Prerequisite 2: Assignment

Foundations of Electromagnetic Principles

Submitted by:

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Problem Statement:

As a physicist working in a research laboratory specializing in electromagnetic studies and applications, your team is conducting experiments to investigate Faraday's law, Lenz's law, and the principles of inductance in electrical circuits. The focus of your research is on understanding electromagnetic induction and inductance phenomena through experimental setups involving coils and magnetic fields.

Tasks to be Performed:

1. Faraday's Law

Given:
During the experiment, a coil with 200 turns experiences a change in magnetic flux at a rate of 0.5 T/s. Calculate the electromotive force (EMF) induced in the coil according to Faraday's Law.

Solution:
Formula:
$E = -N*d\Phi B/dt$
$= - 200 * 0.5$
$= - 100$ V

The magnitude of the induced EMF is **E=100 V**

The negative sign indicates the direction of the induced EMF, which is determined by Lenz's Law.

2. Lenz's Law

Given:
Another coil with 150 turns is placed in the vicinity of the first coil. The magnetic flux through the second coil changes at a rate of 0.3 Wb/s. Calculate the induced voltage (EMF) in the second coil based on Lenz's Law.

Solution:
Formula:
$E = -N*d\Phi B/dt$
$= - 150 * 0.3$
$= - 45$ V

The magnitude of the induced EMF is **E=45 V**

As before, the negative sign indicates the direction of the induced voltage, which opposes the change in flux, per Lenz's Law.

3. Self-Inductance of Solenoid

Given:
A solenoid with 500 turns of wire has a cross-sectional area of 0.02 m^2 and a length of 0.5 m.
Calculate the self-inductance of the solenoid.

Solution:
Formula:
L = μo (N^2 * A / L)
= 4π*10^−7* ((500) ^2 * (0.02)) / 0.5)
= 1.25*10^-6 *((2500) *(0.02) / 0.5)
=1.25*10^-6* (5000/0.5)
=1.25*10^-6*(10000)
= 0.0125 H (or) 12.5 MH
The self-inductance of the solenoid is approximately **L=12.57mH**

4. Self – Inductance of Solenoid

Given:
The first coil has a self-inductance of 0.1 H, and the second coil has a self-inductance of 0.05H. the coefficient of coupling between the coils is 0.8. Calculate the mutual inductance between the coils.

Solution:
Formula:
M= k √L1L2
= 0.8 √ 0.1*0.05
= 0.05657 H (or) 56.57 mH

The mutual inductance between the coils is approximately **56.57mH**