



DEPARTMENT OF PHYSICS AND NANOTECHNOLOGY SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

18PYB101J-Electromagnetic Theory, Quantum Mechanics, Waves and Optics

Module I Lecture-4

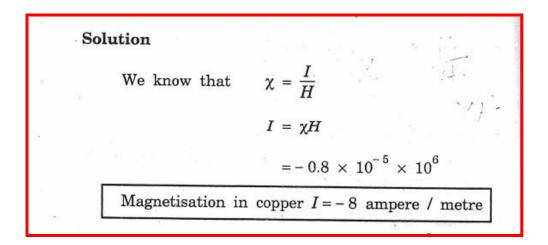
Solving Problems





1. The magnetic field strength of copper is 10⁶ ampere/metre. If the magnetic susceptibility of copper is -0.8×10⁻⁵, calculate the magnetic flux density and magnetisation in copper.

Given data Magnetic field strength $H = 10^6$ ampere/metre Susceptibility of copper = -0.8×10^{-5}







$$\mu_r = 1 + \chi = 1 + (-0.8 \times 10^{-5})$$

$$= 1 - 0.8 \times 10^{-5}$$

$$\mu_r = 0.999$$

$$B = \mu H$$

$$[: \mu = \mu_r \mu_0]$$

$$= \mu_r \mu_0 H$$

$$[: \mu_0 = 4\pi \times 10^{-7} \text{ henry}]$$

$$= 0.999 \times 4\pi \times 10^{-7} \times 10^6$$

$$B = 0.999 \times 4 \times 3.14 \times 10^{-7} \times 10^6$$
Magnetic flux density $B = 1.26$ weber / metre²





2. A magnetic field of 1800 ampere/metre produces a magnetic flux of 3×10⁻⁵ Weber in an iron bar of cross sectional area 0.2 cm². Calculate permeability.

Given data

Magnetizing field H = 1800 ampere/metre

Magnetic flux $\phi = 3 \times 10^{-5}$ weber

Area of cross section $A = 0.2 \text{ cm}^2 = 0.2 \times 10^{-4} \text{ m}^2$





Solution

Magnetic flux density
$$B = \frac{\phi}{A}$$

Substituting the given values, we have

$$B = \frac{3 \times 10^{-5}}{0.2 \times 10^{-4}}$$

 $B = 1.5 \text{ weber / metre}^2$

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

$$\mu = \frac{1.5}{1800}$$

Permeability μ = 8.333 \times 10⁻⁴ henry/metre





3. A magnetic field strength of 2×10^5 amperes/metre is applied to a paramagnetic material with a relative permeability of 1.01. calculate the values of B and M.

Hints:

$$\mathbf{M} = \mathbf{H}(\boldsymbol{\mu}_r - 1)$$

$$\mathbf{B} = \mu_0(\mathbf{M} + \mathbf{H})$$

Ans: 0.2537 Wbm⁻²