeability measures the degree of concentration magnetic lines of force through magnetic materials.

Relative permeability (μ_r):

It is defined as the ratio of magnetic permeability of any medium to that of free space. It is a unit less quantity.

It is denoted by μ_r and given by,

$$\mu_r = \frac{\mu}{\mu_0}$$

Magnetic susceptibility (χ):

It is defined as the ratio of intensity of magnetization to the magnetizing field. It is denoted by χ and given by,

$$\chi = \frac{Intensity\ of\ magnetization\ (I)}{Magnetic\ Intensity\ (H)}$$

- ✓ It has no unit.
- ✓ Magnetic susceptibility gives the information that how easily a magnetic substance can be magnetized.
- ✓ Susceptibility of iron core is more as compared to steel because iron is easily magnetized than steel.
- ✓ The value of magnetic susceptibility gives the idea about Diamagnetic $(-ve, small - \chi)$, Paramagnetic $(+ve, small - \chi)$ and Ferromagnetic $(+ve, very\ high - \chi)$ materials.

Relation between relative permeability & magnetic susceptibility:

Suppose a magnetic material is placed in a uniform magnetic field such as inside a solenoid. The applied magnetic field B_0 magnetizes the material and aligns the magnetic dipole of material so as the induce a magnetic field B_{in} of their own. At any point in medium, the total magnetic field is the sum of magnetic field applied (B_0) and induce magnetic field (B_{in}).

i.e.

$$B = B_0 + B_{in}$$

$$\Rightarrow B = \mu_0 H + \mu_0 I$$

$$\Rightarrow B = \mu_0 H\left(1 + \frac{I}{H}\right)$$

$$\Rightarrow \frac{B}{H} = \mu_0\left(1 + \frac{I}{H}\right)$$

$$\Rightarrow \mu = \mu_0(1 + \chi) \quad [\mu = \frac{B}{H}\ \&\ \chi = \frac{I}{H}]$$