Electro magnetic induction

- Magnetic Flux : $\phi = \oint \vec{B} \cdot d\vec{S}$
- Faraday's Law: $e = -\frac{d\phi}{dt}$
- Lenz's Law: Induced current create a B-Field that opposes the change in magnetic Flux
- Motional emf : $e = B\ell v$
- Self Inductance : $\phi = Li$, $e = -L\frac{di}{dt}$
- Solenoid : $L = \mu_0 n^2 (\pi r^2 \ell)$
- Mutual Inductance : $\phi = Mi$, $e = -M\frac{di}{dt}$
- Growth of current in LR circuit :

$$i = \frac{e}{R}\left[1 - e^{-\frac{t}{L/R}}\right]$$

- Decay of current in LR circuit :

$$i = i_0 e^{-\frac{t}{L/R}}$$

- Time Constant of LR circuit : $\tau = L/R$
- Energy stored in an inductor : $U = \frac{1}{2}Li^2$
- Energy density in B field :

$$u = \frac{U}{V} = \frac{B^2}{2\mu_0}$$

- EMF induced in a rotating coil :

$$e = NAB\omega \sin \omega t$$