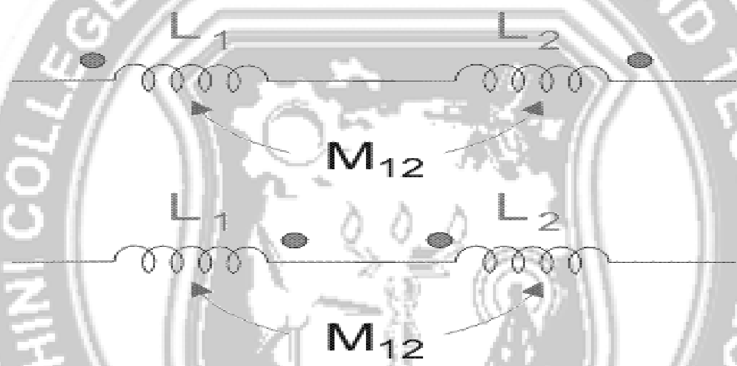
DOT CONVENTION:

- Dot convention is used to determine the polarity of a magnetic coil in respect of another magnetic coil.
- Dot convention is normally used to determine the total or equivalent inductance (**Leq**).

SERIES OPPOSING:

- Suppose two coils are in series with opposite place dot.
- When 2 dots are at the opposite place of both inductors (while one at entering place andother at leaving place) as shown in below figure i.e., the total mutual inductance gets differed

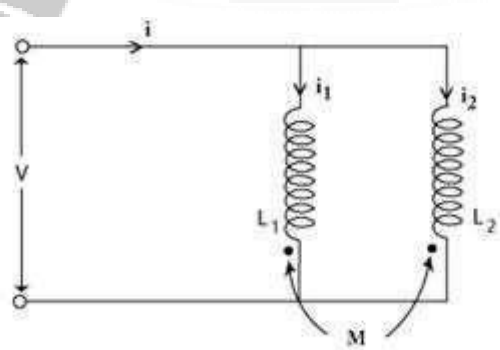


Mutual inductance between them is negative.

$$So, \quad L_{eq} = L_1 + L_2 - 2M_{12}$$

PARALLEL AIDING:

- Suppose two coils are in parallel with same place dot.
- When 2 dots are at the same place of both inductors (while at entering place or leaving place) as shown in below figure i.e. the total mutual inductance gets aided(added)



$$V = L_1 \frac{dI_1}{dt} + M \frac{dI_2}{dt}$$

$$V = L_2 \frac{dI_2}{dt} + M \frac{dI_1}{dt}$$

$$\Delta = \begin{vmatrix} L_1 & M \\ M & L_2 \end{vmatrix} = L_1 L_2 - M^2$$

$$\frac{di_1}{dt} = \frac{\begin{vmatrix} V & M \\ V & L_2 \end{vmatrix}}{\Delta} = \frac{V(L_2 - M)}{\Delta}, \quad \frac{di_2}{dt} = \frac{\begin{vmatrix} L_1 & V \\ M & V \end{vmatrix}}{\Delta} = \frac{V(L_1 - M)}{\Delta}$$

From the above figure,

$$i = i_1 + i_2$$

$$\frac{di}{dt} = \frac{di_1}{dt} + \frac{di_2}{dt} = \frac{V(L_2 - M)}{\Delta} + \frac{V(L_1 - M)}{\Delta} = \frac{V(L_1 + L_2 - 2M)}{\Delta} = \frac{V(L_1 + L_2 - 2M)}{L_1 L_2 - M^2}$$

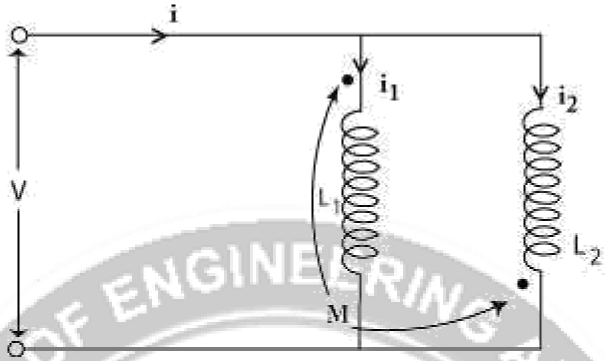
$$V = \frac{L_1 L_2 - M^2}{(L_1 + L_2 - 2M)} \frac{di}{dt}$$

Therefore, total inductance is given by,

$$\mathbf{L_{eq}} = \frac{L_1 L_2 - M^2}{(L_1 + L_2 - 2M)}$$

PARALLEL OPPOSING:

- Suppose two coils are in parallel with opposite place dot.
- When 2 dots are at the opposite place of both inductors (while one at entering place andother at leaving place) as shown in below figure i.e., the total mutual inductance gets differed



$$V = L_1\frac{dI_1}{dt} - M\frac{dI_2}{dt}$$

$$V = L_2\frac{dI_2}{dt} - M\frac{dI_1}{dt}$$

$$\begin{bmatrix} L_1 & -M \\ -M & L_2 \end{bmatrix}\begin{bmatrix} \frac{di_1}{dt} \\ \frac{di_2}{dt} \end{bmatrix} = \begin{bmatrix} V \\ V \end{bmatrix}$$

$$\Delta = \begin{vmatrix} L_1 & -M \\ -M & L_2 \end{vmatrix} = L_1 L_2 - M^2$$

$$\frac{di_1}{dt} = \frac{\begin{vmatrix} V & -M \\ V & L_2 \end{vmatrix}}{\Delta} = \frac{V(L_2 + M)}{\Delta}, \quad \frac{di_2}{dt} = \frac{\begin{vmatrix} L_1 & V \\ -M & V \end{vmatrix}}{\Delta} = \frac{V(L_1 + M)}{\Delta}$$

From the above figure,

$$i = i_1 + i_2$$

$$\frac{di}{dt} = \frac{di_1}{dt} + \frac{di_2}{dt} = \frac{V(L_2 + M)}{\Delta} + \frac{V(L_1 + M)}{\Delta} = \frac{V(L_1 + L_2 + 2M)}{\Delta} = \frac{V(L_1 + L_2 + 2M)}{L_1 L_2 - M^2}$$

$$V = \left(\frac{L_1 L_2 - M^2}{L_1 + L_2 + 2M}\right)\frac{di}{dt}$$

Therefore, total inductance is given by,

$$\mathbf{L_{eq}} = \left(\frac{L_1 L_2 - M^2}{L_1 + L_2 + 2M}\right)$$