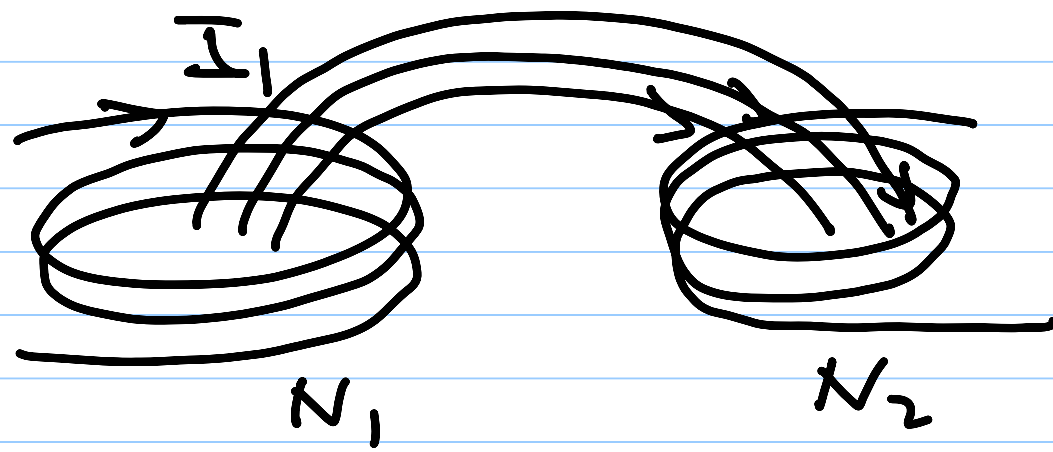
Lecture 7

From sections 8.8 and 8.9

Solve 8.33, 8.35, 8.37, 8.40, 8.41

Flux linkage



$\Psi_{21} = \iint_{S_2} \underline{B}_1 \cdot \underline{ds}$ = flux crossing second circuit due to current in the first circuit

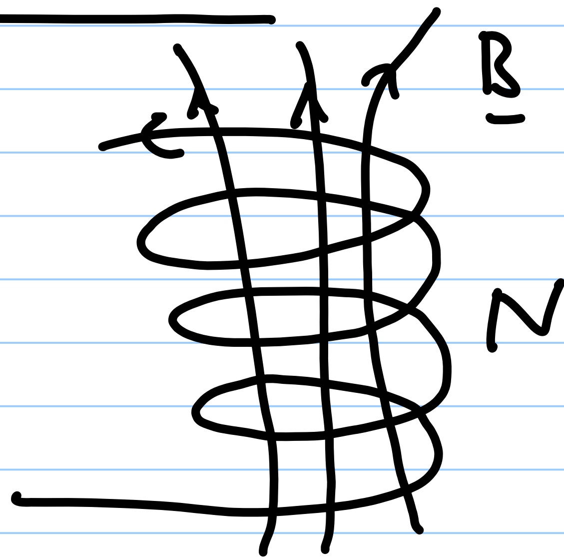
Flux Linkage (Cont'd)

* $\lambda_{21} = N_2 \Psi_{21}$ = flux linkage = flux linking **All** turns of second circuit due to the magnetic field of the first circuit.

* Similarly, we can define Ψ_{12}, and λ_{12}

$$\Psi_{12} = \iint_{S_1} \underline{B} \cdot d\underline{S} \,, \quad \lambda_{12} = N_1 \Psi_{12}$$

Self Flux

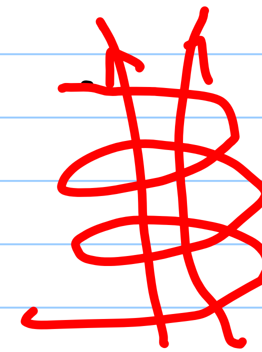


$$\Psi = \iint_S \underline{B} \cdot d\underline{s}$$

$$\lambda = N \Psi$$

Inductance

* Self Inductance $= \frac{\lambda}{I} = L$



* Mutual Inductance

$$M_{12} = \frac{\lambda_{12}}{I_2}$$

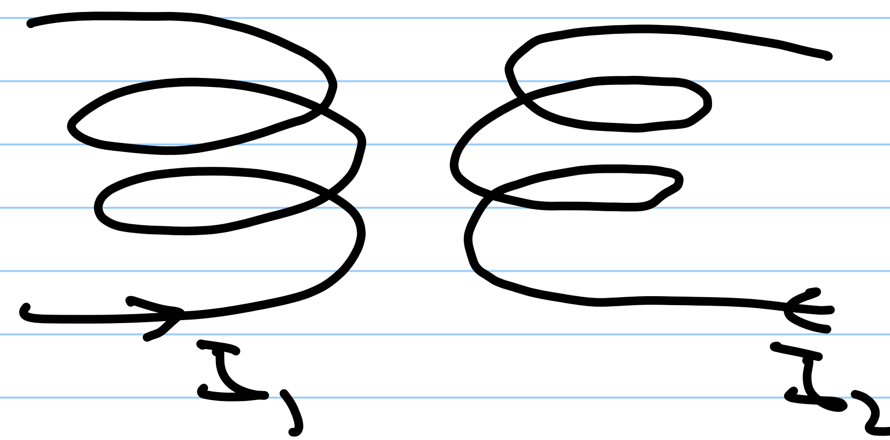
$$M_{21} = \frac{\lambda_{21}}{I_1}$$

* For linear medium $M_{12} = M_{21}$

Coupled Circuits

$$\Psi_1 = \Psi_{11} + \Psi_{12}$$

$$\Psi_2 = \Psi_{22} + \Psi_{21}$$

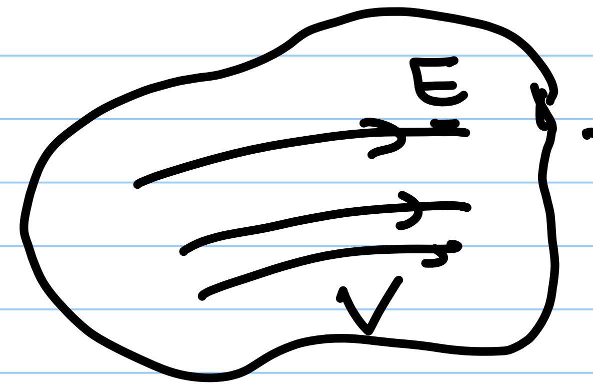


$$W_m = W_1 + W_2 + W_{12}$$

$$W_m = \frac{1}{2} L_1 I_1^2 + \frac{1}{2} L_2 I_2^2 \pm M_{12} I_1 I_2$$

Magnetic Energy

$$W_E = \frac{1}{2} \iiint_V \underline{D} \cdot \underline{E} \, dv$$



$$W_E = \frac{1}{2} \iiint_V \varepsilon |E|^2 \, dv$$

Similarly,

$$W_m = \frac{1}{2} \iiint_V \underline{B} \cdot \underline{H} \, dv = \frac{1}{2} \iiint_V M |\underline{H}|^2 \, dv$$