Date: 4/23/98

To: Rebecca Wang, EE 275 Graduate Teaching Assistant
Department of Electrical Engineering

From: Randy Dimmett
EE 275 A2 Laboratory

Subject: Faraday's Law

In this lab, Faraday's and Lenz's law were studied. A time-varying magnetic field was created and used to produce electromotive force (emf). This emf was measured in given circuit paths, demonstrating Faraday's and Lenz's laws.

Appendix 1: Tabulated resistance measurements and voltages

Appendix 2: Tabulated RMS voltages

Based on the observations, the magnitude of the induced voltage is about .11 Volts. This is the measurement taken on the outside perpendicular to the flux surface. The polarity directly depended on the direction of the magnetic flux.

It would be inaccurate to model the result by putting a voltage source anywhere in the closed circuit. The circuit is simply two resistors in parallel, where the voltage difference between two ends of the resistors is twice as much as it is between the other two ends. Also, the voltage *across* the resistors was measured to be close to zero. This means that KVL does not hold true (2*V – V should be close to zero, but it's not!). Therefore, a voltage source wouldn't accurately model the induced voltage. Measuring the voltage using different configurations through the M-loop, caused different measurements. This is most likely because the M-loop was actually generating current in the meter probes, setting the voltage measurement off. This resulted in a range of voltage readings from 1.9 mV to 108 mV.

The voltage measurements made of V_{14} changed based on the way it was measured through the M-loop. Half of the time, the measured voltage was near to zero, but the other half of the time, the voltage magnitude was near to V_o just because of the way the measurements were taken. During these times, the voltage meter probes were connected in such a way as to make the voltmeter act as if it were measuring the induced voltage across the straight wire perpendicular (as the magnetic field was) to the flux surface.

Appendix 1: Tabulated resistance measurements and voltages

Faraday's Law

Initial Voltage Measurements:

$\mathbf{R_{23}}$	**1.0029 kΩ**
$\mathbf{R_{41}}$	**2.0082 kΩ**

Voltage Measurements:

$\mathbf{V_{12}}$	**109.53 mV**
$\mathbf{V_{23}}$	**.404 mV**
$\mathbf{V_{34}}$	**3.250 mV**
$\mathbf{V_{41}}$	**0.945 mV**

Current Calculations:

$\mathbf{I_{23}}$	**.403 μA**
$\mathbf{I_{41}}$	**.471 μA**

"Hidden Voltage":

$\mathbf{V_o} = V_{23} + V_{41} = \mathbf{1.349\ mV}$

Number of Turns:

$\mathbf{N} = V_{AB} / V_o = (8 / \sqrt{2}) / 1.349\ \text{mV} = \mathbf{4{,}193\ turns}$

Appendix 2: Measured Lengths of Pulses

Faraday's Law

V_{14} Measurements for the Various Configurations:

$\mathbf{V_{14,\,a}}$	3.182 mV
$\mathbf{V_{14,\,b}}$	108.40 mV
$\mathbf{V_{14,\,c}}$	1.870 mV
$\mathbf{V_{14,\,d}}$	107.31 mV

V_{14} = 0.945 mV which matches $V_{14,\,c}$
$(V_{14} + V_o)$ = 2.294 mV which matches $V_{14,\,a}$
$|V_{14} - V_o|$ =.404 mV which matches $V_{14,\,c}$ the closest