

# Mutual Induction



$\Phi_{12}$ : magnetic flux through each loop of coil 2 caused by current  $I_1$  through coil 1

$\Phi_{21}$ : magnetic flux through each loop of coil 1 caused by current  $I_2$  through coil 2

$$M_{12} = \frac{N_2 \Phi_{12}}{I_1} \quad (\text{mutual inductance})$$

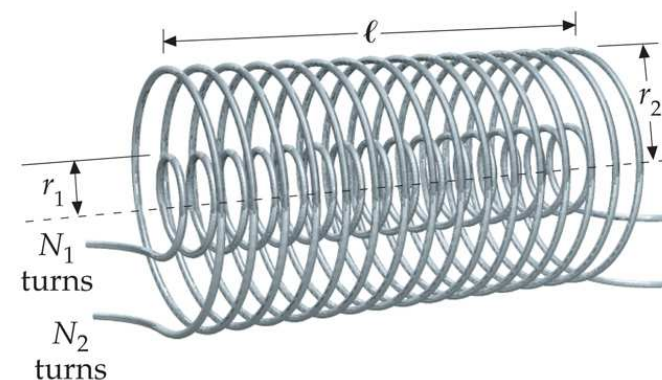
$$M_{21} = \frac{N_1 \Phi_{21}}{I_2} \quad (\text{mutual inductance})$$

$$\mathcal{E}_2 = -M_{12} \frac{dI_1}{dt} \quad (\text{emf induced in coil 2 due to current in coil 1})$$

$$\mathcal{E}_1 = -M_{21} \frac{dI_2}{dt} \quad (\text{emf induced in coil 1 due to current in coil 2})$$

$$M_{12} = M_{21} = M \quad (\text{symmetry property})$$

$$M = \mu_0 \frac{N_1}{\ell} \frac{N_2}{\ell} (\ell \pi r_1^2) \quad (\text{present configuration})$$



(a)