Date 26.4.21

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Paper IV

Physics Hons

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Current Electricity.

Mutual Inductance of Coefficient of Mutual Induction :-

Let two coil P (Primary) and S (Secondary) in which a current i in P Produce a magnetic flux Φ_B in each turn of S. N_S be the total number of turns in S, Then the number of flux linkages through S in $N_S \Phi_B$. For two given coils situated in fixed relative position, the flux linkage through the Secondary is proportional to the current i in the primary. Thus

$$N_S \Phi_B \propto i$$

or $$N_S \Phi_B = M i$$

where M is a constant called the mutual inductance of the coils.

This gives

$$M = \frac{N_S \Phi_B}{i} \quad \text{——} \quad (1)$$

The e.m.f. induced in S is given by

$$E = -\frac{d(N_S \Phi_B)}{dt}$$

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But, $N\Phi_B = Mi$

$$\therefore E = \frac{d}{dt}(Mi) = -M\frac{di}{dt}$$

This gives

$$M = -\frac{E}{di/dt} \quad \text{——— (2)}$$

The equation (1) and (2) enable to define the Mutual inductance in the following two ways —

1) The Mutual inductance of two Coils or Circuits is numerically equal to the Magnetic flux linkages through one Coil or Circuit when unit current flows through the other.

2) The Mutual inductance of two Coils or Circuits is numerically equal to the e.m.f. in one coil or circuit when the rate of change of current in the other is unity. Its units is also henry.