

MEE210 ELECTRICAL MACHINES – Experiment #3

**LABORATORY CONTENT:** Mutual inductance

**EQUIPMENT REQUIRED:** (students should bring electronic components)

**Qty Description**

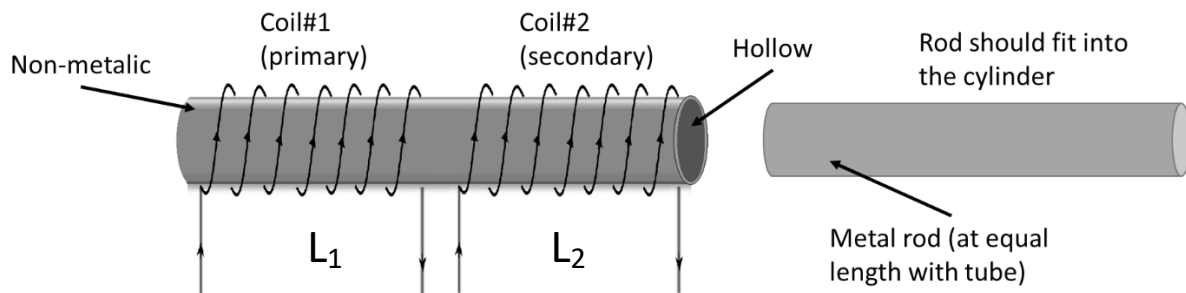
- 1 Voltage supply (will be ready at lab.)
- 1 Oscilloscope (will be ready at lab.)
- 1 Cement resistor 10Ω 5W (refer to preliminary work)
- 1 Iron cylinder/rod/ (ferromagnetic material)
- 1 Plastic pulley (empty inside) (iron rod should get inside the empty part)
- "2" Amperemeters with AC amperemeter functionality (you should bring your own amperemeter)!!!!
- Wiring equipments (crocodiles with cables which are thick enough that can flow 1A current without problem)

**CAUTION:**

This experiment includes health and security threats with careless actions. Be cautious about the isolation and the heating problem (doubling the current increases the heat four times, tripling increases nine times!). An expose to the transformer output pins can be dangerous.

**PRELIMINARY QUESTIONS:**

- 1) Wrap a coil onto the plastic pulley. Wrap another coil next to it. Note number of turns of the first coil and the second coil.
- 2) Write down the general mutual inductance equation for the system.



- 3) Measure the resistor value of first coil (the coil that the voltage source will be applied). If the value is lower than 10Ω, use a cement resistor with a series connection to limit the current.

**EXERCISE STEPS:**

- 1) Measure the resistance values of each coils and note down in Table 1.

Table 1. Resistor values of the coils

$R_1 (\Omega)$	$R_2 (\Omega)$

- 2) Apply 12V AC sine signal to primary side using the transformer on the education set (consider Preliminary-3). Read the voltage values in both coils and fill Table 2 (secondary side is open-circuit).

- 3) Read the current values and fill in Table 3.

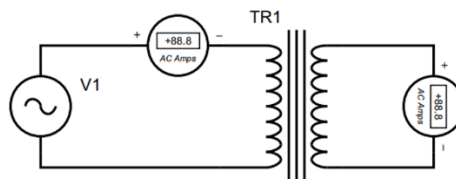


Table 2. Voltage values of the coils

Situation	$V_1 (V)$	$V_2 (V)$
Air core		
Iron core		

4) Insert the iron rod into the pulley and repeat the steps.

Table 3. Voltage values of the coils

Air core		Iron core	
Primary current (A)	Secondary current (A)	Primary current (A)	Secondary current (A)

**POSTLIMINARY QUESTIONS:**

1) Calculate the self-inductance of each coil with iron core with the general formula given below (just find an approximate value)

$$L = \frac{\mu_0 \mu_r N^2 A}{l}$$

2) What is the mutual inductance? (for iron-core and just for one condition with iron core)

$$\frac{V_1}{V_2} = \frac{M}{L_1}$$

3) What is the coupling coefficient?

$$M = k\sqrt{L_1 L_2}$$

4) Comment about the relationship of the core material and current.