DPP 04

SOLUTION

Link to View Video Solution: Click Here

1. $f_2 = \mu_0 n_1 l_1 \times A_2 N_2$

$M = \frac{\phi_2}{I_1} = \frac{\mu_0 N_1 N_2 A_2}{\ell_1}$

$= \frac{4\pi \times 10^{-7} \times 4000 \times 2000 \times 4 \times 10^{-4}}{200 \times 10^{-2}} = 6.4\pi \times 10^{-4} H$

2. $EMF = -\frac{d\phi}{dt}$

$= \left(\frac{\pi a^2 \mu_0 \omega}{2\,b}\right)^2 \frac{I\cos\,2\omega t}{R}.$

3. $\varepsilon_1 = -L\frac{di}{dt}$

$100 = L \times \frac{0.25}{0.25 \times 10^{-4} s}$

$L = 100 \times 10^{-4} = 10^{-2}$ Henry.

$L = 10mH$

4. Magnetic field at center due to hexagon

$B_C = 6\left[\frac{\mu_0 I}{4\pi\, a\sin 60} 2\sin 30\right]$

$B_c = \frac{3\mu_0 I}{\pi a \times \frac{\sqrt{3}}{2}} \times \frac{I}{2} = \frac{\sqrt{3}\mu_0 I}{\pi a}$

$\phi_r = \frac{\sqrt{3}\mu_0 I}{\pi a} \cdot \pi r^2$

$\phi_r = \frac{\sqrt{3}\mu_0 I r^2}{a}$

$M = \frac{\phi}{I} = \frac{\sqrt{3}\mu_0 r^2}{a}$

$K = 3$

5. The magnetic field due to current carrying wire at the location of square loop is

$B = \frac{\mu_0}{4\pi} \frac{2\pi i R^2}{(R^2 + 3R^2)^{3/2}} = \frac{\mu_0 i}{16R}$

The mutual induction

$M = \frac{N\phi}{i} = \frac{2}{i}\left[\frac{\mu_0 i}{16R} \times a^2 \cos\,45^\circ\right]$

$\therefore M = \frac{\mu_0 a^2}{2^{7/2} R}$

Link to View Video Solution: Click Here

6. Using KVL

$V_x - V_y = L\frac{dI}{dt} = 10$ volt.

7. $L = \frac{\mu_0 N^2 \pi r^2}{\ell}$

length of wire $= N\,2\pi r =$ Constant $(= C$, suppose $)$

$\therefore\ L = \mu_0\left(\frac{C}{2\pi r}\right)^2 \frac{\pi r^2}{\ell}\ \ \therefore\ L \propto \frac{1}{\ell}$

$\therefore$ Self inductance will become 2 L.

8. $EMF = \left|-M\frac{dI}{dt}\right| 25 \times 10^{-3} = M \times 15$

or $M = \frac{5}{3} \times 10^{-3} H$

$\phi = MI = \frac{5}{3} \times 10^{-3} \times 3.6 = 6.00 mWb.$

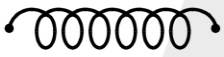
9. $\phi = M \times I$

$\frac{\int_d^{d+b} B \cdot ds}{I} = M$

$M = \frac{\mu_0 a}{2\pi} \ell n\ \frac{b+d}{d}$ Hence $M \propto a$.

10. $M_{max} = \sqrt{L_1 L_2} = 200 mH.$

11. As the flux in the ring due to wire will be zero hence mutual inductance will be zero.

12. 

Using ; $V_A - V_B = RI + L\frac{dI}{dt}$

$140 = 5R + 10\,L$

$60 = 5R - 10\,L$

$\Rightarrow\ L = 4H.$