B.Sc. Part II

Paper IV

Current electricity

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Current electricity.

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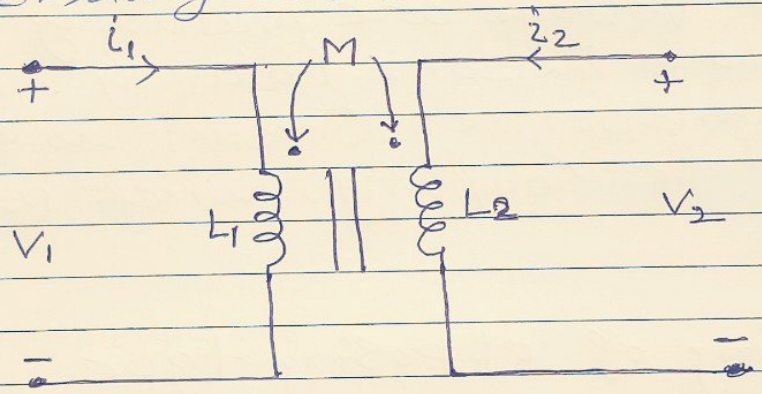
Expt. No. Magnetic Coupling Page No.

Magnetic Coupling occurs, when there is no Physical Connection between two coils. The Coupling can be of either aiding type or opposing type. It is based on whether the current enters at the dotted terminal or leaves from the dotted terminal.

Coupling of Aiding type :-

Consider the following electrical equivalent circuit of transformer. It is having two coils and these are called as Primary and Secondary coils.



The currents flowing through Primary and Secondary coils are i_1 and i_2 respectively. In this case, these currents enter at the dotted terminals of respective coils. Hence, the induced voltage in each coil will be having positive polarity at the dotted terminal due to the current flowing in another coil.

Apply KVL around Primary Coil

$$v_1 - L_1 \frac{di_1}{dt} - M \frac{di_2}{dt} = 0$$

$$\Rightarrow v_1 = L_1 \frac{di_1}{dt} + M \frac{di_2}{dt} \quad \text{——— (1)}$$

Apply KVL around Secondary Coil

$$v_2 - L_2 \frac{di_2}{dt} - M \frac{di_1}{dt} = 0$$

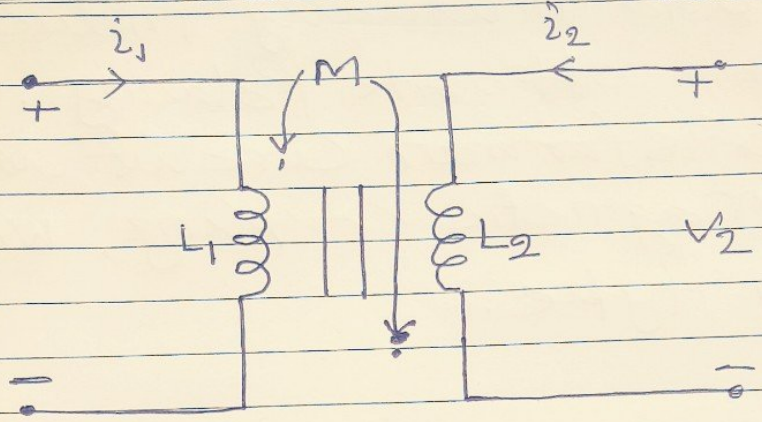
$$\Rightarrow v_2 = L_2 \frac{di_2}{dt} + M \frac{di_1}{dt} \quad \text{——— (2)}$$

In equ^{n} (1) and (2), the self-induced voltage are mutually induced voltage have the same Polarity. Hence, the above transformer Circuit is an example of Magnetic Coupling, which is of aiding type.

Coupling of opposing type

Consider the following electrical equivalent Circuit of transformer.

The currents flowing Through Primary and Secondary coils are i_1 and i_2 respectively. In this case, the current i_1 enters at the dotted terminal of Primary coil. Hence, it induces a voltage in Secondary Coil.



So positive Polarity of the induced voltage is present at the dotted terminal of this secondary coil.

In the above circuit, the current i_2 leaves from the dotted terminal of secondary coil. Hence, it induces a voltage in Primary Coil. So, negative Polarity of the induced voltage is present at the dotted terminal of this Primary Coil.

Apply KVL around Primary Coil.

$$v_1 - L_1 \frac{di_1}{dt} + M \frac{di_2}{dt} = 0$$

$$\Rightarrow v_1 = L_1 \frac{di_1}{dt} - M \frac{di_2}{dt} \quad \text{---(3)}$$

Apply KVL around Secondary Coil

$$v_2 - L_2 \frac{di_2}{dt} + M \frac{di_1}{dt} = 0$$

$$\Rightarrow v_2 = L_2 \frac{di_2}{dt} - M \frac{di_1}{dt} \quad \text{---(4)}$$

Teacher's Signature : _____

In equn (3) & (4), self induced voltage and mutually induced voltage are having opposite polarity. Hence, the above transformer circuit is an example of Magnetic coupling, which is of opposing type.