SRM
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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 10^6 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}

Solution

We know that $\chi = \dfrac{I}{H}$

$$I = \chi H$$

$$= -0.8 \times 10^{-5} \times 10^{6}$$

$$\boxed{\text{Magnetisation in copper } I = -8 \text{ ampere / metre}}$$

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

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

$$\mu_r = 0.999$$

$$B = \mu H$$

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

$$= \mu_r \mu_0 H$$

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

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

$$B = 0.999 \times 4 \times 3.14 \times 10^{-7} \times 10^{6}$$

$$\boxed{\text{Magnetic flux density } B = 1.26 \text{ weber / metre}^2}$$

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 cm^2. 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 $B = \dfrac{\phi}{A}$

Substituting the given values, we have

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

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

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

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

$$\boxed{\text{Permeability } \mu = 8.333 \times 10^{-4} \text{ henry / metre}}$$

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:

$M = H(\mu_r - 1)$

$B = \mu_0(M+H)$

Ans: 0.2537 Wbm^{-2}